Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

Hingna Road, Wanadongri, Nagpur-441 110

NAAC Accredited with 'A' Grade,

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2020-21

Summary

1.2.1 *Percentage of new courses introduced of the total number of courses across all programs offered during the last five years*

Year	2020-21	2019-20	2018-19	2017-18	2016-17
New Courses Introduced	34	15	27	20	21
No. of Courses offered	410	434	443	440	449

- *Minutes of relevant BOS meetings*
- *Curriculum/ Syllabus of the courses*

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List of New Courses Introduced for year 2020-21

1.2.1 Percentage of new courses introduced of the total number of courses across all programmes offered during 2020-21

Sr. No	Name of the Course	Course Code	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development
1	PE-I : Advance Surveying	CV2311	Total Station Surveying
2	PE-I : Advanced Concrete Technology	CV2319	Review of properties of cement, their physical and chemical properties, special purpose cements, ,Rheological behaviour of concrete,Permeability and Durability of concrete,Concrete mix design,Quality management in concrete construction,Special concrete
3	PE-I : Geographical Information Systems	CV2327	Introduction - concept of GIS ,data formats for GIS,Data acquisition process,Coordinate systems,Digitization- Methods of digitization,Digital elevation models,Extraction of topographic parameters: slope, aspect, delineation of watershed and drainage network - DEM applications. ,Operations in GIS ,Application of GIS to various natural resources mapping and monitoring and other civil engineering related problems
4	PE-I Hazardous Waste Management	CV 3979	Solidification/stabilization and innovation techniques. waste Inventorization procedures
5	PE-II : Energy Conversion and Environment	CV3983	Energy Conversion Methods: Thermal, hydro, nuclear, solar, wind, tidal etc. their principles and application,Introduction to Microbial Fuel cell, Gas generations and collection in landfills, Measurements, and Control.
6	PE-I : Computer Application In Civil Engineering	CV2313 -	Introduction : C-Fundamentals,,Control Statements,Advance Topics,Fundamental of Numerical Methods,Computer program based on Transportation Engineering, Geotechnical Engineering, Hydraulic Engineering, Irrigation Engineering, Surveying, Estimating & costing,Use of excel in structural design, estimating & costing
7	PE-V : Structural Engineering Practices	CV2440 -	Structural behavior, Design basis, Design Intent, Standards, Manuals, Methods, material testing, Material Properties, Mix design, Quality Control, Different Tests & checks carried out at site,Preparation of the structural framing plan of the building, beam locations, column positions, column orientations, shear walls locations. Introduction of SP16, IS:1893, IS:13920,Importance, determination & calculation of different loads ,Three dimensional Modeling of the Structure,Static & Dynamic Analysis of structure, Design of structure, Understanding & Interpretation of the results, Deformation control,Foundations – Importance of soil exploration,Construction Methods,Reinforcement detailing of Structures as per SP24
8	EARTHMOVING EQUIPMENTS	ME 2435	Students will be able to: (I)To understand and apply fluid power laws and principles [1,6] (II)Students will be able to understand the basic fluid power hardware system components. [PO-1,2,3,6, PSO- 1,2] (III)Students will be able to interpret and draw hydraulics and electronic system circuits. [PO-1, 11; PSO-1] (IV)Students will be able to design, analyze, use, maintain, carryout troubleshooting, and establish safety procedures of Earthmoving equipments. [PO-1,2,3,11; PSO-1]
9	EARTHMOVING EQUIPMENTS LAB	ME 2436	Students will be able to: (I)To understand and apply fluid power laws and principles [1,6] (II)Students will be able to understand the basic fluid power hardware system components. [PO-1,2,3,6, PSO- 1,2] (III)Students will be able to interpret and draw hydraulics and electronic system circuits. [PO-1, 11; PSO-1] (IV)Students will be able to design, analyze, use, maintain, carryout troubleshooting, and establish safety procedures of Earthmoving equipments. [PO-1,2,3,11; PSO-1]
10	Lab.:Substation Design	EL2355	Study of sub-station,its line diagram,panels and equipments
11	PE III: Electrical Energy Audit and Safety Analysis	EL2423	Study of Energy Monitoring,Targeting and Co-Generation system
12	PEIII:FACTS Devices	EL2422	Study of Static shunt and series compensators
13	PEIII:Advanced Control System	EL2424	Design of PID Controller and types of non-linearities
14	PEIII:Artificial Intelligence Based System	EL2425	Fuzzy control and Neural Network
15	PEIV:Advanced Electrical Drives	EL2431	Induction motor,synchronous motor and special motor drives
16	PEIV:Fundamentals of Smart Grid	EL2432	Smart Grid communication and design
17	PEIV:Computer Methods in Power System	EL2433	Short circuit and stability studies
18	PEIV:EHVAC-HVDC Transmission	EL2434	HVDC Power transmission,HVDC Converter,HVDC Circuit breakers
19	Mini Project	EL2409	Mini project is a group activity
20	PE III : Data Compression & Encryption	ET2412	DCT, JPEG, JPEG – LS, Differential Lossless Compression, DPCM, JPEG – 2000 Standards ,Email, PGP, S/MIME, Intrusion Detection System Web Security Considerations, SSL Architecture, SSL Message Formats, TLS, Secure Electronic Transactions Kerberos, X.509 Authentication Service, Public Key Infrastructure Security Goals, Cryptographic Attacks, Techniques Symmetric Key: Substitution Cipher, Transposition Cipher , Stream and Block Cipher DES, AES
21	PE III : Analog VLSI	ET2413	Basic concept, common source, common source stage with resistive load, CS stage with source degeneration, source follower, common gate,Performance parameters, one stage op amp, Gain boosting, Noise in op amp,he Oversampling ADC, The First-Order Sigma Delta Modulator , The Higher Order Sigma Delta Modulators

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Sr. No	Name of the Course	Course Code	Activities/Content with direct bearing on Employability/ Entrepreneurship/ Skill development
22	PE III : Error Correcting Codes	ET2414	Coding for reliable digital transmission and storage. Groups, Rings, Vector Spaces, Galois Fields, Polynomial rings The Digital Communication Channel, Introduction To Block Codes, Single Parity Check Codes, Product Codes, Repetition Codes, Hamming Codes, Minimum Distance Of Block Codes, Soft – Decision Decoding, Automatic Repeat Request Schemes ,Linear Algebra, Galois Field, Definition and Construction of Binary BCH Codes, Error Syndromes In Finite Fields, Decoding SEC and DEC, Reed- Solomen Codes, LDPC codes,Convolution, Encoding Convolutional Codes, Generator Matrices For Convolutional Codes, Generator Polynomials For Convolutional Codes, Graphical Representation Of Convolutional Codes, The Viterbi Decoder. Concept Of Interleaver And Puncture Coding, Applications of error control coding
23	PE IV : Switching Theory	ET2423	Threshold logic for nanotechnologies, threshold elements, synthesis of threshold networks: Unate function, Identification & Realization of threshold function,Synchronous sequential circuits and iterative networks, memory elements and their excitation functions, synthesis of synchronous sequential circuits, Moore and Mealy machines, finite state machine flow charts, tables,State-identification experiments and testing of sequential circuits, Experiments, Homing experiments, Distinguishing experiments, Machine identification, Checking experiments, Built-in self-test (BIST).
24	PE IV : Topics in Machine Learning	ET2424	Supervised and Unsupervised Learning, Regression, KNN, SVM, Decision tree, Naive Bayes Classifiers, Random Forest , building blocks of CNN,
25	PE V : Wireless Sensor Networks	ET2434	Network architecture-optimization goal and figure of merit-design principles for WSN, service interface of WSN, Gateway concept challenges of WSN, comparison with other network. WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking
26	PE VI : Digital Image Analysis for Remote Sensing	ET2442	Contrast enhancement – band rationing – principal component analysis – vegetation transforms – texture transforms, Spatial Transforms: convolution concept - low and high pass filtering – spatial transformations – Fourier transform – wavelet transforms, Maximum Likelihood and Bayesian classification, Non-parametric & parametric classification
27	PE VI : PLCs & SCADA	ET2446	I/O Installation, Wiring, and Precautions ,PLC Start-Up and Checking Procedures, SCADA Programming Graphics Building & Simulation, Tag types & Management, Tools, Programming techniques, Alarms & Trends Configuration, Screen Navigation, Properties, Scripts, Security.
28	OE II : PLCs and SCADA	ET2325/ET240	Introduction, Processors, Processor Scan, The System Power Supply , Programming Devices, Memory Overview , Memory Types, Memory Structure and Capacity. Configuring the PLC Memory—I/O Addressing, Ladder Diagram Format , Ladder Relay Instructions , Ladder Relay Programming, IEC 1131-3 Programming Languages – FBD/ST/IL/SFC, Control Task, NO-NC & coil based instructions(Relay based Instructions), Timers, Counters, Compare, Mathematics, Jump and Subroutines, Scaling (Analog Instructions). Graphics Building & Simulation, Tag types & Management, Tools, Programming techniques, Alarms & Trends Configuration, Screen Navigation Properties Scripts Security
29	PE II : Internet of Things (IoT)	ET2381	Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies,, Network Function Virtualization, Need for IOT Systems Management, Simple Network Management Protocol, Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IOT Systems management with NETCONF-YANGPython Modules, Packages, File Handling, Date/Time Operations, Classes, Python Packages, Iot Device-Raspberry Pi, Programming Raspberry pi with Python, IoT physical servers and cloud offerings, Introduction to cloud storage models and communication APIs, Python web application frame work-Django. Amezon web service for IoT
30	PE II : Lab. Internet of Things (IoT)	ET2382	Expt.based on Interfacing LED with Raspberry pi,Expt.based onInterfacing DHT11 sensor with Raspberry pi.,Expt.based onPreparing complete IoT system using AWS server
31	Bioinformatics	CT2440	Skill Development: Introduction to Computational algorithms, Computational analysis of next ge
32	Introduction to Spanish Language	GE-2369	Employbility Course
33	Introduction to French Language	GE-2370	Employbility Course
34	Corrosion Engineering	GE-2368	New Course Open Elective

V Semester
CV2311 - PE-I : Advance Surveying

COURSE OBJECTIVE	COURSE OUTCOMES
Students will be introduced to	Students will be able to
1. Different types horizontal and vertical curve.	1. Discuss the modern technique of surveying.
2. Basic principle and application of different types survey such as geodetic, photographic surveying.	2. Operate the modern Surveying equipment's
	3. Discuss basic concepts of electronic surveying
3. Basic principle of electronic surveying	4. Understand the rectangular coordinate system of surveying.

Mapped Program Outcomes: 1,2,4,5

UNIT–1 : **Simple and Compound Curves** a) **Simple Curves**: Elements of simple curves, Types of Horizontal curve Methods of Curve ranging. b) **Compound Curves**: Elements of compound Curves, setting out the curve.	**[06 Hrs.]**
UNIT–2 : **Transition and vertical curve** a) Transition Curves: Elements of transition curves, Super elevation, Length of transition curve, setting out the transition curve. b) Vertical Curves: Elements of vertical curves, Types, Tangent Correction, Location of highest or lowest point.	**[07 Hrs.]**
UNIT–3 **Geodetic Surveying and Triangulation Adjustment (a,b,d)** a) Geodetic Surveying: Classification of triangulation survey, Station marks, Signal and tower, Inter visibility of stations b) Triangulation Adjustment: Definitions, , Laws of weights, Station adjustment.	**[07 Hrs.]**
UNIT–4 : **ELECTRONIC SURVEYING** Introduction, electromagnetic wave theory – electromagnetic application, Modulation, types of EDM instrument, distance measuring system-Principle of working and EDM instrument, distomat, errors in EDM.	**[06 Hrs.]**
UNIT–5 : **TOTAL STATION SURVEYING** Introduction, basic principle, types of total station, characteristics, feature of total station, component of total station, working of total station, sources of error, care and maintenance of total station instrument, advantages of total station over conventional instrument.	**[06 Hrs.]**
UNIT–6 : **Advanced surveying techniques** **Photographic Surveying:** Basic definitions, Terrestrial and aerial photography, Scale of vertical photograph, ground coordinate flight planning, study of photo theodolite and stereoscope, Displacement due to ground relief.	**[07 Hrs.]**

Text Books:
1. Punmia B.C., Jain A.K., Jain A.K, Surveying, (Vol. 2 & Vol. 3), Laxmi Publication, New Delhi. 1, 15th Edition.
2. Kanetkar T.P. & Kulkarni S. V, Surveying & Levelling (Vol.2 & Vol. 3), Pune Vidhyarthi Gruha Prakashan, Pune.
3. Reddy M. A., Remote sensing & GIS, B. S. Publication, Hyderabad.
4. Dr. A.M. Chandra, Higher Surveying, New age international publishers , New Delhi

Reference Books:
1. Thomas M. L., Ralph W. K., Jonathan W., Remote Sensing and Image Interpretation, Chipman Wiley & Sons, 5th Edition (2010).

		June 2019	1.00	Applicable for AY 2019-20 Onwards
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V Semester
CV2319 – PE-I : Advanced Concrete Technology

COURSE OBJECTIVES	COURSE OUTCOMES
1. Understand To develop systematic knowledge of concrete constituents 2. To familiarize with the fundamentals of concrete 3. Principals involved for high performance concrete 4. To understand the basic concepts of special concretes 5. To introduce fundamentals of concreting methods	1. An ability to understand the properties of the constituent materials of concrete. 2. An ability to understand the properties of fresh and hardened concrete and tests to determine these properties. 3. An ability to design concrete mixes and apply statistical quality control techniques 4. An ability to understand importance of Non-destructive testing and various equipment used. 5. An ability to understand the durability of concrete.

Mapped Program Outcomes : 1,3,7,11,12

UNIT–1 : Review of properties of cement, their physical and chemical properties, special purpose cements, Classification and properties of aggregates, soundness of aggregates, alkali aggregate reaction, thermal properties of aggregates, Importance of shape and Surface area and grading, gap graded and aggregates.	**[07 Hrs.]**
UNIT–2 : Rheological behaviour of concrete, requirements of workability of concrete, Effect of environmental conditions, Strength properties of hardened concrete, Impact, Dynamic and fatigue behaviour of concrete, shrinkage and creep of concrete, behaviour of concrete under fire.	**[06 Hrs.]**
UNIT–3 : Permeability and Durability of concrete, Parameters of durability of concrete, chemical attack on concrete, Production of concrete; batching mixing, transportation, placing, compaction of concrete. Special methods of concreting and curing of concrete, Hot weather and cold weather concreting, Guniting (Shotcreting).	**[06 Hrs.]**
UNIT–4 : Concrete mix design, Basic considerations and choice a mix proportions, various methods of mix designs including IS Code method. Quality control and quality assurance of concrete, Acceptance criteria.	**[07 Hrs.]**
UNIT–5 : Quality management in concrete construction, Inspection and testing of concrete. Non-destructive testing of concrete, core test and load test. Admixtures & construction chemicals, Use of Fly Ash, Silica Fumes, Metakaolin & GGBS in concrete.	**[07 Hrs.]**
UNIT–6 : Special concrete such as high strength, Lightweight, heavy weight, vacuum processed concrete. Mass concrete, high performance concrete, Pumpable concrete, Self Compacting concrete, Air entrained concrete, Ferro cement, fiber reinforced concrete, Polymer impregnated concrete. Jet concrete. Deterioration and repair technology of concrete, Distress and type of repairs, crack sealing techniques.	**[06 Hrs.]**

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V Semester
CV2319 – PE-I : Advanced Concrete Technology

Text Books :
1. Gambhir M.L: Concrete Technology Tata McGraw Hill (Second Edition) 1995.
2. M.S. Shetty, Concrete Technology S. Chand & Company New Delhi 2005.

Reference Books:
1. P.Kumar Mehata, Paulo & J.M. Monteiro, Concrete microstructure, properties & materials, Prentice Hall INC & Mcgraw Hill USA.
2. Short & Kenniburg, Light Weight Concrete, Asia Publishing House, Bombay 1963.
3. Chen Orchard D.F.; Concrete Technology-Vol I. & II Applied Science Publishers (Fourth Edition) 1979.
4. Neville A.M., J.J. Brook Properties of Concrete Addison Wesley 1999.

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V Semester
CV2327– PE-I : Geographical Information Systems

COURSE OBJECTIVES	COURSE OUTCOMES
1. To introduce the fundamentals and components of Geographic Information System 2. To provide details of spatial data structures and input, management and output processes.	The students will be able to understand; 1. The basic concepts and components of GIS. 2. Concepts of spatial and non spatial data, map projections and operations.

Mapped Program Outcomes : 1,2,12

UNIT–1 : Introduction - A Brief History of GIS - Geographical concepts and terminology - Essential components of GIS -utility of GIS- Hardware, Software, Data, People, Methods – Proprietary and open source Software Various GIS packages.	**[06 Hrs.]**
UNIT–2 : Data: Spatial and Non-Spatial Data Spatial Data: Points, Lines, Polygons/Area and Surface - Non-Spatial Data - Scales/Levels of Measurement. Data Base: Data sources, Data Base Structure models.	**[07 Hrs.]**
UNIT–3 : Data acquisition: Vector Data Models, Raster data model, Data Compression, arc-node data structure - Raster to vector conversion - Topology and spatial relationships - Data storage verification and editing.	**[07 Hrs.]**
UNIT–4 : Coordinate systems, Datums- Map projections - Coordinate transformation, Georeferencing, Digitization- Methods of digitization, Common errors in digitization.	**[06 Hrs.]**
UNIT–5 : Discrete and continuous surfaces- Digital elevation models, sources of DEM, TIN structure, Extraction of topographic parameters: slope, aspect, delineation of watershed and drainage network - DEM applications.	**[06 Hrs.]**
UNIT–6 : Operations in GIS - Overlay, Buffers, Spatial analysis, Network analysis, Application of GIS to various natural resources mapping and monitoring and other civil engineering related problems.	**[07 Hrs.]**

Text Books :
1. Lo C.P. and Yeung
2. A.K.W., Concepts and Techniques of Geographic Information Systems, Prentice-Hall, Inc., NJ, 2002.
3. An Introduction to Geographical Information Systems (4th Edition) by Ian Heywood, Sarah Cornelius and Steve Carver, 2012
4. Burrough, P.A. and McDonnell, R.A. (1998) Principles of Geographical Information Systems. Oxford University Press, Oxford.
5. Introduction to Geographic Information Systems by Chang Kang-tsung (Karl), 2006
6. Geographic Information Systems: An Introduction by Tor Bernhardsen, 2005

Reference Books :
1. M. Anji Reddy BS Publications Remote Sensing and Geographical Information Systems Third Edition
2. Geographic Information System and Environment Modeling Keith C. Clerk, Bradely O Parks, Michel P Crane Pritnce Hall of India 2002.

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II Semester
CV3979 - PE-I : Hazardous Waste Management

COURSE OBJECTIVE	COURSE OUTCOMES
1. To provide insight into sources of hazardous waste & the treatment given thereafter.	1. An ability to understand principle of methods given to hazardous waste.
2. To Provide knowledge of generation, characteristic and composition of hazardous Waste	2. An ability to understand the common functional elements of waste management system
3. To enumerate and describe different disposal and treatment methods	3. An ability to suggest suitable waste processing technologies and disposal methods.

PO Mapped : 1,4

UNIT-I : Definition of hazardous waste, U.S.E.P.A. classification, global scenario, episodes. Hazardous waste (management and handling) rules, 1989 and Indian Scenario.	**[06 Hrs.]**
UNIT-II : Source of hazardous waste, effect of Hazardous waste on human health, Sampling and analytical procedures, Overview of treatment and disposal method – waste minimization.	**[07 Hrs.]**
UNIT-III : Physicochemical method and biological method, Thermal Processes. Solidification /stabilization and innovation techniques. In-situ methods for Decontamination of hazardous waste sites	**[06 Hrs.]**
UNIT-IV : Solidification/stabilization and innovation techniques. waste Inventorization procedures.	**[07 Hrs.]**
UNIT-V : Secure landfill. Site selection methodology for establishing treatment and disposal methods and EIRA methodology.	**[06 Hrs.]**
UNIT-VI : Legislation on Management &Handling rules based on Hazardous Waste Management .Common hazardous waste treatment Storage and disposal facility (CHWTSDF)	**[07 Hrs.]**

Text Books:-
1. Charles A. Wentz; " Hazardous Waste Management ", McGraw-Hill Publication, 1995

Reference Books:-
1. The safe disposal of hazardous waste. Vol. I, II, & III Bat stone, Smith, Wilson, Joint study Sponsored by the world bank, the WHO, & UN Environmental Program UNEP,
2. The World Bank Freeman H.M. standard Handbook of Hazardous Waste Treatment and Disposal, 1989.

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II Semester
CV3983 - PE-II : Energy Conversion and Environment

COURSE OBJECTIVE	COURSE OUTCOMES
1. To know the concept of efficient energy forming technologies for sustainable use of resources. 2. To know the Resources Conversion Strategies and Policies.	1. An Ability to Understand and apply basic concept of waste to energy technology and environmental protection. 2. An Ability to understand the concept of environmental appraisal, energy audit and assessment of energy potential of energy sources.

PO Mapped : 2,4

UNIT-I : Significance of Energy Conversion and Environment, Overview of Global and Indian Energy Scenario; Environmental Impacts of Energy Conversion, Principles of Waste Minimization, and Energy Recovery.	**[06 Hrs.]**
UNIT-II : Renewable and Non-Renewable Energy Sources; Estimation of Potential of Energy Recovery from various Sources, Energy economics.	**[07 Hrs.]**
UNIT-III : Energy Conversion Methods: Thermal, hydro, nuclear, solar, wind, tidal etc. their principles and application	**[07 Hrs.]**
UNIT-IV : Waste to Energy options: physical, thermochemical and bio chemical processes: palletization, briquetting, Combustion, Gasification, pyrolysis; Fuels Derived anaerobic digestion, Biogas Technology, Future Technologies for Waste to Energy Systems	**[06 Hrs.]**
UNIT-V : Introduction to Microbial Fuel cell, Gas generations and collection in landfills, Measurements, and Control.	**[07 Hrs.]**
UNIT-VI : Energy and Resources Conservation Strategies and Policies, concept of energy management, Intelligent Green Building, Green Rating Systems Alternative Construction Materials & methods Testing and Verification.	**[06 Hrs.]**

Text Book :-
1. D. O. Hall, G. W. Barnard and P. A. Moss, Biomass for Energy in the Developing Countries, Current Roles, Potentials, Problems, Prospects, Pergamos Press Ltd, 1st edition.
2. W. C. Turner, Energy Management Handbook Wiley Newyork 1st edition.
3. P. Meier, Energy System Analysis for Developing countries, Sringer Verlag 1st edition.
4. Dorthy J De Renzo, Energy from Bioconversion of Waste materials, Noyes data Corporation USA 1st edition.

Reference Book :-
1. G.D. Rai, Non-Conventional Energy Source, Standard Publishers Distributors.
2. Fowler J. M. Energy and the Environment McGraw Hill New York 2nd edition.
3. B.H. Khan, Non-Conventional Energy Resources, 2nd Edition, McGraw Hill Companies.

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V Semester
CV2313 - PE-I : Computer Application In Civil Engineering

COURSE OBJECTIVES	COURSE OUTCOMES
Student will be able to	At the end of course student will be able to
1. Create the knowledge of C programming language	1. Understand the basic concepts of C Programming language.
2. Develop computer programs for the solution of Civil Engineering problems.	2. Develop computer programs for the solution of Civil Engineering problems.
3. Apply the knowledge of various numerical with their applicability and accuracy to specific mathematical problems	3. Translate numerical methods into simple, reusable program modules
4. Evaluate and Apply numerical methods into simple, reusable program modules.	4. Develop good technical understanding & application.

Mapped Program Outcomes : 1,2,3,4,5,10

UNIT–1 : Introduction : C-Fundamentals, character set data type constant and variables, Declaration of constants & variables, Expression, Statements, Symbolic constants. Operator and Expression, Arithmetic operator, Unary operator, Relation and Logical operator, Assignment operators, the conditional operator. Data input & output.	**[06 Hrs.]**
UNIT–2 : Control Statements:-Control statement and its application, the WHILE statements, do-while, for nested loop, if –else, switch break, continue, go to statement.	**[07 Hrs.]**
UNIT–3 : Advance Topics:-User defined Functions, Library functions, Storage class, Arrays, Pointers, structures and Unions, Data files, File Handling.	**[06 Hrs.]**
UNIT–4 : Fundamental of Numerical Methods, Interpolation & extrapolation. Numerical Integration (Simpson's method, Trapezoidal method, Newton's Gauss Quadrature method), Interactive Computer Program Development.	**[07 Hrs.]**
UNIT–5 : Computer program based on Transportation Engineering, Geotechnical Engineering, Hydraulic Engineering, Irrigation Engineering, Surveying, Estimating & costing.	**[07 Hrs.]**
UNIT–6 : Computer program based on Structural analysis, Structural Design, Environmental Engineering, Matrix algebra, Use of excel in structural design, estimating & costing	**[06 Hrs.]**

Reference Books :
1. C programming language, 2th Edition 1996, Dennis Ritchie, Pearson
2. C: The Complete Reference, 4thEdititon 2017, Herbert Schildt, McGraw Hill

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YCCE-CE-32

VII Semester
CV2440 - PE-V : Structural Engineering Practices

COURSE OBJECTIVE	COURSE OUTCOMES
5. To make the students aware about Structural Engineering Practices and pre-requisites in initiating structural design 6. To provide the students the knowledge about various standards and specifications frequently referred by Structural Engineers and their use in practice 7. To make the students aware about architectural plans, structural analysis and design of structural elements, identification of points for discussion between an architect and structural designer 8. To design an RCC building and prepare structural drawings.	5. An Ability to understand structural engineering practices and pre-requisites. 6. An ability to understand relevant standards and software related to structural design. 7. An ability to understand important construction process related to structural members. 8. An ability to design building components and prepare detailed structural drawings.
Mapped Program Outcomes : 1,2,3,4,12 **PSO** : i	

UNIT–1 : Importance of various architectural building plans and sections for the structural design. Structural behavior, Design basis, Design Intent, Standards, Manuals, Methods, material testing, Material Properties, Mix design, Quality Control, Different Tests & checks carried out at site, cube tests, buckling, creep, Shrinkage, etc. Professional ethics	**[07 Hrs.]**
UNIT–2 : Preparation of the structural framing plan of the building, beam locations, column positions, column orientations, shear walls locations. Introduction of SP16, IS:1893, IS:13920	**[06 Hrs.]**
UNIT–3 : Importance, determination & calculation of different loads like Dead load, live load, wall load, seismic load, wind load, finish load, temperature load, vibratory load, etc. Various load combinations.	**[06 Hrs.]**
UNIT–4 : Three dimensional Modeling of the Structure, Boundary Conditions, Section Properties, Applications of Loading, Static & Dynamic Analysis of structure, Design of structure, Understanding & Interpretation of the results, Deformation control, Mode Shapes, Vibrations, Acceptance Criteria's, Tolerances, , .	**[7 Hrs.]**
UNIT–5 : Foundations – Importance of soil exploration, Various types of Foundation, Selection of type of foundation. Construction Methods.	**[07 Hrs.]**
UNIT–6 : Reinforcement detailing of Structures as per SP24 and as per exposure conditions, Fire Rating, etc.	**[06 Hrs.]**

Text books:
1. P.C. Vergese, Limit State Design of Reinforced Concrete, Prentice Hall Publishers, 2nd edition, 2008
2. Shah and Karve, Reinforced Concrete Structures, Structures Publishers, Pune, 5th edition, 2015.
3. Sinha S.N, Reinforced Concrete Design, Tata McGraw Hill Publishing Company Limited, New Delhi, 2007
4. Ashok K. Jain, Reinforced Concrete –Limit State Design, Nem chand and Brothers, 7th edition,2012

Reference books:
1. P.C. Varghese, Advanced Design of Structures, Prentice Hall Publishers,2009
2. Punmia B.C.,Jain A.K.,Jain A.K,Reinforced Concrete Structures (Vol-I),Laxmi Publications Pvt Ltd, New Delhi, 2007
3. N. Krishana Raju,Prestressed Concrete,Tata McGraw Hill Publishing Company Limited, New Delhi, 5th edition 2012

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(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

SoE No. ME-201

B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f. 2020-21 onward)
Mechanical Engineering

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
				Seventh Semester										
1	7	PC	ME2401	Automation In Production	T	3	0	0	3	3	30	30	40	3
2	7	PC	ME2402	**Lab:-** Automation In Production	P	0	0	2	2	1		60	40	
3	7	PE		Professional Elective II	T	3	0	0	3	3	30	30	40	3
4	7	PE		Professional Elective III	T	3	0	0	3	3	30	30	40	3
5	7	PE		**Lab:-** Professional Elective III	P	0	0	2	2	1		60	40	
6	7	PE		Professional Elective IV	T	3	0	0	3	3	30	30	40	3
7	7	PE		Professional Elective V	T	3	0	0	3	3	30	30	40	3
8	7	STR	ME2409	Mini Project	P	0	0	4	4	2		60	40	
9	7	STR	ME2410	Campus Recrutment Training (CRT)	P	0	0	0	0	2		100		
				TOTAL		15	0	8	23	21				

Professional Electives -II

1	7	PE-II	ME2411	PE II : Tool Design	
2	7	PE-II	ME2412	PE II : Additive Manufacturing	
3	7	PE-II	ME2413	PE II : Fuel Cell Technology	
4	7	PE-II	ME2414	PE II : Refrigeration and Air Conditioning	
5	7	PE-II	ME2415	PE II : Material Handling Systems	
6	7	PE-II	ME2416	PE II : Reliability Engineering	
7	7	PE-II	ME2417	PE II : Advanced Manufacturing Techniques	
8	7	PE-II	ME2418	PE II : Optimization Techniques	

Professional Electives -III

9	7	PE-III	ME2421	PE III : Vibration
10	7	PE-III	ME2422	PE III : Lab:- Vibration
11	7	PE-III	ME2423	PE III : Comuter Aided Design and Manufacturing
12	7	PE-III	ME2424	PE III : Lab:- Comuter Aided Design and Manufacturing
13	7	PE-III	ME2425	PE III : Vehicle Engineering
14	7	PE-III	ME2426	PE III : Lab:- Vehicle Engineering
15	7	PE-III	ME2427	PE III : Solar Energy and It'S Utilisation
16	7	PE-III	ME2428	PE III : Lab:- Solar Energy and It'S Utilisation
17	7	PE-III	ME2429	PE III : CNC & Robotics
18	7	PE-III	ME2430	PE III : Lab:- CNC & Robotics
19	7	PE-III	ME2433	PE III :Pipe Design Engineering
20	7	PE-III	ME2434	PE III : Lab:- Pipe Design Engineering
21	7	PE-III	ME2435	PE III : Earth Moving Equipments
22	7	PE-III	ME2436	PE III : Lab:- Earth Moving Equipments

Professional Electives -IV

23	7	PE-IV	ME2441	PE IV : Sysnthesis of Mechanism
24	7	PE-IV	ME2442	PE IV : Design for Manufacturing & Assembly
25	7	PE-IV	ME2443	PE IV : Renewable Energy System
26	7	PE-IV	ME2444	PE IV : Engineering of Plastics
27	7	PE-IV	ME2445	PE IV : Finance & Cost Management
28	7	PE-IV	ME2446	PE IV : Artificial Intelligence
29	7	PE-IV	ME2447	PE IV : Maintenance Management
30	7	PE-IV	ME2448	PE IV : Total Quality Management
31	7	PE-IV	ME2449	PE IV : Project Evaluation & Management

Professional Electives -V

32	7	PE-V	ME2461	PE V : Stress Analysis
33	7	PE-V	ME2462	PE V : Product Design and Development
34	7	PE-V	ME2463	PE V : Power Plant Engineering
35	7	PE-V	ME2464	PE V : Value Engineering
36	7	PE-V	ME2465	PE V : Design of Experiments and Taguchi Methods
37	7	PE-V	ME2466	PE V : Industrial Safety
38	7	PE-V	ME2467	PE V : Control System Engineering
39	7	PE-V	ME2468	PE V : Tribology
40	7	PE-V	ME2469	PE V : Turbines

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA** = for Practical : MSPA will be 15 marks each

Chairperson	Dean (Acad. Matters)	June 2021	1.03	Applicable for AY 2021-22 Onwards
		Date of Release	Version	

Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)
B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f. 2020-21 onward)

SoE No. ME-201

Mechanical Engineering

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
1	8	STR	ME2451	Major Project	P	0	0	12	12	9		60	40	
2	8	STR	ME2452	Extra curricular Activity Evaluation	P	0	0	0	0	1		100		
					TOTAL	0	0	12	12	10				

(Green header row: **Eigth Semester**)

	GRAND TOTAL	87	0	44	132	163	

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA** = for Practical : MSPA will be 15 marks each

Chairperson	Dean (Acad. Matters)	Date of Release	Version	Applicable for
		June 2020	1.02	AY 2021-22 Onwards

ME 2345	EARTHMOVING EQUIPMENTS	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	30	40	100	3 Hrs

Objective	Course Outcome
1. .To introduce and understand the simple Hydraulic power systems and to realize its importance in the world of power transmission. 2. To study various fluids, filters and seals for hydraulic systems 3. To study various components of fluid power systems .	Students will be able to: (I)To understand and apply fluid power laws and principles [1,6]
	(II)Students will be able to understand the basic fluid power hardware system components. [PO-1,2,3,6, PSO- 1,2]
4. To understand symbols associated with Hydraulic circuits and Electronic circuitd. 5. To understand Electronics diagnostic and Computer Aided Diagnostic systems.	(III)Students will be able to interpret and draw hydraulics and electronic system circuits. [PO-1, 11; PSO-1]
6. Maintenance, troubleshooting and safety practices for Earthmoving equipments. **[PO- 1,2,3,4,6,9,11; PSO-1 ,2]**	(IV)Students will be able to design, analyze, use, maintain, carryout troubleshooting, and establish safety procedures of Earthmoving equipments. [PO-1,2,3,11; PSO-1]

Unit 1 : Introduction   [8 hrs]

Earthmoving equipments: Introduction, Types and applications.

Hydraulic systems: Components, advantages, applications in the field of Earthmoving Equipments.

Seals, sealing materials, selection of seals.

Filters, strainers, sources of contamination of fluid & its control.

Hoses & Pipes: Types, materials, pressure drop in hoses/pipes, valves and fittings. Hydraulic piping connections.

Types of Hydraulic fluid petroleum based, synthetic & water based. Properties of fluids. Selection of fluids, additives, effect of temperature & pressure on hydraulic fluids.

Unit 2 : Mechanical Systems: [7 hrs]

Super Structure : Cabin:- dashboard , drive controls and hydraulic controls. Boom, arm and related components.

Under Carriage : Transmission system: drive system , hydraulic systems for earthmoving, Turning system . Gear box and related components.

Attachments : Buckets: Backacter, cam shelve, screening adapter, special buckets.
 End effectors: Earthwork attachments, drilling and boring attachment, piling attachment, crusher adapters, breakers, jaws, grabbing and loading attachments.

Unit 3 : Hydraulic Systems: [7 hrs]

Pumps: Types, classification, principle of working & constructional details of vane pump, gear pumps, radial & axial plunger pumps, power and efficiency calculations, characteristic Curves, selection of pumps for hydraulic power transmission.

Accumulators & Intensifiers: Types & functions of accumulators & intensifiers, applications, selection & design procedure.

Unit 4 : Hydraulic Systems : [8 hrs]

Valves: Types & functions of valves, applications, selection

Actuators: Linear & Rotary actuators.

Hydraulic motors: Types, vane, gear piston, radial piston. Hydraulic motor performance.

Hydraulic Cylinders: Types of cylinder & mountings, calculations of piston velocity, thrust under static & dynamic applications. Design consideration for cylinders.

Hydraulic Circuits: JIC symbols / ISO Symbols for hydraulic circuits

Different hydraulic circuits used in Construction equipments. Hydraulic circuit analysis

Unit 5 : Electrical and Electronics System: [7 hrs]

Basic electrical components switches, cables, colour coding of cables, Relays,.

The basic connections – series and parallel circuits. Electric circuits of earthmoving equipments..

Electronics Circuits: Symbols for Electronics circuits

Different Electronics circuits used in earthmoving equipments. Electronics circuit analysis

Unit 6 : Maintenance of Earthmoving Equipments: [8 hrs]

Preventive, predictive & breakdown maintenance. Trouble shooting & safety precautions. Electronics diagnostic and Computer Aided Diagnostic systems.

Text books:			
Title of the book	**Edition (Year of publication)**	**Author(s)**	**Publisher**
Introduction to Fluid Power	2002	James L Johnson	**Delmar Thomson Learning**
Fluid Power With Applications	6th	Anthony Esposito	PEARSON Prentice Hall
Industrial Hydraulics	3rd or above	J.J. Pipenger & T. G. Hicks	McGraw Hill Co.
Pneumatic Systems: Principles and Maintenance	16th (2006)	S. R. Majumdar	Tata McGraw-Hill Education
Reference Books:			
Power pneumatics	(2007)	Michael J. Pinches	Prentice Hall
Vickers manuals on Industrial Hydraulics	3rd edition or above	Vickers	Vickers, 1996
Hydraulics & Pneumatics	4th edition	Harry L. Stewart	Industrial Press
Fluid Power Design Handbook	3rd edition	Franklin D. Yeaple	Marcel Dekker, 1996

Regular: - 6th Semester   Elective - Practical

Regular: - 6th Semester   Elective - Practical

ME 2346	EARTHMOVING EQUIPMENTS	L=0	T=0	P=2	Credits=1

Evaluation Scheme	MSE-I	MSE-II	CA	ESE	Total	ESE Duration
	0	0	60	40	100	3 Hrs

Objective	Course Outcome
1. To introduce and understand the simple Hydraulic power systems and to realize its importance in the world of power transmission. 2. To study various fluids, filters and seals for hydraulic systems 3. To study various components of fluid power systems . 4. To understand symbols associated with Hydraulic circuits and Electronic circuits. 5. To understand Electronics diagnostic and Computer Aided Diagnostic systems. **6. Maintenance, troubleshooting and safety practices for Earthmoving equipments.** **[PO- 1,2,3,4,6,9,11; PSO-1 ,2]**	Students will be able to: (I)To understand and apply fluid power laws and principles [1,6]
	(II)Students will be able to understand the basic fluid power hardware system components. [PO-1,2,3,6, PSO- 1,2]
	(III)Students will be able to interpret and draw hydraulics and electronic system circuits. [PO-1, 11; PSO-1]
	(IV)Students will be able to design, analyze, use, maintain, carryout troubleshooting, and establish safety procedures of Earthmoving equipments. [PO-1,2,3,11; PSO-1]

Practical:

1. Practical based on syllabus.
2. Industry visit / site visit to experience actual working of Earthmoving equipments.
3. Visit to Service station / workshop of Earthmoving equipments
4. Hands on experience of diagnosis, trouble shooting and repairing of Earthmoving equipments.
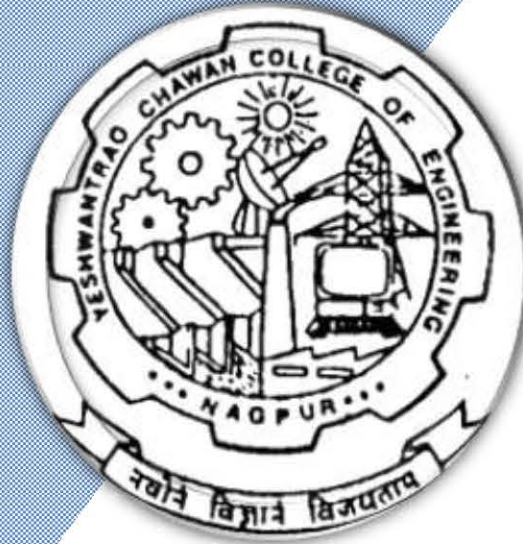
Yeshwantrao Chavan College of Engineering

Bachelor of Engineering
SoE & Syllabus 2018
3rd to 8th Semester
Electrical Engineering

Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)
B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f. 2020-21 onward)

SoE No. EL-201

Electrical Engineering

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
				TOTAL FIRST & SECOND SEM						47				
				Third Semester										
1	3	BS	GE2201	Engineering Mathematics III	T	3	0	0	3	3	30	30	40	3 Hours
2	3	PC	EL2201	Analog Electronics	T	3	0	0	3	3	30	30	40	3 Hours
3	3	PC	EL2202	Lab. : Electronics Engineering Workshop	P	0	0	2	2	1		60	40	
4	3	PC	EL2203	Electrical Machines	T	4	0	0	4	4	30	30	40	3 Hours
5	3	PC	EL2204	Lab.:Electrical Machines	P	0	0	2	2	1		60	40	
6	3	PC	EL2205	Network Analysis	T	3	0	0	3	3	30	30	40	3 Hours
7	3	PC	EL2206	Lab.:Computer Programming	P	0	0	2	2	1		60	40	
8	3	PC	EL2207	Electrical Measurement & Instrumentation	T	3	0	0	3	3	30	30	40	3 Hours
9	3	PC	EL2208	Lab.:Electrical Measurement & Instrumentation	P	0	0	2	2	1		60	40	
				TOTAL		16	0	8	24	20				

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
				Fourth Semster										
1	4	BS	GE2204	Advance Mathematical Techniques	T	3	0	0	3	3	30	30	40	3 Hours
2	4	PC	EL2251	Electrical Machines in Power System	T	3	0	0	3	3	30	30	40	3 Hours
3	4	PC	EL2252	Lab.:Electrical Machines in Power System	P	0	0	2	2	1		60	40	
4	4	PC	EL2253	Electrical Energy Generation System	T	3	0	0	3	3	30	30	40	3 Hours
5	4	PC	EL2254	Lab.:Renewable Energy System	P	0	0	2	2	1		60	40	
6	4	PC	EL2255	Electric & Magnetic Fields	T	3	0	0	3	3	30	30	40	3 Hours
7	4	PC	EL2256	Lab.:Electrical Engineering Workshop	P	0	0	2	2	1		60	40	
8	4	PC	EL2257	Microprocessor	T	3	0	0	3	3	30	30	40	3 Hours
9	4	PC	EL2258	Lab.:Microprocessor	P	0	0	2	2	1		60	40	
10	4	PC	EL2259	Signals & Systems	T	4	0	0	4	4	30	30	40	3 Hours
				TOTAL		19	0	8	27	23				

List of Audit Courses

SN	Sem	Type	Sub. Code	Subject	T/P	L	T	P	Hrs	Credits
1	3	HS	GE2121	Env Studies for 3 Sem. EL,ET,CT	A	3	0	0	3	0

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA** = for Practical : MSPA will be 15 marks each

		June 2020	1.02	Applicable for AY 2020-21 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	

Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)
B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f. 2020-21 onward)

SoE No.
EL-201

Electrical Engineering

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
Fifth Semester														
1	5	HS	GE2312	Fundamental of Economics	T	3	0	0	3	3	30	30	40	3 Hours
2	5	PC	EL2301	Power Electronics	T	3	0	0	3	3	30	30	40	3 Hours
3	5	PC	EL2302	Lab.:Power Electronics	P	0	0	2	2	1		60	40	
4	5	PC	EL2303	Fundamentals of Power System	T	3	0	0	3	3	30	30	40	3 Hours
5	5	PC	EL2304	Electrical Drives	T	3	0	0	3	3	30	30	40	
6	5	PC	EL2305	Lab.:Electrical Drives	P	0	0	2	2	1		60	40	
7		OE		Open Elective - I *	T	3	0	0	3	3	30	30	40	3 Hours
8	5	OE		Open Elective - II *	T	3	0	0	3	3	30	30	40	3 Hours
					TOTAL	18	0	4	22	20				

Audit Courses

1	5	IT	IT1121	Industrial Programmin Language	A	3	0	0	3	0				

Open Electives -I

1	5	OE	EL2311	OEI:Renewable Energy Generation System
2	5	OE	EL2312	OEI:Electrical Machines and their Applications
3	5	OE	EL2313	OEI:Testing and Maintenance of Electrical Machines

Open Electives -II

4	5	OE	EL2321	OEII:Electrical Energy Audit and Safety
5	5	OE	EL2322	OEII:Utilization of Electrical Energy
6	5	OE	EL2323	OEII:Power System Engineering

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA** = for Practical : MSPA will be 15 marks each

		June 2020	1.02	Applicable for AY 2020-21 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	

Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)
B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f. 2020-21 onward)

SoE No. EL-201

Electrical Engineering

SN	Sem	Type	Sub. Code	Subject	T/P	L	T	P	Hrs	Credits	MSEs*	TA**	ESE	ESE Duration Hours
						Contact Hours					% Weightage			

SN	Sem	Type	Sub. Code	Subject	T/P	L	T	P	Hrs	Credits	MSEs*	TA**	ESE	ESE Duration Hours
Sixth Semester														
1	6	HS	GE2311	Fundamental of Management	T	3	0	0	3	3	30	30	40	3 Hours
2	6	PC	EL2351	Control System	T	3	0	0	3	3	30	30	40	3 Hours
3	6	PC	EL2352	Lab.:Control System	P	0	0	2	2	1		60	40	
4	6	PC	EL2353	Power System Analysis	T	3	0	0	3	3	30	30	40	3 Hours
5	6	PE		**Professional Elective I**	T	3	0	0	3	3	30	30	40	3 Hours
6	6	PE	EL2354	**Lab.**:Simulation of Power Electronics & Power System	P	0	0	2	2	1		60	40	
7	6	OE		**Open Elective III ***	T	3	0	0	3	3	30	30	40	3 Hours
8	6	OE		**Open Elective IV ***	T	3	0	0	3	3	30	30	40	3 Hours
9	6	PC	EL2355	Lab.:Substation Design	P	0	0	2	2	1		60	40	
10	5/6	STR	EL2360	**Industry Visit and its report**	P	0	0	0	0	1		60	40	
					TOTAL	18	0	6	24	22				

Professional Electives -I

1	6	PE	EL2361	**PEI:**Advanced Power Electronics
2	6	PE	EL2362	**PEI:**Electrical Distribution in Power System
3	6	PE	EL2363	**PEI:**Illumination Engineering (MOOC)
4	6	PE	EL2364	**PEI:**Electric Vehicles
5	6	PE	EL2365	**PEI:**Electric Power Utilization

Open Electives -III

6	6	OE	EL2371	**OEIII:**Renewable Energy Generation System
7	6	OE	EL2372	**OEIII:**Electrical Machines and their Applications
8	6	OE	EL2373	**OEIII:**Testing and Maintenance of Electrical Machines

Open Electives -IV

9	6	OE	EL2381	**OEIV:**Electrical Energy Audit and Safety
10	6	OE	EL2382	**OEIV:**Utilization of Electrical Energy
11	6	OE	EL2383	**OEIV:**Power System Engineering

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA** = for Practical : MSPA will be 15 marks each

		June 2020	1.02	
Chairperson	Dean (Acad. Matters)	Date of Release	Version	Applicable for AY 2020-21 Onwards

Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)
B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f. 2020-21 onward)

SoE No. EL-201

Electrical Engineering

SN	Sem	Type	Sub. Code	Subject	T/P	L	T	P	Hrs	Credits	MSEs*	TA**	ESE	ESE Duration Hours
						Contact Hours					% Weightage			

SN	Sem	Type	Sub. Code	Subject	T/P	L	T	P	Hrs	Credits	MSEs*	TA**	ESE	ESE Duration Hours
Seventh Semester														
1	7	PC	EL2401	Switchgear & Protection	T	3	0	0	3	3	30	30	40	3 Hours
2	7	PC	EL2402	Lab.:Switchgear & Protection	P	0	0	2	2	1		60	40	
3	7	PC	EL2403	High Voltage Engineering	T	3	0	0	3	3	30	30	40	3 Hours
4	7	PC	EL2404	Lab.:High Voltage Engineering	P	0	0	2	2	1		60	40	
5	7	PE		**Professional Elective II**	T	3	0	0	3	3	30	30	40	3 Hours
6	7	PE		**Professional Elective III**	T	3	0	0	3	3	30	30	40	3 Hours
7	7	PE		**Professional Elective IV**	T	3	0	0	3	3	30	30	40	3 Hours
8	7	STR	EL2409	Mini Project	P	0	0	4	4	2		60	40	
9	7	STR	EL2410	Campus Recrutment Training (CRT)	P	0	0	0	0	2		100		
					TOTAL	15	0	8	23	21				

Professional Electives -II

1	7	PE	EL2411	**PEII:** Fundamentals of Power Quality
2	7	PE	EL2412	**PEII:** Electrical Installation Design
3	7	PE	EL2413	**PEII:** Electrical Machine Design
4	7	PE	EL2421	**PEII:** Power System Operation and Control

Professional Electives -III

5	7	PE	EL2422	**PEIII:** FACTS Devices
6	7	PE	EL2423	**PEIII:** Electrical Energy Management And Audit
7	7	PE	EL2424	**PEIII:** Advanced Control System
8	7	PE	EL2425	**PEIII:** Artificial Intelligence Based System

Professional Electives -IV

9	7	PE	EL2431	**PEIV:** Advanced Electrical Drives
10	7	PE	EL2432	**PEIV:** Fundamentals of Smart Grid
11	7	PE	EL2433	**PEIV:** Computer Methods in Power System
12	7	PE	EL2434	**PEIV:** EHVAC-HVDC Transmission

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA** = for Practical : MSPA will be 15 marks each

		June 2020	**1.02**	
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**	**Applicable for AY 2021-22 Onwards**

Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)
B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f. 2020-21 onward)

SoE No.
EL-201

Electrical Engineering

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
Eigth Semester														
1	8	STR	EL2451	Major Project	P	0	0	12	12	9		60	40	
2	8	STR	EL2452	Extra curricular Activity Evaluation	P	0	0	0	0	1		100		
					TOTAL	0	0	12	12	10				

				GRAND TOTAL	86	0	46	132	163				

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA** = for Practical : MSPA will be 15 marks each

		June 2020	1.02	Applicable for AY 2021-22 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)
BE SoE and Syligzig 2018
<u>ELECTRICAL ENGINEERING</u>

III Semester
GE2201 - Engineering Mathematics III

Objectives	Outcomes
1. Able to find numerical solution of various mathematical equations 2. Give knowledge of Laplace transform, Z transform, Fourier transform 3. Define the periodic functions in the form of Fourier series 4. Solve partial differential equations	The student will be able to: 1. Estimate the Calculus of Numerical Function. 2. Determine transforms and inverse transforms of various functions of variables and use it to solve Mathematical equations. 3. Discuss the nature of periodic function and express it in terms of series. 4. Use appropriate method/s to solve partial differential equations.

Unit I: Finite Differences
Difference table; Operators E and Δ, Central differences, Factorials notation, Numerical differentiation and integration, Difference equations with constant coefficients. **(6 hours)**

Unit II: Laplace Transform
Laplace Transforms: Laplace transforms and their simple properties, Unit step function, inverse of Laplace transform, convolution theorem, Applications of Laplace transform to solve ordinary differential equations .**(7 hours)**

Unit III: Z-transform
Z-Transform definition and properties (with proof), inversion by partial fraction decomposition and residue theorem, Applications of Z-transform to solve difference equations with constant co-efficient. **(6 hours)**

Unit IV: Fourier Series
Periodic Functions and their Fourier series expansion, Fourier Series for even and odd function, Change of interval, half range expansions **(7 hours)**

Unit V: Partial Differential Equation
Partial Differential Equations of first order first degree i.e. Lagrange's form, linear homogeneous equations of higher order with constant coefficient. Application of variable separable method to solve first and second order partial differential equations. **(7 hours)**

Unit VI : Fourier Transform : Definition: Fourier Integral Theorem, Fourier sine and cosine integrals, Finite Fourier sine & cosine Transform Parseval's Identity, convolution Theorem. **(6 hours)**

Text Books:

SNo	Title	Edition	Authors	Publisher
1	Advance Engineering Mathematics	9th Edition (September 2009)	Kreyszig.	Wiley
2	Higher Engineering Mathematics	40th edition, (2010)	B.S. Grewal	Khanna Publishers (2006)
3	Advanced Engineering Mathematics	8th revised edition, 2007	H.K. Dass	Publisher: S.Chand and Company Limited

Reference Books:

SNo	Title	Edition	Authors	Publisher
1	Mathematics for Engineers	19th edition, (2007)	Chandrika Prasad.	John Wiley & Sons
2	Advanced Mathematics for Engineers	4th edition, (2006)	Chandrika Prasad	John Wiley & Sons
3	Applied Mathematics for Engineers	3rd edition, (1970)	L.A. Pipes and Harville	McGraw Hill
4	A text Book of Applied Mathematics	3rd edition, (2000)	P.N. and J.N. Wartikar	Pune Vidyarthi Griha Prakashan
5	A text book of Engineering Mathematics	Reprint 2008	N.P. Bali and Manish Goyal	Laxmi Prakashan

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YCCE-EL-1

III SEMESTER

EL2201	Analog Electronics		L=3	T=0	P=0	Credits=3
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Course Objective	Course Outcomes
After taking this course, the student should be able to analyze, simulate, and design single and multistage amplifiers. Design of single, multistage, and op-amp amplifier are covered in detail including analysis of biasing techniques, frequency response compensation, feedback, stability, noise and nonlinearity	The student will be able: 1. To identify the basic structure, characteristics and various operating modes of BJT 2. To Explain and Describe the various small signal parameters and its applications 3. To demonstrate the knowledge to develop various power amplifier and oscillator circuit. 4. To analyse and evaluate the basic concept of Op-Amp circuit and its various applications.

UNIT-1: Bipolar Junction Transistors (BJT)
BJT, Theory of operation, characteristics, Biasing arrangements (CB, CE, CC modes), operating modes , Stability factor, Transistor as a switch.

UNIT-2: Small Signal Analysis
Small signal analysis of CE, CB, CCmodes and their comparison, AC equivalent circuit, transistor equivalent circuit-CE, Hybrid equivalent model, Analysis of a transistor using h-parameter, emitter follower, RC coupled amplifier, low frequency response of an RC coupled stage

UNIT-3 :Power & Feedback Amplifier
Introduction to Power Transistors, Power amplifiers- classification as A,B, AB, C, Push pull amplifiers, Cross over distortion, Positive and Negative amplifiers- classification, feedback amplifiers, advantages and applications.

UNIT-4:Oscillator Circuits
Basic principle of sinusoidal oscillator, R-C Phase Shift and Wein Bridge oscillators, Tuned oscillators- Collpits and Hartley; Crystal oscillator

UNIT-5 : Operational Amplifier (OA)
Simple linear circuit: Inverting, non-inverting , buffer amplifier, summer integrator , differentiator, log, antilog, Multiplier, instrumentation amplifier, grounding and shielding problem in instrumentation amplifier. Precision rectifier, RMS to DC conversion, constant current and voltage sources, Sinusoidal oscillator with frequency and amplitude stabilization elementary , idea of active filter with Butterworth second order filter design procedure.

UNIT-6: Applications of Operational Amplifier
Applications of Operational amplifier for clipping, clamping, comparator circuit with non-linear components, Multiplexers, Demultiplexer, Astable, Mononstable, Bistable multivibrator circuits using OpAmp, sample/ hold circuits,D/A and A/D conversion circuits.

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Nagar Yuwak Shikshan Sanstha's

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ELECTRICAL ENGINEERING

III SEMESTER

EL2201	Analog Electronics		L=3	T=0	P=0	Credits=4
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Text Books:

SNo.	Title	Authors	Publisher
1	Electronic Principles,	A.P. Malvino,	Tata Mcgraw Hill Publications
2	Electronics : Analog & Digital	I. J. Nagrath	PHI Publication
3	Linear Application Handbook	National Semiconductors	
4	Operational Amplifiers	Dailey	Tata McGraw Hill
5	Introduction to Operational Amp	Wait	Tata McGraw Hill
6	Designing with Op- Amps	France	Tata McGraw Hill

Reference Books:

SNo.	Title	Authors	Publisher
1	Electronic devices and circuits	Jacob Millman, and C.C. Halkias	TMH Publications
2	Introduction to Semiconductor	M. S. Tyagi	John Wiley & Sons Inc
3	Materials and Devices		
4	Solid State Electronic Devices	Ben G. Streetman,	PHI, 5th Ed, 2001

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III SEMESTER

EL2202	Lab. : Electronics Engineering Workshop	L=0	T=0	P=2	Credits=1

Evaluation Scheme	Continuous Assessment	TA	ESE	Total	ESE Duration
	--	40	60	100	---

Course Objective	Course Outcomes
To expose printed circuit board (PCB) design, fixing of components on PCB, testing of components and circuits	1. This course gives the basic introduction of electronic hardware systems. 2. It provides hands-on training with familiarization, identification, testing, assembling, dismantling of various components. 3. Student can identify the active and passive electronic components 4. Testing of electronics components like Resistor, Capacitor, Diode, Transistor, UJT and JFET using multimeter. 5. PCB fabrication and repairing such systems by making use of the various tools and instruments available in the Electronics Workshop.

Mapped program outcomes							

Practical based on following topics :-

Minimum eight practical based on following are to be set up :-

Expt. No.	Experiments based on
01	Design and fabrication of PCB
02	Design of voltage regulators
03	Design of different timers using operational amplifiers.
04	Study and testing of diodes
05	Study and testing of transistors
06	Study and testing of MOSFET, IGBT
07	Study and testing of Thyristor, power diodes
08	Study and testing of power transistors
09	Study and testing of operational amplifiers, LEDs.ICs etc

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ELECTRICAL ENGINEERING

III SEMESTER

EL2203	Electrical Machines		L=3	T=0	P=0	Credits=4
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Course Objective	Course Outcomes
The course objective is to impart knowledge of • The basic principle of transfer of electrical power, operation, construction of 3-phase transformers, their classification, connections and phasor diagrams. • The basic principle, construction, operation, Performance characteristics, steady state analysis and applications of electrical motors andinduction generator.	Students will be able to 1. Demonstrate the knowledge of Operation of single phase and auto-transformer. Develop, analyse and evaluate vector diagrams and performance indices of single phase transformer. 2. Explain Construction, vector grouping, testing and examine the need of parallel operation of three phase transformers 3. Explain and examine principle, construction, types, operation, speed control, characteristic and applications of DC machines and evaluate performance parameters of d.c.machines 4. .Explain and examine principle, construction, operation, starting, speed control ,applications and evaluate the performance indices of induction motors.
Mapped program outcomes:1,2,3	

UNIT 1: ELECTRO MAGNETISM: (6)
Magnetic Field, Magnetic Flux, Magnetic Flux Density, Permeability, Relation between magnetic flux density and field intensity, magnetic field due to current carrying conductor and a coil, Right hand grip rule, Force on a current carrying conductor placed in a magnetic field, Flemings Left hand Rule, Magnetomotive Force, Magnetic Field Strength, Reluctance, Magnetization curves of magnetic materials, Magnetic hysteresis and hysteresis loss, Eddy current and loss, leakage flux and fringing, Faraday's laws of electromagnetic induction, Lenz's Law, Flemings's Right hand rule, Types of induced EMF.

UNIT-2: SINGLE PHASE TRANSFORMER (10)
Phasor diagram of transformer on no load and on load, Load Test, Open circuit and short circuit test on 1 phase transformer, equivalent circuit of transformer, Efficiency and condition for maximum efficiency, Regulation and Efficiency using O.C. & S.C. data, Autotransformer operation, kVA rating of autotransformer.

UNIT-3: THREE PHASE TRANSFORMER (08)
Types of 3 phase transformers, Construction, Labelling of terminals, Vector Groups, Polarity marking & Test, Transformer connections and their comparative features, Open Delta Connection, parallel operation of single and three phase transformers, All day efficiency

UNIT-4 D.C. GENERATOR: (08)
Construction, Magnetic structure, Field and Armature systems, Field and Armature windings (Both Lap and Wave Types),EMF Equation, Characteristics and applications of different types of D.C. Generators, Building of Emf in D.C. Shunt generator, Armature reaction, commutation, straight line commutation, inter-poles, compensating winding.

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III SEMESTER

EL2203	Electrical Machines		L=3	T=0	P=0	Credits=4
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

UNIT 5: D.C. MOTOR: (08)
Principle, Torque Equation, Characteristics and applications of various types of D.C. Motors, Starting of D.C. Motors, Speed control of Series and Shunt motors, Power flow in DC machines, Losses and Efficiency in D.C. machines,

UNIT 6 :THREE PHASE INDUCTION MOTOR (10)
Equivalent circuit, No load and blocked rotor tests and determination of parameters of equivalent circuit, Losses and efficiency. Starting, Speed control, Crawling and cogging, Double cage induction motor: principle, construction, torque slip characteristics. Induction Generator: principle, isolated operation, double fed induction generator, applications

Text Books:

SNo	Title	Edition	Authors	Publisher
1	Electrical Machines	2nd -1993	Dr. P. K. Mukherjee and S. Chakravarti	Dhanpat Rai Publications (P) Ltd
2	Electrical Machines	3rd -2010	I.J.Nagrath and Dr. D.P.Kothari	Tata McGraw Hill
3	Electric Machines		Ashfaq Husain	Dhanpat Rai Publications (P) Ltd.

Reference Books:

SNo	Title	Edition	Authors	Publisher
1	D.C. Machines		Langsdorf	
2	Electrical Machines and Transformers		Nasser Syed	
3	Laboratory manual for Electrical machines		Dr. D.P. Kothari and Prof. Umre	.S. S.CHAND

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III SEMESTER

EL2204	Lab. : Electrical Machines		L=0	T=0	P=2	Credits=1
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	--	40	60	100		---

Course Objective	Course Outcomes
	The student will be able to understand the 1. Circuit connections, selections of measuring instruments and their position in the circuit to determine the circuit quantities 2. Evaluation of performance indices, equivalent circuit parameters and variation of the performance on loading of single phase and three phase transformance, induction motors and DC shunt motors 3. Magnetizing characteristics of the DC Generator, Critical Field resistance and speed of the machine 4. Various methods of speed control of DC shunt motor and three phase wound rotor induction motor

Mapped program outcomes | a | b | c | f | g | h | j |

Minimum Eight Practical are to be performed out of the following :-

Expt. No.	Experiments based on
01	To perform load test on 1-phase transformer to determine its efficiency and voltage regulation.
02	To perform Open Circuit and Short Circuit tests on a 1-phase transformer to evaluate efficiency and voltage regulation.
03	To perform back to back test on two identical 1-phase transformers.
04	To study conversion of a 2-winding transformer into an autotransformer.
05	To study phasing out and polarity marking of a 3-phase transformer.
06	To study voltage and current relations in a 3-phase, Delta-Star connected transformer.
07	To perform Open Circuit and Short Circuit test on a 3-phase transformer.
08	To plot magnetization characteristic of a DC generator.
09	To study speed control of a DC shunt motor by varying – (a) field excitation and (b) armature voltage
10	To perform load test on a DC shunt motor.
11	To study measurement of slip of a 3-phase induction motor by different method.
12	To study control of a 3-phase slip-ring induction motor by – (a) variation of a rotor resistance and (b) varying supply voltage
13	To perform load test on a 3-phase induction motor by indirect loading.
14	To perform load test on a 3-phase induction motor by direct loading.
15	To perform No-Load and Blocked rotor tests on a 3-phase induction motor.
16	To perform No-Load and Blocked rotor tests on a 1-phase induction motor.
17	To study Induction generator operation.

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III SEMESTER

EL2205	Network Analysis		L=3	T=0	P=0	Credits=4
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Course Objective	Course Outcomes
The basic objective of this course is to introduce students to the fundamental theory and mathematics for the analysis of electrical circuits. Through the material presented in this course, students will learn: • The fundamental principles of electrical circuit analysis and to be able to extend these principles into a way of thinking for problem solving in mathematics, science, and engineering • To become adept at using various methods of circuit analysis, including simplified methods such as series-parallel reductions, voltage and current dividers, and the mesh - node method. • To appreciate the consequences of linearity, in particular the principle of superposition and Thevenin - Norton equivalent circuits. • To analyze analog circuits that include energy storage elements. • To utilize Laplace transforms for circuit analysis. • To analyze four terminal networks using two-port parameters.	Upon successful completion of this course, students should be able to: 1) Define basic concepts related to the course of network analysis. 2) 2) Select best possible method of circuit analysis for a given situation. 3) Apply a variety of circuit analysis methods including theorems and Laplace transform. 4) Design circuits for a given voltage, power, as well as for critical frequencies and two port parameters

Mapped program outcomes							

UNIT 6 : THREE PHASE INDUCTION MOTOR   (10)
Equivalent circuit, No load and blocked rotor tests and determination of parameters of equivalent circuit, Losses and efficiency. Starting, Speed control, Crawling and cogging, Double cage induction motor: principle, construction, torque slip characteristics. Induction Generator: principle, isolated operation, double fed induction generator, applications

UNIT-1: NODAL ANALYSIS OF ELECTRIC CIRCUITS
Basics of electric circuits, circuit elements and their voltage – current relationship, classification of circuit elements, sources - their types and characteristics, concept of equivalent sources, source transformation, concept of supernode and V – shift, nodal analysis of circuits containing resistors, inductors, capacitors, transformers, and both independent and dependent sources to determine current, voltage, power, and energy.

UNIT-2: : MESH ANALYSIS OF ELECTRIC CIRCUITS
Concept of supermesh and I – shift, mutual inductance, coefficient of coupling, dot convention, dot marking in coupled coils, mesh analysis of circuits containing resistors, inductors, capacitors, transformers, and both independent and dependent sources to determine current, voltage, power, and energy.

UNIT-3 : NETWORK THEOREM
Superposition Theorem, Thevenin"s Theorem, Norton"s Theorem, Maximum Power Transfer Theorem.

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III SEMESTER

EL2205	Network Analysis		L=3	T=0	P=0	Credits=4
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

UNIT-4: INITIAL AND FINAL CONDITIONS, IMPEDANCE FUNCTIONS AND CIRCUIT ANALYSIS WITH LAPLACE TRANSFORM

Concept of initial and final conditions, behavior of resistor, inductor and capacitor at t = 0- and at t = 0+, procedure for evaluating initial and final conditions, analytical treatment.

Review of Laplace Transform, concept of complex frequency, transform impedance and admittance, s – domain impedance and admittance models for resistor, inductor and capacitor, series and parallel combinations of elements. Transformed network on loop and mesh basis, mesh and node equations for transformed networks, time response of electrical network with and without initial conditions by Laplace transform.

UNIT-5: TRANSFORMS OF OTHER SIGNAL WAVEFORMS, NETWORK FUNCTIONS, POLES AND ZEROS OF NETWORK FUNCTIONS

Unit step, ramp and impulse functions with and without time delay, their Laplace transform, waveform synthesis and its application to electrical networks.

Terminal pairs or ports, network functions for one port and two port networks, definition and physical interpretation of poles and zeros, pole-zero plot for network functions, restrictions on pole and zero locations for driving point and transfer functions, time domain behavior from the pole – zero plot, network synthesis using pole – zero plot.

UNIT-6: TWO PORT PARAMETERS

Standard reference directions for the voltages and currents of a two – port network, defining equations for open circuit impedance, short circuit admittance, transmission, inverse transmission, hybrid and inverse hybrid parameters, relationships between parameter sets, conditions for reciprocity and electrical symmetry in terms of two – port parameters, interconnections of two - port networks.

Text Books:

SNo	Title	Edition	Authors	Publisher
1	Network Analysis	3rd Edition	M. E. Van Valkenburg	PHI Learning Private Limited
2	Engineering Circuit Analysis	8th Edition	William H. Hayt, Jack E. Kemmerly, Steven M. Durbin	McGraw – Hill
3	Linear Circuit Analysis	2nd Edition	Decarlo, Lin	Oxford Univ. Press

Reference Books:

SNo	Title	Edition	Authors	Publisher
1	Schaum"s 3000 Solved Problems In Electric Circuits Book 1 & 2	1st Edition	Syed A. Nasar	McGraw - Hill
2	Schaum"s Outline Series: Theory and Problems of Electric Circuits	5th Edition	Joseph A. Edminister	McGraw - Hill
3	Basic Circuit Theory	3rd Edition	Lawrence P. Huelsman	PHI Learning Private Limited

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III SEMESTER

EL2206	Lab.: Computer Programming		L=0	T=0	P=2	Credits=1
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	--	40	60	100		---

Course Objective	Course Outcomes
To make the student familiar with the application of MATLAB using programming and simulink.	1) The inbuilt functions, keywords, concepts of drawing and using the various toolbars in SCILAB programming. 2) To design the matrix operation and mesh analysis which generally using in mathematical operation. 3) The various conditions like for loop, while loop and if else loop which are used in decision making statement. 4) The RL series circuit which is the basic concept in basic engineering. 5) The differential equations used in mathematical operation. 6) The design of 2-D and 3-D plots.

Mapped program outcomes ☐☐☐☐☐☐☐

Minimum Eight Practical are to be performed from the following :-

Expt. No.	List of Experiments
01	Program to demonstrate the script file and elementary matrix manipulations
02	Program to demonstrate indexing of matrices.
03	Program to create function and calling functions
04	Program to solve linear differential equations
05	Write a function that returns the two roots of a quadratic equation, given the three arguments a, b and c. Test the function from the command line
06	Write a function that returns the mean and standard deviation of a vector of numbers (input vector). While Matlab supplies the mean() and std() functions, try just using the sum() and length() functions.
07	Write a function that reverses the order of letters in a string, and returns the new string.
08	Use the eval() Matlab function to evaluate strings such as: exp1 = „5*6 + 7"; Note this, and feval(), is very useful for dynamic programming
09	Use a cell array to store a list of expressions, stored as strings. Then use eval() and a for loop to iterate over the expressions and evaluate them.
10	Create the vector 0:pi/20:2*pi and use it to sample the sin() function. Plot the results and edit the figure window to put labels on the figure. Save the figure (.fig) and export a .jpg file.
11	Use the meshgrid() function to sample a 2 dimensional input space between 0 and 2p, then use the data to sample the function $sin(x_1)*cos(x_2)$. Plot the results using the mesh() function.
12	Create a GUI that prompts the user for a number and then displays double that number next to the entered value.
13	Start Simulink and using a sin() **source** and a **scope sink**, view the signal over 10 seconds.
14	Change the frequency of the sin() source and again compare the results. Next change the simulation length.
15	Build the first order system H(s) = 1/(1+3s) in the model and pass a sin() signal through the system. Make sure you run the simulation for a long enough time for the transients to die down and the system to settle. Replace the first order system with the second order system, what is the difference when the system settles down H(s) = 1/(1+2s+s^2).
16	We need to simulate the resonant circuit and display the current waveform as we change the frequency dynamically

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III SEMESTER

EL2207	Electrical Measurement & Instrumentation		L=3	T=0	P=0	Credits=3
Evaluation Scheme	**Continuous Assessment**	**TA**	**ESE**	**Total**		**ESE Duration**
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Course Objective	Course Outcomes
Students will be able to understand the operation of different electrical instrument used for measurement of electrical and non-electrical parameters and measurement of resistance, inductance or capacitance using various bridges. CT and PT applications	Upon successful completion of this course, Students should be able to: 1) Explain the working of Electrical instruments and compute the value of Resistances, inductance and capacitance by using bridges. 2) Evaluate electrical power and energy in single phase and three phase circuits. 3) Explain and illustrate the concept of instrumentation system with different Transducers and Sensors. 4) Explain the construction, working principle and applications of Transducers. 5) Evaluate Power calculations and applications of Transducers.

UNIT - I: MEASURING INSTRUMENTS
Electrical Measurement :
Classification of Instruments , Deflection and null type instruments ,forces acting in Indicating instruments , PMMC and MI type instruments (Construction and working principle)
Measurement of Resistance :
Classification of Resistance, Wheatstone bridge , Kelvin's Double Bridge , Loss of charge method.
Megger (Construction and Operating principle, Measurement of Earth Resistance.

UNIT – II: POTENTIOMETERS AND AC BRIDGES
D.C. Potentiometer:
Basic Potentiometer circuit, Lab.Type Potentiometer voltage ratio box.
A.C. Potentiometer:--
Standardization of AC Potentiometer, Drysdale Polar potentiometer, Gall-Tinsley (Co-ordinate type) Potentiometer.
AC Bridges:
General equation of AC bridge balance, measurement of Inductance by Maxwell Inductance-capacitance Bridge, detectors used in AC Bridges, Measurement of Capacitance By High voltage Schering bridge , Measurement of Relative Permittivity by Schering bridge, Measurement of frequency By Wien's Bridge.

UNIT – III: MEASUREMENT OF POWER AND ENERGY
Wattmeter :
Electrodynamometer type wattmeter (construction and operation) , LPF Wattmeter, Measurement of power using instrument transformer, Blondal's Theorem , Measurement of three phase power By single wattmeter , Two wattmeter , and three wattmeter method , measurement of Reactive power for Balanced load using single wattmeter method.
Energy Measurement :
Induction type Energy meter (construction and operating principle)Errors and their compensation , Two element energy meter , maximum demand energy meter , phantom Loading (Merz – price).
Power factor Meter : Three phase Electrodynamometer type power factor meter.

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III SEMESTER

EL2207	Electrical Measurement & Instrumentation	L=3	T=0	P=0	Credits=3
Evaluation Scheme	Continuous Assessment	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

UNIT – IV: INSTRUMENT TRANSFORMERS
Instrument Transformer :
Use of instrument transformer , ratios in instrument transformer , burden , characteristics of CT , Effect of secondary open in CT.
Potential transformer : Difference between CT and PT , Errors in PT , Reduction of errors in PT , characteristics of PT

UNIT – V: DIGITAL INSTRUMENTS AND TRANSDUCERS
Digital Voltmeters, Digital Ammeters:
Ramp type digital Voltmeter and   Ammeter, Integrating type digital voltmeter and ammeter.
Digital Frequency Meter: Basic circuit, Time base , start and stop Gate circuit for measurement of frequency.
Electrical resonance type frequency meter , Weston frequency meter
Transducers: Introduction , Types (Piezoelectric Transducer , Active , Passive transducers)

UNIT – VI: ANALOG TRANSDUCERS
Transducers :
Transducers required for the measurement of (Non electrical quantities)
Linear displacement ,(LVDT), Strain , (Strain gauge, Un bounded metal Strain gauge, semi conductor
Strain gauge),Pressure , (Bourden Tube,Bellows, Pirani Gauge),Torque ,
Linear velocity, Angular Velocity, Temperature,(Thermocouples ,First and Second Law of Thermocouple,
Thermistors , Bimetallic Thermocouples), Flow (Electromagnetic Flow meter), Acceleration : LVDT Accelerometer.
Digital Encoding transducers – Contacting or Brush type, Shaft encoder.

Text Books:

SNo	Title	Edition	Authors	Publisher
1	Electrical Measurement And Instrumentation	Eighteenth Revised and Enlarged Edition , 2007)	A.K.Sawhney	
2	Electrical Measurement :		J. Singh	
3	Electrical Measurement and Measuring Instrument.			Tata McGraw Hills

Reference Books:

SNo	Title	Edition	Authors	Publisher
1	Electrical And Electronics Measurement	19th Edition	A.K.Sawhney	

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III SEMESTER

EL2208	Lab: Electrical Measurement & Instrumentation		L=0	T=0	P=2	Credits=1
Evaluation Scheme	Continuous Assessment		TA	ESE	Total	ESE Duration
	-		40	60	100	--

Course Objective	Course Outcomes
	The student will be able to understand 1) Measure resistance, capacitance, and inductance using AC and DC bridges 2) Calibrate single phase energy meter 3) Determined the characteristics of RTD,themistor,pressure and transducer 4) Measure the active and reactive power using different types of method

Mapped program outcomes   a | b | c | f | g | h | j

Minimum Eight Practical are to be performed out of the following :-

Expt. No.	Experiments based on
01	To measure high resistance using loss of charge method.
02	To measure low resistance using Kelvins" double bridge.
03	To measure inductance using Maxwell"s inductance capacitance bridge.
04	To measure inductance using Anderson"s bridge.
05	To measure three phase power using two wattmeter method
06	To measure electrical energy using electromechanical energy meter.
07	Determination of self inductance using Owen"s bridge.
08	Testing of single phase induction type energy meter.
09	Measurement of reactive power in balanced three phase ac circuit using single wattmeter.
10	Study of Pressure gauge.
11	Study of Strain gauge.
12	To measure Torque using sensors.
13	To study first order response of filters- (i) High pass filters (ii) Low pass filters (iii) Notch filter.
14	Study of an instrumentation amplifier.
15	Study of Cathode Ray Oscilloscope.
16	Draw the characteristics of LVDT.
17	Measurement of distance by ultrasonic transducers.
18	Draw the characteristics of RTD, Thermo couple and Thermistor.

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IV Semester
GE2204 - Advanced Mathematical Techniques

Objective	Outcomes Students will be able to
• To introduce various Numerical Methods to solve algebraic and differential equations • To understand the concept of Probability distribution • To introduce the concept of Fuzzy Set theory and functions • To make aware of different optimization techniques	• Utilize numerical techniques to obtain approximate solutions of mathematical equations • Measure the Statistical parameters for random variables • Explain the basic concept of fuzzy sets, Relations and fuzzy logic. • Design and determine the solution of linear programming problems

Unit I:
Numerical Methods for Algebraic And Transcendental Equations: Errors in numerical calculation, Errors in series approximation, Rounding of error solutions of algebraic and transcendental equations, Iteration method, Bisection method, False position method, Newton Raphson method and their convergence
Numerical Methods System of Algebraic Equations: Solution of System of linear equations, Gauss- Seidel method, Crouts method. **(7 hours)**

Unit II:
Numerical Methods for Differential Equations: Numerical solution of ordinary differential equation by Taylor's series method, Picard's method, Runge's second and third order method, Runge-Kutta 4th order method, Euler's method, Euler's modified method, Milne's Predictor and Corrector method. **(6 hours)**

Unit III:
Random Variables and Probability Distribution: Discrete and continuous random variables, probability density function of one and two variables, Probability distribution function of one and two variables, Joint distributions and conditional distributions. **(6 hours)**

UNIT IV:
Mathematical Expectation: Definition of mathematical expectation, functions of one and two random variables, The variance and standard deviations, moment generating function other measures of central tendency and dispersion, Skewness and Kurtosis. **(7 hours)**

UNIT V:
Fuzzy Sets And Fuzzy Logic: Fuzzy sets and systems, crisp sets, overview of fuzzy logic and classical logic, fuzzy compliment, fuzzy union, fuzzy intersection and combinations of these fuzzy sets operations crisp and fuzzy relations. **(7 hours)**

Unit VI:
OPTIMIZATION TECHNIQUES: Definition of basic concepts of LPP, Formulation of LPP and its Solution by graphical, simplex methods and Big M method. **(6 hours)**

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IV Semester
GE2204 - Advanced Mathematical Techniques

Text Books:

SN	Title	Edition	Authors	Publisher
1	Computer based Numerical and Statistical Techniques	Paperback Firstedition 2003	M. Goyal	Laxmi Publication
2	Numerical Methods	Fourth Edition (2004)	S.S. Sastri	PHI Publishers
3	Fuzzy Engineering	Softcover edition (2005)	Bari Kosko	Prentice Hall PTR
4	Optimization Techniques	Year-2009. First Edition	C.Mohan and Kasum Deep	New Age International Publication

Reference Books:

SN	Title	Edition	Authors	Publisher
1	Advanced Engineering Mathematics	4th edition 2006	H.K.Dass	S. Chand Group
2	Advanced Engineering Mathematics	9th Edition-2007	Kreyszig	JOHN WILEY & SONS
3	Mathematics for Engineers	19th edition 2007	Chandrika Prasad.	JOHN WILEY & SONS
4	Advanced Mathematics for Engineers	4th edition 2006	Chandrika Prasad	JOHN WILEY & SONS
5	Higher Engineering Mathematics	40 edition 2010	B S Grewal	Khanna Publishers
6	A text book of Engineering Mathematics	Reprint 2008	N.P. Bali and Manish Goyal	LaxmiPrakashan

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IV SEMESTER

EL2251	Electrical Machines in Power System	L=3	T=0	P=0	Credits=3
Evaluation Scheme	Continuous Assessment	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Course Objective	Course Outcomes
To make student aware about • The basic principle, construction, operation, performance characteristics and steady state and transient analysis of synchronous machines. • The principle, construction, operation, control and applications of special electric motors.	The student will be able to understand : 1) Explain constructional features, develop phasor diagram and winding layout, examine steady state performance of synchronous machines and determine induced emf and voltage regulation of synchronous alternator 2) Illustrate the need and method of parallel operation of alternators, analyse and evaluate the behaviour of synchronous machine connected to infinite bus. 3) Interpret behaviour & determine time constant and equivalent circuit parameters under transient conditions of synchronous machines 4) Explain the principle, construction and operation of special machines and identify their applications

UNIT-1: Three Phase Synchronous Generator (07)
Introduction, Constructional features of cylindrical and salient pole rotor machines, Full pitch coil, short pitched coil, Coil span factor, concentrated winding, distributed winding, distribution factor, introduction to armature winding and field winding, MMF of armature winding, induced EMF with and without harmonics.

UNIT-2: Steady State Operation of Three phase synchronous generators (07)
Effect of loading on terminal voltage, Armature reaction, Effect of load power factor on armature reaction, concept of synchronous reactance, Phasor diagram on load, regulation by Direct loading, Emf method, Load characteristics, External Characteristic, Zero power factor characteristics (ZPFC), construction of Potier triangle.

UNIT-3: Parallel Operation (06)
Conditions of synchronization of generator with another generator and or Infinite busbars, Parallel operation, Load sharing between parallel connected generators. Effect of variable excitation and power input on generator operation.

UNIT-4: Synchronous Motor (06)
Principle of operation, Methods of starting, phasor diagram, expression for torque, Excitation Emf, load/torque angle, Effect of variable excitation and load on motor operation, V and inverted V curves, Concept of synchronous condenser,
Introduction to Reluctance and Hysteresis motor

UNIT 5: Synchronous Machine Connected to Infinite Bus (08)
Power Angle Characteristic of Synchronous machines with and without armature resistance. Expression for electrical and electromechanical power developed, losses and efficiency in synchronous machines.

UNIT-6: Transient Behaviour (06)
Short circuit ratio, unbalanced Loading, Sequence Component, Sudden 3-phase short circuit, Constant flux linkage theorem, Transient and sub–transient reactances, Time constants and equivalent circuit diagram, role of damper winding in both generator and motor operation. Experimental determination of steady state & transient parameters

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IV SEMESTER

EL2251	Electrical Machines in Power System		L=3	T=0	P=0	Credits=3
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Text Books:

SN	Title	Edition	Authors	Publisher
1	Electrical Machines	2nd -1993	Dr. P. K. Mukherjee and S. Chakravarti	Dhanpat Rai Publications (P) Ltd
2	Electrical Machines	3rd -2010	I.J.Nagrath and Dr. D.P.Kothari	Tata McGraw Hill
3	Alternating Current Machines	1st -1983	M.G. Say	CBS Publishers
4	Electrical Machinery	7TH -2008	P.S.Bhimbra	
5	Electrical Machinery	1ST -1985	A.E.Fitzgerald, C.Kingsley, S.D.Umens	Mc Graw Hill
6	Electric Machines	2nd -2008	Ashfaq Husain	Dhanpat Rai Publications (P) Ltd.

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IV SEMESTER

EL2252	Lab: Electrical Machines in Power System		L=0	T=0	P=2	Credits=1
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	--	40	60	100		--

Course Objective	Course Outcomes
To make student aware about The basic principle, construction, operation, performance characteristics and steady state and transient analysis of synchronous machines. The principle, construction, operation, control and applications of special electric motors	The student will be able to understand : 1) Explain constructional features, develop phasor diagram and winding layout, examine steady state performance of synchronous machines and determine induced emf and voltage regulation of synchronous alternator 2) Illustrate the need and method of parallel operation of alternators, analyse and evaluate the behaviour of synchronous machine connected to infinite bus. 3) Interpret behaviour & determine time constant and equivalent circuit parameters under transient conditions of synchronous machines. 4) Explain the principle, construction and operation of special machines and identify their applications

Mapped program outcomes	1	2	3				

Minimum Eight Practical are to be performed out of the following :-

Expt. No.	Experiments based on
01	To determine voltage regulation of an alternator by direct loading.
02	To determine voltage regulation of an alternator by synchronous impedance method.
03	To plot external characteristics of synchronous generator at different power factor loads.
04	To perform slip test on a 3-phase synchronous machine.
05	To study synchronization of a 3-phase alternator with infinite bus-bars.
06	To determine sub-transient reactances of synchronous machine.
07	To determine negative sequence reactance of a 3-phase synchronous machine.
08	To determine zero sequence reactance of a 3-phase synchronous machine.
09	To observe armature voltage and current waveforms of a 3-phase alternator during slip-test on C.R.O.
10	To plot V and inverted V curves of a 3-phase synchronous motor.

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IV SEMESTER

EL2253	Electrical Energy Generation System	L=3	T=0	P=0	Credits=3
Evaluation Scheme	Continuous Assessment	TA	ESE	Total	ESE Duration
	30	10	60	100	3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Course Objective	Course Outcomes

Unit I: Introduction to generation systems (7)
Importance of Electrical Energy, Generation of Electrical Energy, Relationships among Energy units, Calorific value of fuels.
Sources of Electrical energy- Coal, oil and natural gas, hydro, solar, wind and nuclear energy.
Different factors associated with a generating station : connected load, maximum demand, demand factor, load factor, diversity factor, plant capacity and utilization factor, load curve and load duration curveload survey, base load and peak load station, advantages of interconnection.
Tariff-: Definition, Objective, Characteristics of tariff, Types of Tariff (Numerical), economical choice of tariff.

Unit II: Solar Energy (7)
Solar radiation & its Measurement: - Solar constant, Solar radiation at earth's surface, Solar radiation geometry, Solar radiation on tilted surfaces, Solar radiation measurement, Solar Energy Collectors: - Physical principles of the conversion of solar radiation into heat, flat plate collectors. Applications of Solar energy: Solar Dryer, Solar Still, Solar cooker
Solar Photovoltaic Cell: Principle of solar photovoltaic energy conversion, Equivalent circuit of solar cell,

Unit III: Wind Energy (7)
Principle of wind energy conversion, Power in the wind, Cut In, Cut Off Wind Speed ,Site selection considerations, Basic components of wind energy conversion systems(WECS),Classification of WEC systems, Advantages and Limitations of WECS,,Types of wind Machines(HAWT and VAWT), Application of wind energy.

Unit IV: Hydro Power Station (6 or7)
Schematic arrangement of Hydroelectric Power Station, Constituents of Hydroelectric power plant, Advantages and Limitations of Hydro-electric Plants ,Hydrology, stream flow, flow duration curve, power duration curve, mass curve, reservoir capacity, Water Power equation (Numerical), type of hydro power plants and their field of use, pumped storage plant and their utility, surge tanks. General study of Hydro Turbine, Introduction to Small hydro plants.

Unit V: Thermal Power Station (7)
Introduction, Site selection, size and number of units, general layout, major equipment, auxiliaries, electric supply to auxiliary, cost of generation ,effect of different factors on costs.
General study of steam Turbine.
Condenser: Different types of condensers. Construction and Working principle of Condenser

Unit VI: Nuclear Power Plant and Biomass Energy (7)
A)Site selection for nuclear power plant, introduction to nuclear physics, chain reaction, Working Principle of nuclear Power Plant, Components of a nuclear reactor, types of nuclear reactor, material for moderator and control rods, control of nuclear reactors, , economics of nuclear power generation.
B)Biogas production from waste biomass, classification of biogas plants, operational parameters, availability of raw material and gas yield.

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IV SEMESTER

EL2253	Electrical Energy Generation System		L=3	T=0	P=0	Credits=3
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Course Objective	Course Outcomes

Text Books:

SN	Title	Edition	Authors	Publisher
1	A Textbook on Power System Engineering	2nd edition 2014	M.L.Soni, P.V.Gupta, U.S.Bhatnagar	Dhanpat Rai and Co.
2	Principles of Power System	2nd edition 2008	V.K.Mehta, Rohit Mehta	S.Chand
3	Generation of Electrical Energy	5th edition 2007	B.R.Gupta	S.Chand
4	Non-Conventional Energy Sources	5th edition 2011	G. D. Rai	Khanna

Text Books:

SN	Title	Edition	Authors	Publisher
1	Power System Analysis	1st edition 2007	T.K. Nagsarkar, M.S. Sukhija	Oxford
2	Electrical Power System	5th edition 2007	Ashfaque Hussain	CBS
3	Non-Conventional Energy Resources	2nd edition 2010	B. H. Khan	Tata McGraw-Hill

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IV SEMESTER

EL2254	Lab.: Renewable Energy Sources		L=0	T=0	P=2	Credits=1
Evaluation Scheme	**Continuous Assessment**	**TA**	**ESE**	**Total**		**ESE Duration**
	--	40	60	100		--

Course Objective	Course Outcomes
To make student aware about The basic principle, construction, operation, performance characteristics and steady state and transient analysis of synchronous machines. The principle, construction, operation, control and applications of special electric motors	The student will be able to understand : 1) Explain constructional features, develop phasor diagram and winding layout, examine steady state performance of synchronous machines and determine induced emf and voltage regulation of synchronous alternator 2) Illustrate the need and method of parallel operation of alternators, analyse and evaluate the behaviour of synchronous machine connected to infinite bus. 3) Interpret behaviour & determine time constant and equivalent circuit parameters under transient conditions of synchronous machines. 4) Explain the principle, construction and operation of special machines and identify their applications

Minimum Eight practical are to be performed based on the following :-

Expt. No.	Experiments based on
01	To plot V-I characteristics of a single PV module.
02	To plot V-I characteristics of a series connected PV modules.
03	To plot V-I characteristics of a parallel connected PV modules
04	To study the effect of tilt angle on power output of module.
05	To study the effect of shadow on power output of solar PV module.
06	To study the solar based battery charger
07	To study the wind based battery charger
08	To study the hybrid wind and solar based charger
09	To study the biogas generation plant model set up at YCCE Campus
10	To study the box type solar cooker
11	To study solar water heater in natural convection and force convection mode
12	Study of Hydroelectric Power Plant
13	To design home solar PV system.
14	To study Parabolic Solar Cooker

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IV SEMESTER

EL2255	Electric and Magnetic Fields		L=3	T=0	P=0	Credits=3
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Course Objective	Course Outcomes
To educate the student in static electric and magnetic fields. To make them aware about various laws of electromagnetic & electrostatic fields.	The student will be able to : 1. Remember, Understand and Analyze the properties of electrostatic field. 2. Apply electrostatics on different mediums and analyze the boundary characteristics. 3. Remember and Understand and Apply the properties of electromagnetic field. 4. Understand the electromagnetic waves and analyze them over different medium.

UNIT-1:Vector Analysis

Scalars and vectors, vector algebra, the Cartesian coordinate system , the scalar and vector field, the dot product, the cross product, Cylindrical coordinate system, Spherical coordinate system.

UNIT-2:Coulomb's Law and Electric Field Intensity; Electric Flux Density, Gauss's Law, and Divergence

Coulomb"s Law, electric field intensity, types of charge distributions, electric field due to line charge density, surface charge density, and volume charge density, streamlines and sketches of fields. Concept of electric flux, electric flux density, Gauss"s Law, application of Gauss"s Law to symmetrical charge distributions, application of Gauss"s law to differential volume element, divergence, Maxwell"s first equation in electrostatics, the vector operator □and the Divergence theorem.

UNIT-3Energy and Potential: Conductors, Dielectrics, and Capacitance

Energy expended in moving a point charge in an electric field, potential difference and potential, the potential field of a point charge, line charge density and surface charge density, the potential field of a system of charges, potential gradient, the dipole, energy density in the electrostatic field, Current and current density, continuity of current, metallic conductors, conductor properties and boundary conditions, the method of images, semiconductors, the nature of dielectric materials, boundary conditions for perfect dielectric materials, capacitance, several capacitance examples.

UNIT-4:Poisson's and Laplace's Equations

Poisson"s and Laplace"s equations, Uniqueness theorem, examples of the solution of Laplace"s equation (involving one variable only).

UNIT-5 Steady Magnetic Field: Magnetic Forces, Materials, and Inductance

Biot – Savart law, magnetic field due to infinitely long current filament, finite length current filament, Ampere"s circuital law, magnetic field due to coaxial cable, uniform sheet of surface current, solenoid, toroid, curl and its physical interpretation, Stoke"s theorem, magnetic flux and magnetic flux density, scalar and vector magnetic potentials, Force on a moving charge, force on a differential current element, force between differential current elements, force and torque on a closed circuit, nature of magnetic materials, magnetization and permeability, magnetic boundary conditions, potential energy and forces on magnetic materials, inductance and mutual inductance.

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IV SEMESTER

EL2255	Electric and Magnetic Fields		L=3	T=0	P=0	Credits=3
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Course Objective	Course Outcomes
To educate the student in static electric and magnetic fields. To make them aware about various laws of electromagnetic & electrostatic fields.	The student will be able to : 1. Remember, Understand and Analyze the properties of electrostatic field. 2. Apply electrostatics on different mediums and analyze the boundary characteristics. 3. Remember and Understand and Apply the properties of electromagnetic field. 4. Understand the electromagnetic waves and analyze them over different medium.

UNIT-6: Time-Varying Fields and Maxwell's Equations, Uniform Plane Wave

Faraday"s Law, derivation of Maxwell"s equations in point form and integral form, displacement current and its physical interpretation, concept of retarded potentials, Maxwell"s equations in phasor form, wave equations, uniform plane waves, solution of wave equation in free space, perfect dielectric, lossy dielectrics and good conductor, skin effect and skin depth, Poynting vector.

Text Books:

SN	Title	Edition	Authors	Publisher
1	Engineering Electromagnetics	7th Edition	W.H. Hayt J. A. Buck	McGraw Hill Publication.
2	Schaum"s Outline Series Theory and Problems of Electromagnetics	2nd Edition	Joseph A. Edminister	Schaum"s outline Series of Engineering
3	Principles of Electromagnetics	4th-2007	Matthew N.O.Sadiku	Oxford University Press

Reference books:

SN	Title	Edition	Authors	Publisher
1	Applied Electromagnetic	1978	Plonus M. A.	MGH
2	Electromagnetics	1998	Kraus J. D.	MGH
3	Fundamentals of Electromagnetics with MATLAB	2nd Edition	Karl E. Lonngren, Sava V. Savov, Randy J. Jost	Scitech Publishing Inc.

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IV SEMESTER

EL2256	Lab.: Electrical Engineering Workshp		L=0	T=0	P=2	Credits=1
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	--	40	60	100		--

Course Objective	Course Outcomes
This practical will allow to handle different electrical daily use equipment used by electrical engineer. Concept of illumination from design point is also studied. House wiring concept will also be understood by student.	The student will be able to 1. Describe the basic concept of various electrical components. 2. Demonstrate, formulate and solve the basic maintenance and troubleshooting of household equipments, energy saving etc. 3. Outline the fundamentals of major electrical devices and actual operation of devices like induction motor.

Mapped Program Outcomes	1	2	3	4	5	6	12

Practical based on following topics :-

Expt. No.	Experiments based on
01	a. To set up a staircase wiring using given lamp, controlledby switches. b. To set godown wiring using given lamp, controlled by switches.
02	Determination of polarity marking of single phase transformer.
03	To make connections of a fluorescent lamp wiring and to study accessories of the same.
04	To implement residential house wiring using switches, fuse, indicator, lamp and energy meter.
05	Study of 11 KV sub-station at YCCE.
06	Testing of DC Compound Motor
07	To study internal and external parts of ceiling fan.
08	To measure earth resistance by Earth Tester.
09	Study of Power Cables.
10	Study of line insulators.

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IV SEMESTER

EL2257	Microprocessors		L=3	T=0	P=0	Credits=3
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Course Objective	Course Outcomes
1) To learn the microprocessor applications in electrical engineering 2) To understand principle of microprocessor chip working. 3) To study Interfacing with memory and other peripherals	The students will be able to: CO1: List, select and explain types of memory devices and architecture of 8085 microprocessor CO2: Recall, experiment with and make use of assembly language instructions of 8085. CO3: Demonstrate and test microprocessors and its interfacing devices. CO4: Illustrate and make use of DMA controller and timer.

Mapped Program Outcomes	1	2	3	12

UNIT-1: Memory devices
Memory devices, RAM, ROM, Introduction to Intel"s 8085 Architecture, Flag register, Instruction set, Addressing modes, assemblers, hand coding   (7 Hours)

UNIT-2: Programming Instructions
Branching instruction, Simple programmes, stack, PUSH, POP Instructions, CALL/RETURN instruction & Subroutines- simple & nested programmes, Programmes using Subroutines.   (8 Hours)

UNIT-3: Timing Diagrams
Timing Diagrams, Timing Diagram of instruction. Delay programmes, Serial data transfer, Interrupts - concept and structure in 8085 Interrupt service routine, advanced instructions & Programming of 8085A.   (7 Hours)

UNIT-4: Interfacing of Microprocessor
Complete signal description of 8085, interfacing memory devices interfacing I/O devices. Methods of data transfer- serial, parallel synchronous and asynchronous. IN/OUT instructions. Hardware considerations bus contention, slow memory interfacing.   (8 Hours)

UNIT-5: Hardware interfacing and Handshaking
Simple hardware interface to 8085 of standard latches & buffers as I/O ports. Architecture and interface of 8255 & 8085. Handshaking concepts. Interfacing of multiplexed keyboard/ display interface and assembler directives. Interfacing of ADC & DAC, stepper motor Interface with 8085.   (8 Hours)

UNIT-6: Architecture and Interface
Architecture and interface of 8253 with & 8085, Different modes of 8253. Architecture and interface of 8257 with & 8085, Different modes of operation of 8257, Application of microcontroller. (7 Hours)
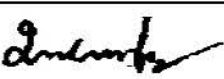
Text Books:

SN	Title	Edition	Authors	Publisher
1	Programming and Interfacing 8085		Gaonkar	
2	Programming of 8085		D.V. Hall	

Reference Books:

SN	Title	Edition	Authors	Publisher
1	Microprocessor & Interfacing Manual , Intel Perpheral		Barry Brey	

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IV SEMESTER

EL2258	Lab.: Microprocessors		L=0	T=0	P=2	Credits=1
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	--	40	60	100		--

Course Objective	Course Outcomes
1) To learn the microprocessor applications in electrical engineering 2) To understand principle of microprocessor chip working. 3) To study Interfacing with memory and other peripherals	The students will be able to: CO1: List, select and explain types of memory devices and architecture of 8085 microprocessor CO2: Recall, experiment with and make use of assembly language instructions of 8085. CO3: Demonstrate and test microprocessors and its interfacing devices. CO4: Illustrate and make use of DMA controller and timer.

Mapped Program Outcomes	1	2	3	12

Practical based on following topics :-

Expt. No.	Experiments based on
01	Write Assembly Language Program (ALP) to add 16 bit numbers 1324 H & 4532 H.
02	Write Assembly Language Program (ALP) to add two 08 bit BCD numbers 78 + 45 & store result in memory 2150 H.
03	Write Assembly Language Program (ALP) to subtract two 08 bit BCD numbers78 – 45 store result in memory 215 H.
04	X & Y are two 32 bit numbers present in memory from address 2150 H & 2300 H. Write ALP to add these two 32 bit binary numbers & store result in memory from address 2710 H.
05	Ten 8 bit binary number are present in memory from address 2340 H. Write ALP to transfer this number to destination memory from address 2400 H.
06	Twelve 8 bit binary numbers are present in memory from address 2540 H. Write ALP to transfer this number to destination memory from address 2548 H.
07	Ten 8 bit binary nos. are present in memory from address 2200 H. Write ALP to transfer this number to destination memory from address 2190 H in reverse order.
08	Fifteen 8 bit binary numbers are present in memory from address 2200 H. Write ALP to transfer this number to destination memory from address 2190 H in reverse order.
09	Fifteen 8 bit binary numbers are present in memory from address 2340 H. Write ALP to find greatest number in data block & store result in memory at the end of data block.
10	Ten 8 bit binary numbers are present in memory from address 2345 H. Write ALP to find smallest number in a data block & store result in memory at end of block.
11	Write ALP to convert 8 bit BCD to binary number.
12	Write ALP to convert 8 bit binary number to BCD number.

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IV SEMESTER

EL2259	Signals & Systems		L=4	T=0	P=0	Credits=4
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Course Objective	Course Outcomes
To make the student conversant with the analysis of the signal and how to represents the periodic and non-periodic signals.	The student will be able : 1) To classify signals and systems and analyze continuous and discrete time signals. To understand the properties of LTI system 2) To Interpret periodic signals and representing them by using Fourier series.ToInterpret continuous and discrete time signals in frequency domain and to summaries properties of Fourier transform. 3) To do the time and frequency characterization of signals and systems. 4) to understand the Laplace and Z-transform

Mapped Program Outcomes	1	2	3	12

UNIT-1: Signals and Systems
Continuous-Time and Discrete-Time Signals. Transformations of the Independent Variable. Exponential and Sinusoidal Signals. The Unit Impulse and Unit Step Functions. Continuous-Time and Discrete-Time Systems. Basic System Properties.

Linear Time - Invariant Systems
Discrete-Time LTI Systems: The Convolution Sum. Continuous-Time LTI Systems: The Convolution Integral. Properties of Linear Time-Invariant Systems. Causal LTI Systems Described by Differential and Difference Equations. Singularity Functions.

UNIT-2: Fourier Series Representation of Periodic Signals
The Response of LTI Systems to Complex Exponentials. Fourier Series Representation of Continuous-Time Periodic Signals. Convergence of the Fourier Series. Properties of Continuous-Time Fourier Series. Fourier Series Representation of Discrete-Time Periodic Signals. Properties of Discrete-Time Fourier Series. Fourier Series and LTI Systems. Filtering. Examples of Continuous-Time Filters Described by Differential Equations. Examples of Discrete- Time Filters Described by Difference Equations.

UNIT-3 : The Continuous-Time Fourier Transform
Representation of Aperiodic Signals: The Continuous-Time Fourier Transform. The Fourier Transform for Periodic Signals. Properties of the Continuous-Time Fourier Transform. The Convolution Property. The Multiplication Property. Systems Characterized by Linear Constant-Coefficient Differential Equations.
The Discrete-Time Fourier Transform
Representation of Aperiodic Signals: The Discrete-Time Fourier Transform. The Fourier Transform for Periodic Signals. Properties of the Discrete-Time Fourier Transform. The Convolution Property. The Multiplication Property. Duality. Systems Characterized by Linear Constant-Coefficient Difference Equations.
:
UNIT-4: Time & Frequency Characterization of Signals and Systems
The Magnitude-Phase Representation of the Fourier Transform. The Magnitude-Phase Representation of the Frequency Response of LTI Systems. Time-Domain Properties of Ideal Frequency-Selective Filters. Time-Domain and Frequency-Domain Aspects of Non - ideal Filters. First-Order and Second-Order Continuous-Time and Discrete- Time Systems.

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IV SEMESTER

EL2259	Signals & Systems		L=4	T=0	P=0	Credits=4
Evaluation Scheme	Continuous Assessment	TA	ESE	Total		ESE Duration
	30	10	60	100		3 Hours

CA (Continuous Assessment)* = Three MSEs of 15 Marks each will conducted and marks of better 2 of these 3 MSEs will be considered for Continuous Assessment

Sampling
Representation of a Continuous-Time Signal by Its Samples: The Sampling Theorem. Reconstruction of a Signal from Its Samples Using Interpolation. The Effect of Under - sampling : Aliasing. Discrete-Time Processing of Continuous- Time Signals. Sampling of Discrete - Time Signals.

UNIT-5 : The Laplace Transform
The Laplace Transform. The Region of Convergence for Laplace Transforms. The Inverse Laplace Transform. Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot. Properties of the Laplace Transform. Analysis and Characterization of LTI Systems Using the Laplace Transform. System Function Algebra and Block Diagram Representations. The Unilateral Laplace Transform.

UNIT-6: The Z-Transform
The z-Transform. The Region of Convergence for the z-Transform. The Inverse z-Transform. Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot. Properties of the z-Transform. Analysis and

Characterization of LTI Systems Using z-Transforms. System Function Algebra and Block Diagram Representations. The Unilateral z-Transform.

Text Books:

SN	Title	Edition	Authors	Publisher
1	Signals and Systems	2nd Edition, 2013	Alan V. Oppenheim, Alan S. Willsky, with S. Hamid	PHI Learning Private Limited.

Reference Books:

SN	Title	Edition	Authors	Publisher
1	Signals & Systems	2nd Edition., 2005	Simon Haykin and Van Veen	Wiley
2	Signals, Systems and Transforms	3rd Edition, 2004	C. L. Philips, J.M.Parr and Eve A.Riskin	Pearson education
3	Schaum's Outlines of Signals and Systems	3rd Edition, 2002	Hwei P. Hsu	McGraw Hill
4	Linear Systems and Signals	2nd Edition	B.P. Lathi	Oxford University Press

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ELECTRICAL ENGINEERING

SoE No. EL-201

V Semester
GE 2312 - Fundamental of Economics

Objectives	Outcome (Students will be able to)
Recognizes consumer's behavior and pricing.	Relate their buyer behaviour to particular product and the pricing in the market.
Extrapolates an operations in market with productions constrain.	Examine and classify various market structure and factors of production and its role in production process.
Describes the national income accounting and public finance.	Analyse the national income accounting and the various issues related to banking, taxation, and inflation.
Interprets international trade and institutions.	Elaborate about international economics, foreign trade and its agreement, export, foreign exchange and the various international financial institutions.

UNIT-1: Introduction to Economics and Consumers' Behaviors:
Definitions, meaning and importance of economics Utility analysis: concept and measurement (cardinal and ordinal), Law of diminishing marginal utility, exceptions to law of diminishing marginal utility, law of equi-marginal utility, Indifference curve analysis: Meaning and properties of indifference curve, marginal rate of substitution, budget constraint, Complement and substitute goods, Consumer's equilibrium. Demand Analysis: Meaning and determinants of demand, law of demand, exception to law of demand, Elasticity of Demand-price, cross and income elasticity, measurement of elasticity of demand.   **(8 Hours)**

UNIT-2: Production and Costs
Factors of Production: Land, Labour, Capital, Enterprise and their peculiarities, Importance of Capital in production process. Entrepreneur and Innovations, Product and Process innovations, Concepts and types of costs: Fixed vs variable, total, average and marginal costs, Short run and long run cost curves. Law of Variable proportions (Law of diminishing marginal returns) and Return to Scale (Increasing, constant and decreasing), Economies and diseconomies of scale. Depreciation: Meaning and various method of calculating depreciation.   **(6 Hours)**

UNIT-3: Market structures - equilibrium output and price
Forms of market structures: Perfect competition, monopolistic competition, oligopoly, duopoly and monopoly, Demand and revenue curves for firm and industry in various forms of market structure, Total, average and marginal revenue curves, equilibrium of firms and industries under various forms of market structures, Price discrimination - Degrees and conditions of discrimination.   **(7 Hours)**
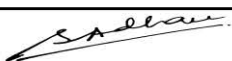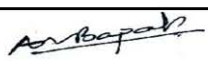
UNIT-4: National income accounting:
Concepts of GDP and GNP, Estimation of GDP and GDP at factor and market prices, at constant and current prices, difference between GDP and NDP, GNP and NNP, per capita income as a measure of economic well-being, concepts of economic growth and development, Factors affecting economic growth and development. Capital formation and accumulation.   **(5 Hours)**

UNIT-5: Money, Banking and Public Finance
Money: definition, functions and role, Evolution of money, Banking- reserve ratios and credit creation by commercial banks, Functions of a central bank and instruments of credit control, Functions of money market. Inflation: Meaning, types, causes and consequences, measures to control inflation, Concepts of deflation and Stagflation. Sources of public revenue and forms of government expenditure, Taxation: Cannons of taxation. Classification of taxes-Direct (Income tax, Wealth tax, Corporation tax, tax on capital, capital gains, etc) and Indirect Taxes (GST, Import duties), Revenue and capital expenditure.
                (7 Hours)

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ELECTRICAL ENGINEERING

| SoE No. EL-201 |

V Semester
GE 2312 - Fundamental of Economics

UNIT-6: International Trade and Institutions

Definitions of closed vs. open economy, small open economy, Concept of exchange rate- Fixed, flexible and managed, Role of Multilateral institutions, viz., IMF, World Bank, WTO (GATT) in promoting, Trade, growth and international financial transactions. **(5 Hours)**

Text Books

SN	Title	Edition	Authors	Publisher
1	Modern Economics	13th Edition	H. L. Ahuja	S. Chand Publisher, 2009.
2	Modern Economic Theory	3rd edition	K. K. Devett	S. Chand Publisher, 2007

Reference Books

SN	Title	Edition	Authors	Publisher
1	Advance Economic Theory	17th Edition	H. L. Ahuja	S. Chand Publisher, 2009
2	International Trade	12th edition	M. L. Zingan	Vindra Publication, 2007
3	Macro Economics	11th Edition	M. L. Zingan	Vindra Publication, 2007
4	Economics: Samuelson,			
5	Monitory Economics	11th Edition	M. L. Sheth	Vindra Publication, 2007
6	Economics of Development and Planning	12th Edition	S. K. Misra and V. K. Puri	Himalaya Publishing House, 2006.

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SoE No. EL-201

ELECTRICAL ENGINEERING

V Semester
EL 2301 - Power Electronics

Objective	Course Outcome
The student should be able to	**On completion of this course, the student will be able to**
) understand the basics of power electronics. 2)understand SCR"s, MOSFET, UJT, IGBT, Concept of rectification, inversion and commutation .	1) Demonstrate the learnings of various power semiconductor devices with their protection and apply them for various applications. 2) Analyse different Power Electronics Converter circuits and choose them for suitable applications. 3) Demonstrate the knowledge of chopper circuits, analyse and utilise them for different applications. 4) Analyse inverter circuits with different modulation techniques and identify their applications.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Demonstrate the learnings of various power semiconductor devices with their protection and apply them for various applications.	1											1	1	
CO2	Analyse different Power Electronics Converter circuits and choose them for suitable applications.	1	3	2									1	1	
CO3	Demonstrate the knowledge of chopper circuits, analyse and utilise them for different applications.	1	3	2									1	2	
CO4	Examine inverter circuits with different modulation techniques and identify their applications	1	3	2									1	2	
CO5	Develop practical aspects of power semiconductor devices, converters, inverters and chopper circuits.	1	1	2									1	2	

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**SoE No.
EL-201**

V Semester
EL 2301 - Power Electronics

Unit No.	Contents	Max. Hrs.
1	**Power Semiconductor Devices** SCR and its characteristics, Gate characteristics, SCR turn off, ratings, Triggering circuits and opto-couplers	6
2	**Single Phase Line Commutated Converters** Series and parallel connections of SCRs, Single phase line commutated converters, single pulse converter, two pulse mid-point converter, single phase bridge converter, effect of source inductance, effect of freewheeling diode, single phase half controlled rectifier cyclo converter (single phase)	5
3	Three **Phase Line Commutated Converters** Three phase three pulse converter, three phase bridge converter, speed control of dc motors (with single phase rectifier).	5
4	**Forced Commutated Semiconductor Devices and Protection** Characteristic and working of MOSFET, Gate turn off thyristor and insulated gate bipolar transistor, protection of SCR, gate circuit protection, over voltage and over current protection, snubber circuit design.	5
5	**D.C. Choppers** Principles of step down chopper, step up chopper classification, Control strategies, time ratio control and current limit control Impulse commutated and resonant pulse choppers, Multiphase choppers, Application of choppers.	6
6	**Single Phase and Three Phase Bridge Inverters** Single phase and three phase bridge inverters, Output voltage control, Harmonics in output voltage waveforms, Harmonic attenuation by filters, Harmonic reduction by pulse width modulation techniques, analysis of single pulse width modulation, working of current source inverters, applications.	6

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V Semester
EL 2301 - Power Electronics

Text books:

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Power Electronics Circuit"s Devices and Applications	3rd Edition,2004	M.H.Rashid	Prentice Hall Limited
2	Power Electronics		D.Y.Shingare	Electrotech Publication Engineering Series

Reference books:

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Power Electronics	1981	C.W.Lander	McGraw Hill
2	Thyristors and their Applications	2nd Edition 2002	Dr.M.Ramamoorty	East West Press
3	Thyristors and their Applications		Dr.G.K.Dubey, Doralda Sinha and Joshi	New Age International
4	Power Electronics	1989	Ned Mohan, T.M.Undeland, and W.P.Robbins	John Wiley and Sons

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ELECTRICAL ENGINEERING

**SoE No.
EL-201**

V Semester
EL 2302 - Power Electronics Lab

S.N	TITLE
1	To show V-I characteristics of SCR and measure holding and latching current of SCR.
2	To estimate sensitivity of four modes operation of TRIAC
3	To evaluate average dc voltage of single phase half wave rectifier with Resistive load.
4	To show transfer and output characteristics of Power MOSFET.
5	To show speed control of DC Shunt Motor with Semi Converter.
6	To demonstrate single phase step down Cycloconverter with Resistive load.
7	To demonstrate Forced Commutation methods of SCR.
8	To evaluate RMS AC Voltage of single phase MOSFET based full Bridge inverter.

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ELECTRICAL ENGINEERING

| SoE No. EL-201 |

V Semester
EL 2303 - Fundamentals of Power System

Objective	Course Outcome
The student should be able to Calculate the basic parameters of transmission line of power systems. To know the power flow through transmission lines under different circumstances.	**On completion of this course, the student will be able to** 1) Define and explain basic components of power system and representation of its elements in terms of per unit. 2) Analyze and evaluate the transmission line parameters which limits the transmission capacity of a line. 3) Classify, evaluate and determine the performance of distribution and transmission system. 4) Choose, Compare and select the type of insulators and underground cables and improve the performance of system.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	Define and explain basic components of power system and representation of its elements in terms of per unit.	2	2											1	
CO2	Analyze and evaluate the transmission line parameters which limits the transmission capacity of a line.	2	2	2										2	
CO3	Classify, evaluate and determine the performance of distribution and transmission system.	2	3	2	2								1	2	
CO4	Choose, Compare and select the type of insulators and underground cables and improve the performance of system.	2	2	2										1	

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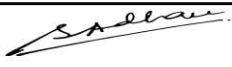(Revised Scheme of Examination w.e.f. 2020-21 onward)
ELECTRICAL ENGINEERING

**SoE No.
EL-201**

V Semester
EL 2303 - Fundamentals of Power System

Unit No.	Contents	Max. Hrs.
1	**Introduction to power system** Structure of Electrical Power System, use of high voltage, idea about substation, classification, Indoor, outdoor substation, symbols for equipment used in substation, concept of real, reactive and complex power. Per unit system: Representation of power system elements, models and parameters of generator, transformer and transmission lines, Numericals.	6
2	**Inductance of transmission line** Constants of transmission line, flux linkages, inductance of single phase two wire line, inductance of 3 phase overhead line, self GMD and mutual GMD,Numericals	5
3	**Capacitance of transmission line** Electric Potential, Capacitance of single phase 2 wire line, capacitance of 3 phase overhead line, Symmetrical and unsymmetrical spacing, Numericals.	5
4	**Distribution system and Load flow analysis** Types of distribution system, comparison, Feeders and distributors, Numericals on DC and AC distribution Y Bus formation, Illustration of active and reactive power transmission, Introduction to load flow studies in multi bus system (SLFE).	5
5	**Insulators and Cables** Types, Potential distribution over suspension insulator string, String efficiency, Numericals on string efficiency. CABLES: Construction, classification, insulation resistance, capacitance, Dielectric stress, economical size, Grading of cables, Numericals.	6
6	**Transmission Systems** Short, medium (Nominal T and Nominal Π method) and Long line, Voltage regulation & efficiency of power transmission lines using simple series equivalent representation, ABCD parameters of transmission lines.	6

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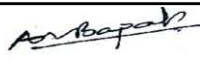**(Revised Scheme of Examination w.e.f. 2020-21 onward)**

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ELECTRICAL ENGINEERING

V Semester
EL 2303 - Fundamentals of Power System

Text books:

1	Power System		S.Chand	V.K.Mehta
2	Electrical Power Systems	5th edition	CBS	Ashfaq Hussain
3	Modern Power System Analysis	3rd -2008	Tata McGraw Hill	I. J. Nagrath and D.P. Kothari

Reference books:

1	Elements of Power system analysis	4th - 1982	MGH	W. D. Stevenson
2	Electrical Power system	3rd -2005	New Age International	C.L Wadhwa

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ELECTRICAL ENGINEERING

**SoE No.
EL-201**

V Semester
EL 2304 - Electrical Drives

Objective	Course Outcome
The student should be able to	**On completion of this course, the student will be able to**
After studying Electrical machines this subject elaborates applications of different machines in industry. Characteristics under starting, running braking and speed control of different motors are explained. Programmable logic controller, contactors, tractions is also explained.	1) Classify and compare characteristics of AC and DC motors to interpret application of motors in electrical drives. 2) Apply Selection criteria for electrical drives by adapting electrical and mechanical characteristics of motor. 3) Categorize and compare contactors and relays for application of control circuit. 4) Explain the applications of PLCs in electrical drives and compare and assess control of electrical drive. 5) Estimate and adapt different motors for traction work.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	Classify and compare characteristics of AC and DC motors to interpret application of motors in electrical drives.	3	3												
CO2	Apply Selection criteria for electrical drives by adapting electrical and mechanical characteristics of motor	3	3												
CO3	: Categorize and compare contactors and relays for application of control circuit.	3												1	
CO4	Explain the applications of PLCs in electrical drives and compare and assess control of electrical drive.	3				3							1		1
CO5	Estimate and adapt different motors for traction work	3	3										1		

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**SoE No.
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V Semester
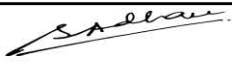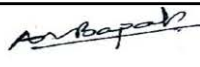### EL 2304 - Electrical Drives

Unit No.	Contents	Max. Hrs.
1	**<u>Introduction to Drives and Speed Control</u>** Definition of a Drive, Classification of Drives, Brief idea about drives commonly used in industries, Speed-torque characteristics of common drive motors (DC and AC), Characteristics of Drives under starting and running, Types of braking, Speed Control of AC and DC motors.	6
2	**Selection of motors** Selection of motors and bearings of motor: Power capacity for continuous and intermittent periodic duties, Flywheel effect, Duty cycles of motor, transmission, enclosure systems for drives.	5
3	**AC and DC contactor and relays** AC and DC contactor and relays: Limit Switches, Lock out contactor, magnetic structure, operation, arc interruption, Contactor rating, H.V. Contactor, control circuit for automatic starting and braking of DC motor and three phase induction motor, Control panel design for Motor Control Centre(MCC).	5
4	**Programmable Logic Controllers** Programmable Logic Controllers (PLC), programming methods, Ladder programming with few examples, Applications of PLC"s in electrical drives.	5
5	**Traction motors** Traction motors: Motors use in AC/DC traction and their performance and desirable characteristics, requirement and suitability of motor for traction duty, Speed time characteristics of train, Traction motor control. Series parallel control with numerical method, Starting and braking of traction motor.	6
6	**Digital speed control of Electric motors** Digital speed control of Electric motors, comparison with Analog method of speed control, Block Diagram arrangement for microprocessor based speed control of AC/DC motor, Flowcharts and algorithms for speed control and speed reversal of motor. Digital signal processors (DSP"s) for drive control. Variable frequency Drive(VFD)	6

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ELECTRICAL ENGINEERING

V Semester
EL 2304 - Electrical Drives

Text Books:

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	A Course in Electrical Power	1st-2005	Soni, Gupta, Bhatnagar	Dhanpat Rai and Company
2	Magnetic control of motors	Industrial New York 1947	Heumann	Chapman and Hall
3	Introduction to Programmable Logic Controllers	3rd Edition, 2008.	Gary Dunning	Cengage Learning

Reference books:

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Modern Electric Traction	4th -2005	H. Pratap	Dhanpat Rai and Company
2	Modern utilization of traction motor	2003	J.B. Gupta	
3	A Textbook of Electrical Technology Volume III Transmission, Distribution, Utilization		B.L.Theraja, A.K.Theraja	S.Chand

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| SoE No. |
| EL-201 |

V Semester
EL 2305 - Electrical Drives Lab

S.N	TITLE
1	To evaluate and explain the control circuit of star delta starter
2	To evaluate and explain control circuit of direct online starter (DOL)
3	To explain function of side rotary limit switch.
4	To categorize different types contactors
5	To classify and explain programming logic control (PLC) M-1200, M-1400 and LOGO PLC.
6	To make use of operating limit switch to turn ON contactor (output device).
7	To design ladder programming in PLC to control lamp.
8	To design ladder programming using LOGO PLC to control lamp.
9	To explain Implementation of timer using LOGO PLC
10	To design ladder programming in PLC to Control of lamps in pre defined sequence
11	To design a program for Reversal of synchronous motor using PLC
12	To make use of limit switch, and sensors to turn ON contactor motor, lamp .

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SoE No. EL-201

ELECTRICAL ENGINEERING

V Semester
EL 2311 - OE I : Renewable Energy Generation Systems

Objective	Course Outcome
This subject introduce the different renewable energy sources to the students. Students get knowledge of Electric Power generation by wind, solar, small hydro.	**On completion of this course, the student will be able to** 1) Summarize, classify and compare types of renewable energy sources, outline as per Global and Indian context. 2) Utilize solar energy for various applications, estimate solar radiation geometry and classify types of wind turbine generator. 3) Demonstrate, Classify and utilize geothermal and biomass energy. 4) Compare, classify and apply energy from ocean, tide, wave and hydro for power generation, explain storage methods for renewable energy sources.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Summarize, classify and compare types of renewable energy sources, outline as per Global and Indian context.	1		1			1	1							
CO2	Utilize solar energy for various applications, estimate solar radiation geometry and classify types of wind turbine generator.	1	2	1	1	1		2	1			1			
CO3	Demonstrate, Classify and utilize geothermal and biomass energy.	1		1		1	1	2	1			1			1
CO4	Compare, classify and apply energy from ocean, tide, wave and hydro for power generation, explain storage methods for renewable energy sources.	1		1		1		1				1		1	1

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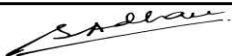
ELECTRICAL ENGINEERING

SoE No.
EL-201

V Semester
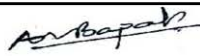## EL 2311 - OE I : Renewable Energy Generation Systems

Unit No.	Contents	Max. Hrs.
1	**Introduction** Fundamentals of Renewable / Non-renewable Energy Sources, Renewable Energy sources, Renewable Energy Potential in India, Renewable Energy Sources and their sustainable development. Storage methods for renewable energy sources.	6
2	Solar Energy Principles, scope and applications, solar radiation, its measurement & prediction, flat plate collectors-design & theory, solar water heating, solar dryers, solar stills, solar cooling and refrigeration. Solar cells, thermal storage, street lighting, solar power generation.	5
3	Wind Energy Introduction, Historical development, Wind energy resources, sites identification, blade element theory, aero-foil design, component of wind energy conversion system, wind turbine generator classification, and windmill and wind electrical generator, Advantages, disadvantages, economics and present status of wind energy generation systems, grid connection of wind energy.	5
4	Geothermal Energy and Biomass Energy Introduction, history of geothermal resources, basics of geological process, dry rock and hot aquifer analysis, geothermal exploration, geothermal well drilling and fluid extraction, utilization of geothermal resources, geothermal heat pump, site of geothermal energy in India. Biomass energy resources and conversion processes, urban waste to energy conversion.	5
5	Mini & Micro hydro-plants Introduction, Classification of water turbines, hydroelectric system, essential components of hydroelectric system, system efficiency, advantages and disadvantages of hydroelectric system, present Indian power scenario of mini- micro hydro.	6
6	Ocean Energy Ocean thermal energy conversion (OTEC), Open cycle and closed cycle OTEC, Ocean wave energy conversion, tidal energy conversion. Introduction of Fuel cells.	6

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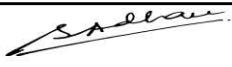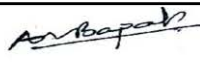(Revised Scheme of Examination w.e.f. 2020-21 onward)
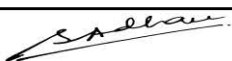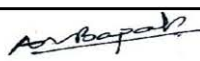
ELECTRICAL ENGINEERING

SoE No. EL-201

V Semester
EL 2311 - OE I : Renewable Energy Generation Systems

Text Books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Non Conventional Sources of Energy	4th edition	G.D.Rai	Khanna Publisher
2	Energy Technology:Nonconventional Renewable and Conventional	,	S. Rao and B.B Parulekar	Khanna Publisher New Delhi

Reference books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Solar Energy : Principles of Thermal collection and storage	3rd edition,1994	S.P.Sukhatme,J.K.Nayak	Tata McGraw Hill
2	Wind and Solar Power System		M. R. Patel	CRC Press, New York
3	Renewable Energy Sources Basic Principles and Applications		G. N. Tiwari and M. K. Ghoshal	Narosa Publishing House,New Delhi

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ELECTRICAL ENGINEERING

V Semester
EL 2312 - OE I : Electrical Machines and their Applications

Objective	Course Outcome
The student should be able to	**On completion of this course, the student will be able to**
This subject introduce the applications of different machines and commonly used drives	1) To explain speed-torque characteristics, need for starters, starting methods and braking of AC and DC motors.
	2) To build/apply criterion for selection of motors, duty cycle, enclosures, transmission system and insulation classes.
	3) To illustrate/interpret/explain the principle, operation and construction of 1-phase and 3-phase transformers and autotransformers.
	4) To show/define the principle. Construction, types, characteristics and performance of special machines like BLDC, Stepper motor and Universal motor

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	To explain speed-torque characteristics, need for starters, starting methods and braking of AC and DC motors	3													1
CO2	To build/apply criterion for selection of motors, duty cycle, enclosures, transmission system and insulation classes	3	1					1							1
CO3	To illustrate/interpret/explain the principle, operation and construction of 1-phase and 3-phase transformers and autotransformers	2	1												2
CO4	To show/define the principle. Construction, types, characteristics and performance of special machines like BLDC, Stepper motor and Universal motor	3													1

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ELECTRICAL ENGINEERING

**SoE No.
EL-201**

V Semester
EL 2312 - OE I : Electrical Machines and their Applications

Unit No.	Contents	Max. Hrs.
1	Introduction to Drives and Speed Control: Classification of Drives, brief idea about commonly used drives (AC and DC) drives in industry, speed- torque characteristics of different drive motors, their behaviour under starting and running conditions.	6
2	Need of starter, Starting methods, Braking and Speed Control of AC and DC motors.	5
3	Selection Criterion for Drive Motors: Criterion for selection of motors, Duty Cycle, Power Rating for Continuous and Intermittent Duty Cycles, Environment and Enclosures, Transmission System, Insulation Classes.	5
4	Single Phase transformer Review of Principle, constant flux machine, losses, efficiency etc., Operation on load (Phasor diagrams), Voltage regulation, effect of load power factor on regulation, Application of Single phase transformer in Electronic circuitry, autotransformer, welding transformer, furnace transformer.	5
5	Three Phase Transformer. Concept of three phase transformer, Comparison between unit and bank of single phase transformer, connections, All Day Efficiency, application in power system.	6
6	Special Machines: Brushless DC motor: - Principle, construction , operation, converter for BLDC, rotor position sensor (Hall Sensor), Stepper motor: types, slewing, torque-speed characteristics, stepper motor converter, Universal motor, applications Applications of three phase and single phase induction motors in cement industry, steel rolling mill, textile mill, etc.	6

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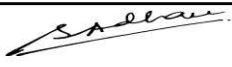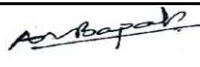## ELECTRICAL ENGINEERING

**SoE No.
EL-201**

V Semester
EL 2312 - OE I : Electrical Machines and their Applications

Text books

S.N	Title	Year/Edition	Author	Publisher
1	A Course in Electrical Power	First-2005	Soni, Gupta, Bhatnagar	Dhanpat Rai and Company
2	Fundamentals of Electric Drives	2nd Edition	G. K.Dubey	Narosa Publications
3	Electric Machines	2nd Edition	Ashfaq Husain	Dhanpat Rai and Company

Reference Books:

Sr. No.	Title	Year/Edition	Author	Publisher
1	A Course in Electrical Power	First-2005	Soni, Gupta, Bhatnagar	Dhanpat Rai and Company
2	Fundamentals of Electric drives	2nd Edition	G. K.Dubey	Narosa Publications
3	Electric Machines	2nd Edition	Ashfaq Husain	Dhanpat Rai and Company

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ELECTRICAL ENGINEERING

SoE No. EL-201

V Semester
EL 2313 - OE I : Testing and Maintenance of Electrical Equipment's

Objective	Course Outcome
The student should be able to	**On completion of this course, the student will be able to**
To adopt various testing and maintenance procedures for electrical equipments by providing effective insulation to enhance their life and working condition	1) Classify, the causes of hazards, accidents, shock and the remedial action taken against the electrical shock. 2) Demonstrate, apply and evaluate different types of tests and the various maintenance techniques to be employed on various electrical machines and it installation. 3) Demonstrate, apply and estimate the factors affecting the life of insulation, its testing and maintenance. 4) Explain, develop and determine the various tests to be conducted on distribution transformer, I. S. Standards.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	Classify, the causes of hazards, accidents, shock and the remedial action taken against the electrical shock.	1					2	1	3				3		1
CO2	Demonstrate, apply and evaluate different types of tests and the various maintenance techniques to be employed on various electrical machines and it installation	1					2		1				1	2	
CO3	Demonstrate, apply and estimate the factors affecting the life of insulation, its testing and maintenance.	1					2								
CO4	Explain, develop and determine the various tests to be conducted on distribution transformer, I. S. Standards.	1					1		1				1	2	

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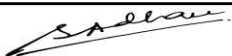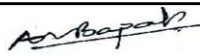(Revised Scheme of Examination w.e.f. 2020-21 onward)

ELECTRICAL ENGINEERING

| SoE No. |
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V Semester
EL 2313 - OE I : Testing and Maintenance of Electrical Equipment's

Unit No.	Contents	Max. Hrs.
1	**Safety & Prevention of Accidents** Definition of terminology used in safety; safety, hazards, accident, major accident hazard, responsibility, authority, accountability, monitoring, I.E. Act & statutory regulations for safety of persons & equipments working with electrical installation, Dos & don"ts for substation operators as listed in IS Meaning & causes of electrical accidents factors on which severity of shock depends, Procedure for rescuing the person who has received an electric shock, methods of providing artificial respiration, Precautions to be taken to avoid fire due to electrical reasons, operation of fire extinguishers.	6
2	**General Introduction** Objectives of testing significance of I.S.S. concept of tolerance, routine tests, type tests, special tests, Methods of testing a) Direct, b) Indirect, c) Regenerative. Concept of routine, preventive & breakdown maintenance, advantages of preventive maintenance, procedure for developing preventive maintenance schedule, Factors affecting preventive maintenance schedule. Introduction to total productive maintenance.	5
3	**Testing & maintenance of rotating machines** Type tests, routine tests & special tests of 1 & 3 phase Induction motors, Routine, Preventive, & breakdown maintenance of 1 & 3 phase Induction motors as per IS 9001:1992. Parallel operation of alternators, Maintenance schedule of alternators & synchronous machines as per IS 4884-1968. Brake test on DC Series motor.	5
4	**Testing & maintenance of Insulation** Classification of insulating materials as per I.S. 8504(part III) 1994, factors affecting life of insulating materials, measurement of insulation resistance & interpretation of condition of insulating. Methods of measuring temperature of internal parts of windings/machines & applying the correction factor when the machine is hot.	5
5	**Testing & maintenance of Transformer** Listing type test, routine test & special test as per I.S. 2026-1981. Procedure for conducting following tests: Measurement of winding resistance, no load losses, & no load current, Impedance voltage, load losses, Insulation resistance, Induced over voltage withstand test, separate source voltage withstand test, Impulse voltage withstand test, Temperature rise test of oil & winding, Different methods of determining temp rise- back to back test, short circuit test, open delta (delta – delta) test. Preventive maintenance & routine maintenance of distribution transformer as per I.S. 10028 (part-III): 1981, Periodic checks for replacement of oil, silica gel, parallel operation of 1 & 3 phase transformer, load sharing calculations (numerical).	6
6	**Installation** Factors involved in designing the machine foundation, Requirement of different dimension of foundation for static & rotating machines procedure for levelling & alignment of two shafts of directly & indirectly coupled drives, effects of misalignment. Installation of rotating machines as per I.S. 900-1992. Use of various devices & tools in loading & unloading, lifting, carrying heavy equipment.	6

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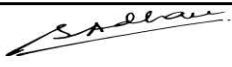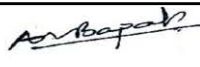## EL 2313 - OE I : Testing and Maintenance of Electrical Equipment"s

Text Books:

S. N.	Author	Title	Publisher
01.	B. V. S. Rao	Operation and Maintenance of Electrical machines Vol – I	Media Promotors & Publisher Ltd. Mumbai
02.	B. V. S. Rao	Operation and Maintenance of Electrical machines Vol – II	Media Promotors & Publisher Ltd. Mumbai

Reference Books:

S. N.	Author	Title	Publisher
01.	B. L. Theraja	Electrical Technology Vol I to IV	S. Chand & Co., New Delhi
02.	C. J. Hubert	Preventive Maintenance Hand Books & Journals	-----------------

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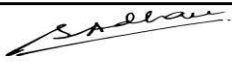(Revised Scheme of Examination w.e.f. 2020-21 onward)

SoE No. EL-201

ELECTRICAL ENGINEERING

V Semester
EL 2321 - OE II: Electrical Energy Audit and Safety

Objectives	Course Outcomes
The student should be able to	**On completion of this course, the student will be able to**
Understand various operating characteristics of electrical equipments, its monitoring, tools used in comprehensive energy audit and its procedure to save the electricity with and without investment, calculation of energy saving and its global impact	1) Classify, the energy sources, methods of energy conservation and its pattern, electricity act 2003. 2) Demonstrate, apply and evaluate different forms of electrical and thermal energy. 3) Demonstrate, apply and estimate the Energy Management, Energy Audit, Energy Monitoring and Targeting. 4) Explain, develop and determine the various Global Environmental Concerns and Electrical safety procedures.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	Classify, the energy sources, methods of energy conservation and its pattern, electricity act 2003	1							1				1		
CO2	Demonstrate, apply and evaluate different forms of electrical and thermal energy.		1										1	1	
CO3	Demonstrate, apply and estimate the Energy Management, Energy Audit, Energy Monitoring and Targeting.		2			1	1	2					1		1
CO4	Explain, develop and determine the various Global Environmental Concerns and Electrical safety procedures.	1									1		1		1

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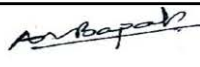(Revised Scheme of Examination w.e.f. 2020-21 onward)

ELECTRICAL ENGINEERING

SoE No.
EL-201

V Semester
EL 2321 - OE II: Electrical Energy Audit and Safety

Unit No.	Contents	Max. Hrs.
1	**Energy Scenario** Commercial and Non-commercial energy, primary energy sources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance. Re-structuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features, Salient Features of Electricity Act 2003.	6
2	**Basics of Energy and its various forms** Electricity basics- DC & AC currents, electricity tariff, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.	5
3	**Energy Management & Audit** Definition, need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.	5
4	**Energy Monitoring and Targeting** Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques - energy consumption, production, cumulative sum of differences (CUSUM).	5
5	**Global environmental concerns** United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), Prototype Carbon fund (PCF).	6
6	**Electrical Safety** Primary hazards associated with electricity. Control measures and safety-related work practices to minimize the risk associated with electrical hazards. Response procedures in the event of electrical shock or fire.	6

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V Semester
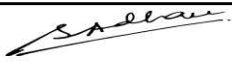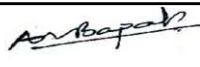## EL 2321 - OE II: Electrical Energy Audit and Safety

Text Books:

S. N.	Author	Title	Publisher
01	Archie,W Culp	Principles of Energy Conversion	McGraw Hill
02	Wayne C Turner	Energy Management Handbook Bureau	John Willey and Sons
03		Bureau of Energy Efficiency Study Material for Energy Managersand Auditors Examination	Bureau of Energy Efficiency www.beeindia.in

Reference Books:

S. N.	Author	Title	Publisher
01.	Amit Kumar Tyagi	Handbook on Energy Audit and Management	TERI

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ELECTRICAL ENGINEERING

V Semester
EL 2322 - OE II: Utilization of Electrical Energy

Objectives	Course Outcomes
The student should be able to To understand the basic principle of electrical heating, welding, illumination, refrigeration and air conditioning, fans, pumps, compressors and digi sets.	**On completion of this course, the student will be able to** 1) Demonstrate and utilize electrical energy for various purposes including heating and traction system. Students will also be able to classify illumination, its types and purpose. 2) Demonstrate and apply electric energy to different types of welding 3) Explain how refrigeration system and air condition system works. 4) Analyse, determine and estimate proper economic generation.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Demonstrate and utilize electrical energy for various purposes including heating and traction system. Students will also be able to classify illumination, its types and purpose	3	2	2					2	1	1				1
CO2	Demonstrate and apply electric energy to different types of welding			1		1			1						
CO3	Explain how refrigeration system and air condition system works	1		1	1				1						
CO4	Analyse,determine and estimate proper economic generation	3	2	2	1		1		2	2	3	1		3	1

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ELECTRICAL ENGINEERING

SoE No. EL-201

V Semester
EL 2322 - OE II: Utilization of Electrical Energy

Unit No.	Contents	Max. Hrs.
1	**Electric Heating:** i) Electric Heating : Types and methods of electrical heating, advantages of electrically produced heat Types & application of electric heating equipment"s, transfer of heat. ii) Resistance Ovens: General constructions, design of heating elements, efficiency & losses, radiant heating. iii) Induction heating: Core type & core less induction furnace, indirect induction oven, medium and high frequency eddy - current heating. iv) Dielectric heating: Principle and application. v) Arc furnace: Direct & indirect arc furnace, power supply, characteristics & control.	6
2	**Electric Welding:** i) Importance, Advantages & Disadvantages of welding, classification of welding processes. ii) Resistance welding, Butt welding, Spot welding, Projection welding, Seam welding. iii) Electric arc welding: carbon arc welding, metal arc welding, submerged arc welding, Welding positions, Types of welding electrodes iv) Ultrasonic welding, electron beam welding, laser beam welding.	5
3	**Illumination:** Nature of light, terms used in illumination, solid angle, laws of illumination, polar curves, Colour Rendering Index (CRI), types of lamps, luminaries, Design of illumination systems, indoor lighting systems, factory lighting, outdoor lighting design, flood lighting, street lighting, energy saving in lighting systems.	5
4	**Refrigeration & Air conditioning:** Terminology, refrigeration cycle, refrigeration systems (Vapour compression, vapour absorption), domestic refrigerator, water cooler, desert cooler. Air conditioning: Factors involved in air conditioning, comfort air conditioning, industrial air conditioning, effective temperature, summer / winter air conditioning systems, types of air conditioning systems, room air conditioning, and central air conditioning.	5
5	**Electric Traction** Traction system, requirement of an ideal traction system, different systems for traction, system of railway electrification, comparison between AC and DC systems, power supply for electric traction system, overhead equipments (collector gear for overhead equipments, conductor-rail equipment)Speed- Time curve for train movement, crest speed, average speed and schedule speed, simplified speed-time curve	6
6	Economics of Power Generation, Electric Power Supply and Utilization Terms and Definitions, base load and peak load, selection of power plant equipment (boilers, prime-movers, size and number of generating units), economics in plant selection, economics of hydroelectric power plant, economics of combined hydro and steam power plant, performance and operating characteristics of power plants, power plant useful life, tariff for electrical energy, objective and requirements of tariff, general tariff forms, comparison between private generating plant and public supply.	6

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ELECTRICAL ENGINEERING

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V Semester
EL 2322 - OE II: Utilization of Electrical Energy

Text books:

S.N	TITLE	EDITION	AUTHOR	PUBLISHER
1	Utilization of Electric Power & Electric Traction		J.B. Gupta	Kataria & Sons
2	Art and Science of Utilization of Electrical Energy		H Pratap	Dhanpat Rai & Sons, Delhi
3	Utilization of Electrical Power		R. K. Rajput	Laxmi Publications Pvt. Ltd.

Reference books:

	TITLE	EDITION	AUTHOR	PUBLISHER
1	Guide book for National Certification Examination for Energy Managers and Energy Auditors			Bureau of Energy Efficiency
2	Utilization of Electrical Power		Dr N. Suryanarayana V.	Wiley Eastern Ltd, Age International New
3	Utilization of Electrical Energy		E.Openshaw Taylor	Orient Longman

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ELECTRICAL ENGINEERING

SoE No.
EL-201

V Semester
EL 2323- OE II: Power System Engineering

Objective	Course Outcome
The student should be able to :- (1) To comprehend the different issues related to overhead lines and underground cables. (2) To train the students with a solid foundation in power system concepts required to solve engineering problems. (3) To provide the knowledge about the system transients, sag and various issues related to cables and transmission lines. (4) To introduce the students to the general structure of the network for transferring power from generating stations to the consumers. (5) To expose the students to the different electrical & mechanical aspects of the power network along with its environmental and safety constraints	On completion of this course, the student will be able to (1) Articulate types of load and power system concepts required to engineering problems. (2) Develop the ability to implement the appropriate safety equipments for design of electrical power system with enhancing the efficiency of the transmission and distribution system with environment friendly technology. (3) Formulate A.C and D.C distribution networks for necessary variable calculation. (4) Ability to design and analyze switchgear protection system with respect to various electrical parameters which is required in substation.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	Articulate types of load and power system concepts required to engineering problems.	2				1		1			1			1	
CO2	Develop the ability to implement the appropriate safety equipments for design of electrical power system with enhancing the efficiency of the transmission and distribution system with environment friendly technology.	1	2	1				1				1	1	2	
CO3	Formulate A.C and D.C distribution networks for necessary variable calculation.	2	1					1						2	
CO4	Ability to design and analyze switchgear protection system with respect to various electrical parameters which is required in substation.	1	1	2				1			1			1	

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ELECTRICAL ENGINEERING

**SoE No.
EL-201**

V Semester
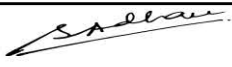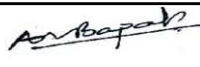## EL 2323- OE II: Power System Engineering

Unit No.	Contents	Max. Hrs.
1	**Introduction to Power System** Restructuring of power sector, Constituents of present day power system, sources of electrical energy, types and characteristics of generating stations: Thermal, hydro, nuclear , solar ,wind and other renewable, salient features of electricity act 2003.	6
2	**Load on Power Stations** Load, Important terms and factors, and Units generated per annum , Load duration curve , Types of loads, Load demand and diversity factors, Load curves and selection of generating units, Base load and peak load on Power station, Method of meeting the load ,Interconnected grid system.	5
3	**Transmission System I** Electric supply system, A.C power supply scheme, D.C transmission scheme, Comparison of AC and DC transmission system, advantages of A.C. transmission system, Comparison of various transmission system (Two wire dc system, Single phase two wire A.C system, Single phase three wire system , three phase three wire system, Three phase four wire system) Elements of transmission line, Economic choice of transmission voltage, requirements of satisfactory electric supply, Concept of HVDC transmission.	5
4	**Transmission System II** Line support insulators, types of insulators (pin type, suspension type, strain type, shackle type), Commonly used conductor material, concept of corona, factor affecting corona, advantages and disadvantages of corona, methods of reducing corona effect, Sag and its effects, Constants of transmission line (R, L and C) , Resistance of transmission line, skin effect , Classification of overhead transmission line and voltage regulation .	5
5	**Distribution System** Classification of distribution system, Types of distribution AC and DC, Overhead verses underground system, Requirements of distribution system, Design consideration of distribution system, AC distribution types, Voltage drop calculations in different distribution system , importance of voltage control, location of voltage control equipment and its methods, Tap changing transformer , Concept of tariff, desirable characteristics of tariff, types of tariff.	6
6	**Introduction to Switchgear** Essential features of switchgear, switchgear equipment's, switches, fuses, circuit breakers, relays, HRC fuses, Bus Bar arrangement (single bus system, One and half feeder ,Main and transfer bus system) , MCB, MCCB, ELCB Introduction to Instrument transformer Current Transformer (CT) and Potential transformer (PT).	6

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ELECTRICAL ENGINEERING

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V Semester
EL 2323- OE II: Power System Engineering

Text books:				
	Title	Edition	Author	Publication
1.	Power System Analysis	1st edition 2007	T.K. Nagsarkar, M.S. Sukhija	Oxford
2.	Principles of Power System	2nd edition 2005	V.K.Mehta, Rohit Mehta	S.Chand
3.	Electrical Power System	5th edition 2007	Ashfaque Hussain	CBS

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Electrical Engineering

SoE No.
EL-201

VI Semester
GE2311 - Fundamentals of Management

Objective	Outcomes Students will be able to
To introduce the fundamentals and legal provision of Management	Explain the Legal provision and Functions of Management.
To introduce the Human Resource and Financial practice of organization	Analyze the role of Human Resource and Financial Management in the organization.
To Introduce the Project Management	Analyze the project life cycles.
To provide knowledge of Marketing Activities of Management	Identify tools and techniques for the marketing of goods and services.

Unit – 1 - Principle of Management
Evolution of Management Thought : Scientific and Administrative Theory of Management , Definition and Concept of Management, Functions of Management : Planning, Organizing, Directing, Coordinating and Controlling, Motivational Theories, Concept of Leadership

UNIT-2: Legal Aspects of Management
The Indian Contract Act, 1872 – Formation of Valid Contract, Discharge of Contract, Quasi Contract, Indemnity and Guarantee. The Indian Partnership Act, 1932- Essentials of Partnership, The Companies Act – Nature and Definition of Company, Registration and Incorporation, Memorandum and Article of Association, Kinds of companies, Winding up of the Company

UNIT-3: Human Resource Management
Human Resource Management-Meaning and Scope, Principles of HRD, Job Analysis – Job Description and Job Specification, Job Enrichment, Job Rotation, Training and Development – Purpose and Methods, Performance Appraisal- Purpose, Procedure and Techniques, Grievance Redressal Procedure .

UNIT-4: Project Management
Concept, Classification and Characteristics of Project, Project Life Cycle, Project Proposal, Tools and Techniques of Project Management, Network techniques - Introduction and Use of CPM &PERT for planning, SWOT Analysis, Project Risk Analysis, Project Control.

UNIT-5: Marketing Management
Marketing Management - Definition & scope, Selling & Modern Concepts of Marketing, Market Research, Customer Behaviors, Product Launching, Sales Promotion, Pricing, Channels of Distribution, Advertising, Market Segmentation, Marketing Mix, Positioning, Targeting

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VI Semester
GE2311 - Fundamentals of Management

UNIT-6: Financial Management

Definition & Functions of Finance department, Sources of finance, Types of capital, Profit maximization vs. Wealth Maximization, Functions of Finance Manager in Modern Age, Concept of Risk and Return , Break Even Analysis, Budgets & Budgetary Control, Make or Buy Analysis, Introduction to financial statement – profit and loss A/c and Balance Sheet

Text book and Reference

1. Harold Koontz Ramchandra, Principles of Management, Tata McGrow hills
2. Bare Acts – Indian Contract Act, Indian Partnership Act and Company Law
3. Dr. V.S.P.Rao - Human Resource Management - Text and Cases
4. C.B.Mamoria and S.V.Gankar, A Text book of Human Resource Management,
5. Lock, Gower - Project Management Handbook
6. Ramaswamy V.S. and Namakumari S - Marketing Management: Planning, Implementation and Control (Macmillian, 3rd Edition).
7. Rajan Saxena: Marketing Management, Tata McGraw Hill.
8. Fabozzi - Foundations of Financial Markets and Institutions (Pretice hall, 3rd Ed.)
9. Parameswaran- Fundamentals of Financial Instruments (Wiley India)
10. Bhole L M - Financial Institutions and Markets (Tata McGraw-Hill, 3rd edition, 2003)
11. Khan M Y - Financial Services (Tata Mc Graw Hill, 19

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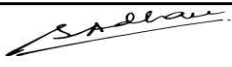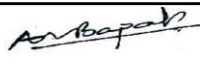**(Revised Scheme of Examination w.e.f. 2020-21 onward)**
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VI Semester
EL2351- Control System

Course Learning Objectives	Course Outcomes
This is a first course in feedback control of dynamic systems. The main goal is to introduce and familiarize students with dynamic systems modeling and analysis techniques that can be employed on a large variety of engineering systems. Being an interdisciplinary course, students will learn: 1 the role of a control engineer in multi- disciplinary teams. 2 to apply the knowledge gained in basic mathematics, physical sciences and engineering courses to derive mathematical models of typical engineering processes. 3 to use transfer function and state space models for control system analysis in time and frequency domain. 4 the basic concepts of proportional, integral, and derivative (PID) control. 5 the importance of stability in control systems and the various methods to determine it. 6 to construct root locus plot and frequency response plots such as polar plot, Bode plot, Nyquist plot etc.	The students will be able to: CO1: Classify, select types of control systems, interpret transfer function of the system and compare and evaluate electrical and mechanical systems. CO2: Illustrate the time response, develop and evaluate the controller. CO3: Demonstrate, apply and evaluate stability using transfer function and state variable approach. CO4: Demonstrate, construct and select design parameters using root locus and frequency domain methods Mapped program outcomes:1,2,3,12

UNIT I : Introduction to Control Systems: History of control system, Basic Components of Control System, Open loop control and close loop control with examples, classification of control systems.

Transfer Function, Block Diagram and Signal Flow Graph : Transfer function and gain, Order of a system, block diagram algebra & reduction techniques, signal flow graph, its constructions and Mason"s gain formula.

Mathematical Modelling of physical systems: Mathematical modelling of physical system such as – electrical, mechanical, electro-mechanical, thermal, hydraulic, pneumatic etc., Analogous systems.

UNIT II: Characteristics of Feedback Control Systems : Effect of negative feedback compared to open loop system such as – sensitivity to parameter variation, speed of time response, bandwidth, disturbance rejection and linearizing effect, Effect of positive feedback.

UNIT III:Time Domain Analysis of Control Systems: Concept of transient response, Steady state response and time response, standard test signals, Time response of first order systems, Transfer function of second order system, Time response of second order system, Time response specifications of second order system, steady state error (e_{ss}) analysis, static error constants and system type, dominant poles, Approximation of high order systems by low order systems, Relation between roots of characteristic equation, damping ratio and transient response, effect of proportional(P), Integral (I) and derivative (D) controllers on the time response concept of transportation lag.

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VI Semester
EL2351- Control System

UNIT IV: Stability of Linear Control Systems : Concept of stability, stable, unstable and marginally stable system, Absolutely stable and conditionally stable system, Necessary conditions for stability, method to determine stability, Routh-Hurwitz stability criterion with special cases, relative stability analysis.

State Variable Analysis : Concept of state, state variables and state model, state model of linear systems, state model using physical variables, phase variables and canonical variables, state model from differential equations, block diagram and signal flow graph, transfer function from state model, stability of systems modeled in state variable form, solution of state equations, state transition matrix, its properties and computation.

UNIT V: Root LocusTechnique : Definition, magnitude and angle criteria, properties of root locus, construction rules for root locus plot of negative feedback systems, determining the gain from root locus plot, effect of addition of poles and zeros of G(s)H(s).

UNIT VI: Frequency domain analysis of control systems: Concept of frequency response and sinusoidal transfer function, resonant frequency, resonant peak, cut off frequency, bandwidth, correlation between time and frequency response, polar plot, inverse polar plot, bode plot, all pass and minimum – phase system, experimental determination of transfer function, log magnitude versus phase plot.

Stability in Frequency domain : Principle of argument, Nyquist stability criterion, Assessment of relative stability using Nyquist criterion, concept of gain margin and phase margin and its computation using polar plot and log magnitude versus phase plot. Constant M and constant N circles, Nicholas chart.

Text books:

1	Control system Engineering	5TH Edition I. J. Nagrath & M. Gopal	New Age International
2	Automatic control systems	7th Edition B. C. Kuo	PHI Learning Private Limited

Reference Books:

1	Sigma Series: Control Systems	1st Edition Ashok Kumar	McGraw - Hill
2	Control systems :Principles and Design	4th Edition M. Gopal	McGraw - Hill
3	Modern Control Engineering	5th Edition Katsuhiko Ogata	PHI Learning Private Limited

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VI Semester
EL2352- Lab.: Control System

Practical based on above syllabus are to be covered.

	TITLE
1	To study transient response of a second order system.
2	Study of Stepper Motor
3	Study of Potentiometer as an Error Detector.
4	To study the Speed Torque Characteristic of AC Servo Motor
5	To study the Frequency Response of RLC network
6	To study the Synchros a)To plot the characteristic of synchro transmitter. b)To plot the characteristic of synchro receiver
7	Study of synchro as an error detector
8	Study of DC Position Servo Mechanism
9	Verification of Root Locus using MATLAB
10	Verification of Bode Plot using MATLAB
11	To Study Effect of Type of System on Steady State Error
12	PID Controller

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VI Semester
EL2353- Power System Analysis

Course Objective	Course Outcomes
After learning basic concepts of power system this subject explain functioning of power system with balance, unbalanced condition. Concept of faults, stability, grounding and economics of power system is also explained.	The student will be able to understand the 1) Symmetrical component transformation and sequence networks. 2) Symmetrical fault analysis with various faults with and without pre fault load currents. 3) Unsymmetrical fault analysis with and without fault impedance for various faults using symmetrical components. 4) Steady state and transient stability analysis of power system. 5) Economic operation of power system and representation of transmission loss using loss formula co-efficient. 6) Concept of Neutral grounding, shunt and series compensation of power system.
Mapped Program Outcomes:a,b,c,d,e,f,g,I,j	

UNIT-I: Symmetrical Fault Analysis

Define fault & its causes, effect of fault on power system, purpose of fault analysis, assumptions made for fault analysis, transient in a series R-L circuit, short circuit analysis on synchronous machine at no-load & loaded condition, selection of circuit breaker & its short circuit MVA calculation, current limiting reactors.

UNIT-II: Symmetrical Component:-

Introduction, α-operator, symmetrical components of an unbalanced Three phase system, symmetrical components of voltage & current phasors, zero sequence components of voltage & current, power in terms of symmetrical components, phase shift in star-delta transformers, sequence network for fault calculation, sequence impedances of transmission line & synchronous machines, zero sequence networks of transformers, assembly of sequence networks of power system.

UNIT-III: Unsymmetrical Fault Analysis

Assumptions made for unsymmetrical fault analysis, sequence voltages of a generator, sequence voltages at a fault point, general procedure for analysis of various fault with and without fault impedance for Line to Ground (L-G), L-L-G, L-L, Open conductors faults analysis using symmetrical components.

UNIT-IV: Power System Stability

Stability of power system:-Steady state, Dynamic and Transient stability definition, Dynamics of synchronous machine, swing equation, swing equation for machines swinging coherently and Non-Coherently. Power angle equation, Steady state stability studies.

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VI Semester
EL2353- Power System Analysis

<u>Transient stability studies</u>: - Swing curve, Equal Area criterion for transient stability, Application of equal area criterion for different disturbances. Solutions of swing equation by point by point method. Methods of improving transient stability.

UNIT-V: Economic operation of power system

Introduction, incremental fuel cost, economic dispatch neglecting transmission losses, transmission loss as a function of plant generation, general loss formula, and optimum load dispatch considering transmission losses

UNIT-VI: System Neutral Grounding & Reactive Power Compensation

<u>Neutral Grounding</u>: - Introduction to neutral grounding, methods of neutral grounding, peterson coil grounding.

<u>Compensation</u>: - Series & shunt compensation, location of series capacitors, protective schemes for series capacitors, problem associated with series capacitors, Static VAR system with its different schemes.

Text Books

	TITLE	EDITION	AUTHOR	PUBLICATION
	Electrical Power System	5TH edition 2007	Ashfaque Hussain	CBS

Reference books

	TITLE	EDITION	AUTHOR	PUBLICATION
	Elements of Power System Analysis	4th-1984	W. D. Stevenson	Tata McGraw Hill
	Modern Power System analysis	4th-2011	I. J. Nagrath & D. P. Kothari	Tata McGraw Hill
	Electrical Power System	3rd- 2005	C. L. Wadhawa	NEW AGE INTERNATIONAL

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VI Semester
EL2354- Lab.: Simulation of Power Electronics & Power System

Course Objective	Course Outcomes
To understand Power electronics and Drives through various software available for power electronics.	Students shall be able to understand practically the 1) Use of semiconductor devices for realizing uncontrolled and controlled rectifiers. 2) The implementations of inverters without and with PWMs 3) The working and implementation of multilevel inverter and the modulation control 4) The inverter fed AC drive with open loop control.

Expt.No.	Name of Experiment
1	To study half wave uncontrolled rectifier
2	To study half wave controlled rectifier
3	To study full wave controlled rectifier
4	To study single phase H-bridge inverter(withoutPWM)
5	To study three phase bridge inverter(180 degree mode)
6	To study sinusoidal pulse width modulation(APOD,POD and IPD)
7	To study single phase H-bridge inverter using SPWM
8	Introduction to multilevel inverter and implementation of 3 and 5 level inverter
9	To study voltage sag on distribution system using symmetrical fault
10	To study inverter fed induction motor

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VI Semester
EL2355- Lab. Substation Design

Course Objectives	Course Outcomes
The student will understand different aspects of substation design that is layout drawing, earthing Drawing, lighting drawing and cable wiring.	The students will be able to: CO1: Illustrate and Explain, single line diagram of substation with rating of different equipment's, types of relays required and their settings CO2: Construct plan of equipment's and panels mounted in a substation. CO3: Design earthing system of a substation.

Mapped Program Outcomes				4	

Practical based on following topics may be performed.

1) One Line diagram

2) Switchyard and control panel layout for 132 and 11 kV substation.
3) Lighting layout of substation and switchyard.

4) Substation earthing.

Text books:				
1	Handbook of Electrical Power Distribution	2nd Edition	Gorti Ramamurthy	University Press
2	Electric Power Distribution	4th edition, 1997	A.S. Pabla	Tata Mc Graw-Hill Publishing Company

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VI Semester
EL2361- PE-I: Advanced Power Electronics

Course Objective	Outcomes
To study soft switching and various soft switched converters, Multilevel inverters, Pulse Width modulation with different modulation strategies are covered.	1) To gain the knowledge of semi conductor devices regarding their structure and operation. 2) Concept of converters which uses the special switching techniques 3) Operation of different multilevel and hybrid multilevel inverter topologies. 4) Various types of modulation techniques, their significance, implementation and applications. 5) Causes, effects and remedies of different power quality problems 6) Various types of harmonics, their measuring indices and elimination methods.
Mapped Program Outcomes: a,b,c,d,f,j	

UNIT-1: Power Semiconductor Devices
Power Semiconductor Devices: Metal Oxide Turn off thyristor (MTO), Metal oxide Controlled Thyristor (MCT), Emitter Turn off Thyristor (ETO), Static Induction Thyristor (SIT). Injection enhanced gate transistors (IEGT), integrated gate commutated thyristor (IGCT).

UNIT-2: Hard Switched and Soft Switched Converters
Hard Switched and Soft Switched Converters: Load Resonant Converters, Series, Parallel & Hybrid Loaded Converters, Resonant Switch Converter, Zero Current, Zero Voltage switched Resonant Converter, DC-DC Resonant link inverters, Hybrid resonant link inverters.
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UNIT-3: Multilevel Inverters
Multilevel Inverters: Diode Clamped Inverters, Flying Capacitor Inverters, Cascaded multilevel Inverters and Hybrid Cascaded Inverter. Introduction to latest multilevel inverter topologies.

UNIT-4: Modulation Techniques
Modulation Techniques: Pulse Width Modulation, Selective Harmonic Elimination (SHE) Space Vector Pulse Width Modulation (SVPWM), Random PWM.

UNIT 5: Harmonics
Harmonics: Effects within power system, Interference with Communication Harmonic Measurements and.Harmonic Indices

Unit 6:Harmonics Mitigation Techniques

Passive Filter ,Active Power Filter-Series and Shunt(Open Loop and Closed Loop Control).

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VI Semester
EL2361- PE-I: Advanced Power Electronics

Text Books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Power Electronics:Converters,Application and Design	2007	Ned Mohan, T.M. Undeland and W.P. Robbins	Wiley Publication(Wiley Student Edition)
2	Power Electronics;Principles and Applications	2017	Joseph Vithayathil	Tata McGraw Hill Publication (Indian Edition)
3	Power Electronics and AC Drives	2003	B.K. Bose	Pearson Education

Reference Books

	Power Semiconductor Circuits	1984	S.B. Dewan and Straughen	John Wiley and Sons, Inc
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VI Semester
EL2362- PEI: Electrical Distribution in Power System

Course Objectives	Course Outcomes
Student will be able to understand the various Aspects of distribution system **Mapped Program Outcomes: a,b,d,f,j**	The student will be able to understand the 1) The factors which affect the performance of distribution system, nature of load, its growth and forecasting. 2) Types of feeders, its loading, causes of unbalance, fault isolation, System restoration. 3) Distribution line parameter, supports and the causes and effects of voltage drop in distribution line 4) Different method Reactive power compensation Benefits of power factor improvement. 5) To decide optimal location of substation 6) Problems with existing distribution systems and function of substation automation system

UNIT-1: Load Forecasting
Introduction, Explanation of basic terms like demand factor, utilization factor, load factor, plant factor, diversity factor, coincidence factor, contribution factor and loss factor, load & load characteristics, load and load duration curve, relation between load and loss factor, load curve and diversified demand, load modeling,load growth and forecasting.

UNIT-2: Distribution Feeders:
Introduction, Primary and secondary distribution, Radial and loop types, Distribution substation location and planning, Feeder loading and voltage drop considerations, Voltage drop in feeder with different loading, Engineering considerations for voltage levels and loading, causes of unbalance and unequal drops, common faults in feeders, fault location, fault isolation, restoration.

UNIT-3: Overhead lines and Cables
Introduction, Line parameters, Overhead lines, insulators and supports, cables, Insulation resistance, Voltage drop and power loss in conductors, voltage drop in ac single phase distribution system, voltage drop computation based on load density, voltage drop in underground cable distribution.
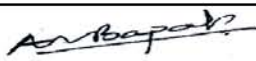
UNIT-4: Reactive power compensation and applications of capacitors
Introduction, advantages and benefits of power factor improvement, power factor improvement using capacitors: mathematical calculations, location of capacitors, application of capacitor banks for power factor improvement, sub harmonic oscillations and ferro resonance due to capacitor banks, optimum power factor for distribution system.

UNIT-5: Substation & Metering, instrumentation & Tariffs
Introduction, substation types, substation components, equipment and layouts, substation location and size, Grounding, earth connection and earthing system, measurement of power, measurement of energy, maximum demand and trivector meter, automatic meter reading (AMR), AMR systems, substation instrumentation, tariffs and billing.
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VI Semester
EL2362- PEI: Electrical Distribution in Power System

UNIT-6: Distribution automation (DA) & SCADA
Problems with existing distribution systems, need for distribution automation, distribution automation, feeder automation, communication requirements for DA. Remote terminal unit (RTU), Block diagram of SCADA, Components of SCADA, Functions of SCADA, SCADA applied to distribution automation, Advantages of DA through SCADA, DA integration mechanisms, Functions of substations automation systems, state and trends of substation automation.

Text books

1	Electrical Power Distribution Systems	2009	V. Kama Raju	Tata Mcgraw Hill Education Private Ltd., New Delhi
2	A Text Book of Electric Power Distribution Automation	1st Edition, 2010	Dr. M. K. Khedkar And Dr. G. M. Dhole,.	University Science Press

Reference books:

1	Electric Power Distribution	4th edition, 1997	A.S.Pabla	Tata Mc Graw-Hill Publishing Company
2	Electrical Distribution System	1st Edition,2013	Dr.H.P.Inamdar	Electrotech Publication

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**SoE No.
EL-201**

Electrical Engineering

VI Semester
EL2363- PEI: Illumination Engineering (MOOC)

Unit I:
Radiation & Colour
Eye & Vision
Different entities of illuminating systems

Unit II:
Light sources: daylight, incandescent, electric discharge, fluorescent, arc lamps and lasers
Luminaries, wiring, switching & control circuits

Unit III:
Laws of illumination; illumination from point, line and surface sources
Photometry and spectrophotometry; photocells
Environment and glare

Unit IV:
General illumination design
Interior lighting – industrial, residential, office departmental stores, indoor stadium, theatre and hospitals

Unit V:
Exterior lighting- flood, street, aviation and transport lighting, lighting for displays and signalling- neon signs, LED-LCD displays beacons and lighting for surveillance Utility services for large building/office complex & layout of different meters and protection units

Unit VI:
Different type of loads and their individual protections
Selection of cable/wire sizes; potential sources of fire hazards and precautions. Emergency supply stand by& UPS
A specific design problem on this aspect

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SoE No.
EL-201

Electrical Engineering

VI Semester
EL2364- PEI: Electric Vehicles

Unit 1:- Introduction to Electric Vehicles & Vehicle mechanism

EV System, Components of an EV, History of EV, EV Advantages, EV Market, Vehicle Mechanics:- Roadway Fundamentals, laws of Motion, Dynamics of Vehicle motion (Numerical), Propulsion power, Velocity and acceleration, Propulsion system design.

Unit 2:- Battery and other alternative Energy Sources

Battery basics, lead acid battery, alternative batteries, battery parameters (Numerical), technical characteristics of battery, targets and properties of batteries, battery modeling.

Fuel cells- Basic Operation, Fuel Cell model and cell voltage, No-Load and Load voltage of a PEM(Numerical), Basic Operation of super capacitorsand ultra-capacitors, Basic Operation of flywheels.

Unit 3:- Electric Machines

Motor and engine ratings, EV and HEV motor requirements, dc and three phase ac machines, space vector representation, dq modeling, induction machine dq model, power and electromagnetic torque, permanent magnet machines, switched reluctance machines, BLDC machines(Numerical).

Unit 4:- Power Electronics and motor Drives

Electric drive components, dc drives, operating point analysis, ac drives, Buck Converter in Continuous Conduction Mode (CCM) (Numerical), Boundary Conduction Mode (BCM) (Numerical), Discontinuous Conduction Mode (DCM),PM synchronous motor drives, Switched Reluctance motor drives, design of current and speed controller.

Unit 5: Drive Train
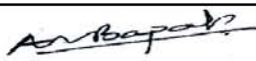
EV transmission configuration, transmission components, gears, automobile differential, clutch, brakes, ideal gear box, EV motor sizing(Numerical).

Unit 6: Hybrid Electric Vehicle

Types of Hybrids, series and parallel HEVs, IC engines, reciprocity engines, various air cycles, design of HEV, hybrid drive train, sizing of components, rated vehicle velocity, initial acceleration, maximum velocity and maximum gradeability

Text Book: -

1) Iqbal Husain, "**Electric and Hybrid Vehicles: Design Fundamentals**", CRC Press, 2005.

2) John G. Hayes, John G. Hayes,"**Electric Powertrain- Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles**", John Wiley & Sons, 2018

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SoE No.
EL-201

VI Semester
EL2365- PEI: Electric Power Utilization

Course Objectives	Course Outcomes
Student will understand. The knowledge about energy utilization .The application of electrical energy such as lightning, heating welding, fans and pumps.	The student on completion will be able to understand 1) Types of electric heating techniques, their field of application, relative advantages and limitations. 2) Types of electric welding techniques, their field of application, relative advantages and limitations, defects in welding, new advancements in welding technology. 3) Basic concepts of illumination, various types of lamps along with their light characteristic and field of application. They will be able to design illumination system for various criterions. 4) Basic refrigeration cycle, VCRS and VARS, various types of air conditioning systems and its use as per requirement. 5) Difference between fans and blowers with respect to its characteristics , various energy saving methods to be used. They can classify pumps with respect to its characteristic and field of application. 6) Classification of compressors, application of compressors as per requirement of compressed air. They will understand basics of DG system, its major components, working under different conditions and energy saving opportunities in DG system

UNIT-1: Electric Heating

Introduction, Advantages of electric heating, modes of heat transfer, methods of electric heating, resistance heating, arc heating, arc furnaces, induction heating, dielectric heating, infrared and radiant heating.

UNIT-2: Electric Welding:

Definition, welding process, resistance electric welding, electric arc welding, submerged arc welding, MIG welding, Ultrasonic welding, laser beam welding, welding of various metals, underwater welding, defects in welding, testing of welding joints.

UNIT-3: Illumination :

Nature of light, terms used in illumination, solid angle, laws of illumination, polar curves, Colour Rendering Index (CRI), types of lamps, luminaries, Design of illumination systems, indoor lighting systems, factory lighting, outdoor lighting design, flood lighting, street lighting, energy saving in lighting systems.

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VI Semester
EL2365- PEI: Electric Power Utilization

UNIT-4: Refrigeration & Air conditioning:

Terminology, refrigeration cycle, refrigeration systems (Vapor compression, vapor absorption), domestic refrigerator, water cooler, desert cooler.

Air conditioning: Factors involved in air conditioning, comfort air conditioning, industrial air conditioning, effective Temperature, summer / winter air conditioning systems, types of air conditioning systems, room air conditioning, and central air conditioning.

UNIT-5: Fans & Pumps:

Fans and Blowers: Fan types, fan performance evaluation & efficient system operation, fan design & selection criteria, flow control strategies, fan performance assessment, energy saving opportunities.

Pumps: Pump types, system characteristics. Pump curves, factors affecting pump performance, efficient pumping system operation, flow control strategies, energy conservation opportunities in pumping system.

UNIT-6: Compressors and DG Sets:

Compressors: Compressor types, Compressor efficiency, Compressed air system components.

Diesel Generating Systems: Introduction, selection and installation factors, operational factors, energy performance assessment in DG sets, energy saving measures for DG sets.

Text books:

1	Utilization of Electric Energy		E. Openshaw Taylor	Orient Longman
2	Utilization of Electric Power & Electric Traction		J.B. Gupta	Kataria & Sons
3	Art and Science of Utilization of Electrical Energy		H Partap	Dhanpat Rai & Sons, Delhi
4	Utilisation of Electrical power	1st Edition, 2006	R. K. Rajput	Laxmi Publications Pvt. Ltd.

Reference books:

	Guide book for National Certification Examination for Energy Managers and Energy Auditors			Bureau of Energy Efficiency
	Utilization of Electrical Power		Dr N. V. Suryanarayana	Wiley Eastern Ltd, New Age International

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**SoE No.
EL-201**

Electrical Engineering

VI Semester
EL2371- OEIII: Renewable Energy Generation System

Course Objective	Course Outcomes
This subject introduce the different renewable energy sources to the students. Students get knowledge of Electric Power generation by wind, solar, small hydro.	1. Basic aspects of renewable energy supply presenting fundamental characteristics of the resource base (solar radiation, wind energy, geothermal, etc.) and principles of related technical systems (photovoltaic, wind, hydroelectric power generation, etc.).Fundamentals of fuel cells. 2. Solar radiation geometry , basic concepts of solar energy to heat conversion, different types of solar energy collectors with different applications. 3. Concepts of wind energy conversion system, types of WECS and their connection with the grid. 4. Basics of geological process, tapping geothermal energy, biomass energy resources and its conversion processes. 5. Basic concept of Mini & Micro hydro-plants with site selection criteria. 6. Basic concepts of energy from ocean including tidal and wave energy with focus on conversion cycles from ocean energy to electrical energy.

UNIT-1: Introduction

Fundamentals of Renewable / Non-renewable Energy Sources, Renewable Energy sources, Renewable Energy Potential in India, Renewable Energy Sources and their sustainable development. Storage methods for renewable energy sources

UNIT-2: Solar Energy

Principles, scope and applications, solar radiation, its measurement & prediction, flat plate collectors-design & theory, solar water heating, solar dryers, solar stills, solar cooling and refrigeration. Solar cells, thermal storage, street lighting, solar power generation.

UNIT-3: Wind Energy

Introduction, Historical development, Wind energy resources, sites identification, blade element theory, aero-foil design, component of wind energy conversion system, wind turbine generator classification, and windmill and wind electrical generator, Advantages, disadvantages, economics and present status of wind energy generation systems, grid connection of wind energy.

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VI Semester
EL2371- OEIII: Renewable Energy Generation System

UNIT-4: Geothermal Energy and Biomass Energy

Introduction, history of geothermal resources, basics of geological process, dry rock and hot aquifer analysis, geothermal exploration, geothermal well drilling and fluid extraction, utilization of geothermal resources, geothermal heat pump, site of geothermal energy in India. Biomass energy resources and conversion processes, urban waste to energy conversion.

UNIT-5: Mini & Micro hydro-plants
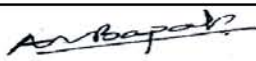
Introduction, Classification of water turbines, hydroelectric system, essential components of hydroelectric system, system efficiency, advantages and disadvantages of hydroelectric system, present Indian power scenario of mini-micro hydro.

UNIT-6: Ocean Energy

Ocean thermal energy conversion (OTEC), Open cycle and closed cycle OTEC, Ocean wave energy conversion, tidal energy conversion. Introduction of Fuel cells.

Text Books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Non Conventional Sources of Energy	4th edition	G.D.Rai	Khanna Publisher
2	Energy Technology:Nonconventional Renewable and Conventional	,	S. Rao and B.B Parulekar	Khanna Publisher New Delhi

Reference books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Solar Energy : Principles of Thermal collection and storage	3rd edition,1994	S.P.Sukhatme,J.K.Nayak	Tata McGraw Hill
2	Wind and Solar Power System		M. R. Patel	CRC Press, New York
3	Renewable Energy Sources Basic Principles and Applications		G. N. Tiwari and M. K. Ghoshal	Narosa Publishing House,New Delhi

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Electrical Engineering

SoE No.
EL-201

VI Semester
EL2372- OEIII: Electrical Machines and their Applications

Course Objective	Course Outcomes
This subject introduce the applications of different machines and commonly used drives.	1. To explain speed-torque characteristics, need for starters, starting methods and braking of AC and DC motors. 2. To build/apply criterion for selection of motors, duty cycle, enclosures, transmission system and insulation classes. 3. To illustrate/interpret/explain the principle, operation and construction of 1-phase and 3-phase transformers and autotransformers. 4. To show/define the principle. Construction, types, characteristics and performance of special machines like BLDC, Stepper motor and Universal motor

Unit 1: Introduction to Drives and Speed Control:

Classification of Drives, brief idea about commonly used drives (AC and DC) drives in industry, speed- torque characteristics of different drive motors, their behaviour under starting and running conditions.

Unit 2:

Need of starter, Starting methods, Braking and Speed Control of AC and DC motors.

Unit 3: Selection Criterion for Drive Motors:

Criterion for selection of motors, Duty Cycle, Power Rating for Continuous and Intermittent Duty Cycles, Environment and Enclosures, Transmission System, Insulation Classes.

Unit 4: Single Phase transformer

Review of Principle, constant flux machine, losses, efficiency etc., Operation on load (Phasor diagrams), Voltage regulation, effect of load power factor on regulation, Application of Single phase transformer in Electronic circuitry, autotransformer, welding transformer, furnace transformer.

Unit 5: Three Phase Transformer.

Concept of three phase transformer, Comparison between unit and bank of single phase transformer, connections,

All Day Efficiency, application in power system.

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VI Semester
EL2372- OEIII: Electrical Machines and their Applications

Unit 6: Special Machines:

Brushless DC motor: - Principle, construction , operation, converter for BLDC, rotor position sensor (Hall Sensor), Stepper motor: types, slewing, torque-speed characteristics, stepper motor converter, Universal motor, applications Applications of three phase and single phase induction motors in cement industry, steel rolling mill, textile mill, etc.

Text books

S.N	Title	Year/Edition	Author	Publisher
1	A Course in Electrical Power	First-2005	Soni, Gupta, Bhatnagar	Dhanpat Rai and Company
2	Fundamentals of Electric Drives	2nd Edition	G. K.Dubey	Narosa Publications
3	Electric Machines	2nd Edition	Ashfaq Husain	Dhanpat Rai and Company

Reference Books:

Sr. No.	Title	Year/Edition	Author	Publisher
1	A Course in Electrical Power	First-2005	Soni, Gupta, Bhatnagar	Dhanpat Rai and Company
2	Fundamentals of Electric drives	2nd Edition	G. K.Dubey	Narosa Publications
3	Electric Machines	2nd Edition	Ashfaq Husain	Dhanpat Rai and Company

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**SoE No.
EL-201**

VI Semester
EL2373 - OEIII: Testing and Maintenance of Electrical Machines

Course Objective	Course Outcomes
To adopt various testing and maintenance procedures for electrical equipment's by providing effective insulation to enhance their life and working condition	The students will be able to: CO1: Classify, the causes of hazards, accidents, shock and the remedial action taken against the electrical shock. CO2: Demonstrate, apply and evaluate different types of tests and the various maintenance techniques to be employed on various electrical machines and it installation. CO3: Demonstrate, apply and estimate the factors affecting the life of insulation, its testing and maintenance. CO4: Explain, develop and determine the various tests to be conducted on distribution transformer, I. S. Standards.
Mapped program outcomes:1,6,7,8,12	

Unit 1: Safety & Prevention of Accidents

Definition of terminology used in safety; safety, hazards, accident, major accident hazard, responsibility, authority, accountability, monitoring, I.E. Act & statutory regulations for safety of persons & equipments working with electrical installation, Dos & don"ts for substation operators as listed in IS Meaning & causes of electrical accidents factors on which severity of shock depends, Procedure for rescuing the person who has received an electric shock, methods of providing artificial respiration, Precautions to be taken to avoid fire due to electrical reasons, operation of fire extinguishers.

Unit 2: General Introduction

Objectives of testing significance of I.S.S. concept of tolerance, routine tests, type tests, special tests, Methods of testing a) Direct, b) Indirect, c) Regenerative. Concept of routine, preventive & breakdown maintenance, advantages of preventive maintenance, procedure for developing preventive maintenance schedule, Factors affecting preventive maintenance schedule. Introduction to total productive maintenance.

Unit 3: Testing & maintenance of rotating machines

Type tests, routine tests & special tests of 1 & 3 phase Induction motors, Routine, Preventive, & breakdown maintenance of 1 & 3 phase Induction motors as per IS 9001:1992. Parallel operation of alternators, Maintenance schedule of alternators & synchronous machines as per IS 4884-1968. Brake test on DC Series motor.

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VI Semester
EL2373 - OEIII: Testing and Maintenance of Electrical Machines

Unit 4: Testing & maintenance of Insulation

Classification of insulating materials as per I.S. 8504(part III) 1994, factors affecting life of insulating materials, measurement of insulation resistance & interpretation of condition of insulating. Methods of measuring temperature of internal parts of windings/machines & applying the correction factor when the machine is hot.

Unit 5: Testing & maintenance of Transformer

Listing type test, routine test & special test as per I.S. 2026-1981. Procedure for conducting following tests:

Measurement of winding resistance, no load losses, & no load current, Impedance voltage, load losses, Insulation resistance, Induced over voltage withstand test, separate source voltage withstand test, Impulse voltage withstand test, Temperature rise test of oil & winding, Different methods of determining temp rise- back to back test, short circuit test, open delta (delta – delta) test. Preventive maintenance & routine maintenance of distribution transformer as per I.S. 10028 (part-III): 1981, Periodic checks for replacement of oil, silica gel, parallel operation of 1 & 3 phase transformer, load sharing calculations (numerical).

Unit 6: Installation

Factors involved in designing the machine foundation, Requirement of different dimension of foundation for static & rotating machines procedure for levelling & alignment of two shafts of directly & indirectly coupled drives, effects of misalignment. Installation of rotating machines as per I.S. 900-1992. Use of various devices & tools in loading & unloading, lifting, carrying heavy equipment.

Text Books:			
S. N.	Author	Title	Publisher
01.	B. V. S. Rao	Operation and Maintenance of Electrical machines Vol - I	Media Promotors & Publisher Ltd. Mumbai
02.	B. V. S. Rao	Operation and Maintenance of Electrical machines Vol - II	Media Promotors & Publisher Ltd. Mumbai

Reference Books:			
S. N.	**Author**	**Title**	**Publisher**
01.	B. L. Theraja	Electrical Technology Vol I to IV	S. Chand & Co., New Delhi
02.	C. J. Hubert	Preventive Maintenance Hand Books & Journals	-----------------

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SoE No. EL-201

VI Semester
EL2381 - OEIV: Electrical Energy Audit and Safety

Course Objectives	Course Outcomes
Understand various operating characteristics of electrical equipments, its monitoring, tools used in comprehensive energy audit and its procedure to save the electricity with and without investment, calculation of energy saving and its global impact	The students will be able to: CO1: Classify, the energy sources, methods of energy conservation and its pattern, electricity act 2003. CO2: Demonstrate, apply and evaluate different forms of electrical and thermal energy. CO3: Demonstrate, apply and estimate the Energy Management, Energy Audit, Energy Monitoring and Targeting. CO4: Explain, develop and determine the various Global Environmental Concerns and Electrical safety procedures. 1) Mapped program outcomes:1,3,5,6,7,8,9,10,12

UNIT-1: Energy Scenario

Commercial and Non-commercial energy, primary energy sources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance. Re-structuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features, Salient Features of Electricity Act 2003.

UNIT-2: Basics of Energy and its various forms
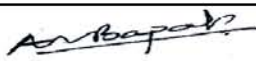
Electricity basics- DC & AC currents, electricity tariff, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

UNIT-3 : Energy Management & Audit

Definition, need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.

UNIT-4: Energy Monitoring and Targeting

Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques - energy consumption, production, cumulative sum of differences (CUSUM).

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VI Semester
EL2381 - OEIV: Electrical Energy Audit and Safety

UNIT-5: Global environmental concerns

United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), Prototype Carbon fund (PCF).

UNIT-6: Electrical Safety

Primary hazards associated with electricity. Control measures and safety-related work practices to minimize the risk associated with electrical hazards. Response procedures in the event of electrical shock or fire.

Text Books:

S. N.	Author	Title	Publisher
01	Archie,W Culp	Principles of Energy Conversion	McGraw Hill
02	Wayne C Turner	Energy Management Handbook Bureau	John Willey and Sons
03		Bureau of Energy Efficiency Study Material for Energy Managersand Auditors Examination	Bureau of Energy Efficiency www.beeindia.in

Reference Books:

S. N.	Author	Title	Publisher
01.	Amit Kumar Tyagi	Handbook on Energy Audit and Management	TERI

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VI Semester
EL2382 - OE IV: Utilization of Electrical Energy

Course Objectives	Course Outcomes
To understand the basic principle of electrical heating, welding, illumination, refrigeration and air conditioning, fans, pumps, compressors and digi sets.	On completion of this course, students will be able to 1. understand working of various electric heating equipment 2. understand electric welding methods and its operation 3. understand nature of light and design various lighting schemes and fittings in use 4. Understand operation of refrigeration , AC system 5. figure-out the different schemes of traction schemes and its main components. Design a suitable scheme of speed control for the traction systems 1) understand economics of various power generating units, tariff

UNIT 1: Electric Heating:

i)   Electric Heating : Types and methods of electrical heating, advantages of electrically produced heat Types & application of electric heating equipment"s, transfer of heat.
ii) Resistance Ovens: General constructions, design of heating elements, efficiency & losses, radiant heating.
iii) Induction heating: Core type & core less induction furnace, indirect induction oven, medium and high frequency eddy - current heating.
iv) Dielectric heating: Principle and application.
v)   Arc furnace: Direct & indirect arc furnace, power supply, characteristics & control.

UNIT-2: Electric Welding:

i)   Importance, Advantages & Disadvantages of welding, classification of welding processes.
ii) Resistance welding, Butt welding, Spot welding, Projection welding, Seam welding.
iii) Electric arc welding: carbon arc welding, metal arc welding, submerged arc welding, Welding positions, Types of welding electrodes
iv) Ultrasonic welding, electron beam welding, laser beam welding.

UNIT-3: Illumination:

Nature of light, terms used in illumination, solid angle, laws of illumination, polar curves, Colour Rendering Index (CRI), types of lamps, luminaries, Design of illumination systems, indoor lighting systems, factory lighting, outdoor lighting design, flood lighting, street lighting, energy saving in lighting systems.

UNIT-4: Refrigeration & Air conditioning:

Terminology, refrigeration cycle, refrigeration systems (Vapour compression, vapour absorption), domestic refrigerator, water cooler, desert cooler.

Air conditioning: Factors involved in air conditioning, comfort air conditioning, industrial air conditioning, effective temperature, summer / winter air conditioning systems, types of air conditioning systems, room air conditioning, and central air conditioning.

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SoE No.
EL-201

VI Semester
EL2382 - OE IV: Utilization of Electrical Energy

UNIT-5: Electric Traction

Traction system, requirement of an ideal traction system, different systems for traction, system of railway electrification, comparison between AC and DC systems, power supply for electric traction system, overhead equipments (collector gear for overhead equipments, conductor-rail equipment)Speed- Time curve for train movement, crest speed, average speed and schedule speed, simplified speed-time curve

UNIT-6: Economics of Power Generation, Electric Power Supply and Utilization

Terms and Definitions, base load and peak load, selection of power plant equipment (boilers, prime-movers, size and number of generating units), economics in plant selection, economics of hydroelectric power plant, economics of combined hydro and steam power plant, performance and operating characteristics of power plants, power plant useful life, tariff for electrical energy, objective and requirements of tariff, general tariff forms, comparison between private generating plant and public supply.

Text books:

S.N	TITLE	EDITION	AUTHOR	PUBLISHER
1	Utilization of Electric Power & Electric Traction		J.B. Gupta	Kataria & Sons
2	Art and Science of Utilization of Electrical Energy		H Pratap	Dhanpat Rai & Sons, Delhi
3	Utilization of Electrical Power		R. K. Rajput	Laxmi Publications Pvt. Ltd.

Reference books:

	TITLE	EDITION	AUTHOR	PUBLISHER
1	Guide book for National Certification Examination for Energy Managers and Energy Auditors			Bureau of Energy Efficiency
2	Utilization of Electrical Power		Dr N. V. Suryanarayana	Wiley Eastern Ltd, New Age International
3	Utilization of Electrical Energy		E.Openshaw Taylor	Orient Longman

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Electrical Engineering

SoE No.
EL-201

VI Semester
EL2383 - OEIV: Power System Engineering

Unit 1: Introduction to Power System

Restructuring of power sector, Constituents of present day power system, sources of electrical energy, types and characteristics of generating stations: Thermal, hydro, nuclear , solar ,wind and other renewable, salient features of electricity act 2003.

Unit 2: Load on Power Stations

Load, Important terms and factors, and Units generated per annum , Load duration curve , Types of loads, Load demand and diversity factors, Load curves and selection of generating units, Base load and peak load on Power station, Method of meeting the load ,Interconnected grid system.

Unit 3: Transmission System I

Electric supply system, A.C power supply scheme, D.C transmission scheme, Comparison of AC and DC transmission system, advantages of A.C. transmission system, Comparison of various transmission system (Two wire dc system, Single phase two wire A.C system, Single phase three wire system , three phase three wire system, Three phase four wire system) Elements of transmission line, Economic choice of transmission voltage, requirements of satisfactory electric supply, Concept of HVDC transmission.

Unit 4: Transmission System II
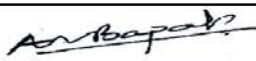
Line support insulators, types of insulators (pin type, suspension type, strain type, shackle type), Commonly used conductor material, concept of corona, factor affecting corona, advantages and disadvantages of corona, methods of reducing corona effect, Sag and its effects, Constants of transmission line (R, L and C) , Resistance of transmission line, skin effect , Classification of overhead transmission line and voltage regulation .

Unit 5: Distribution System

Classification of distribution system, Types of distribution AC and DC, Overhead verses underground system, Requirements of distribution system, Design consideration of distribution system, AC distribution types, Voltage drop calculations in different distribution system , importance of voltage control, location of voltage control equipment and its methods, Tap changing transformer , Concept of tariff, desirable characteristics of tariff, types of tariff.

Unit 6: Introduction to Switchgear

Essential features of switchgear, switchgear equipment's, switches, fuses, circuit breakers, relays, HRC fuses, Bus Bar arrangement (single bus system, One and half feeder ,Main and transfer bus system) , MCB, MCCB, ELCB Introduction to Instrument transformer Current Transformer (CT) and Potential transformer (PT).

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EL-201**

Electrical Engineering

VI Semester
EL2383 - OEIV: Power System Engineering

Text books:

	Title	Edition	Author	Publication
1.	Power System Analysis	1st edition 2007	T.K. Nagsarkar, M.S. Sukhija	Oxford
2.	Principles of Power System	2nd edition 2005	V.K.Mehta, Rohit Mehta	S.Chand
3.	Electrical Power System	5th edition 2007	Ashfaque Hussain	CBS

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ELECTRICAL ENGINEERING

VII Semester
EL- 2401 Switchgear and Protection

Unit No.	Contents	Max. Hrs.
3	**Distance protection** High voltage line Protection: - Distance relays, carrier distance schemes, Generation of various distance relay characteristics using static comparators.	7
4	**Circuit Breaker** **Circuit breakers** Switchgear : Circuit breakers Arc interruption theory, recovery and Restriking voltage ,RRRV, breaking of inductive & capacitive currents, C. B. rating, different media of arc interruption, overview of oil circuit breakers, Air blast, SF6 and vacuum breakers.	6
5	**Equipment Protection** Equipment Protection: Principles of differential relaying, protection, transformers and busbars by differential relaying and other relays. Miniature circuit breakers, moulded case circuit breaker, release, earth leakage circuit breaker.	7
6	**Equipment Protection** **Protection of Generators** Various Faults and Abnormal Operating Conditions, Transverse Differential Protection, Rotor Faults, Abnormal Operating Conditions, Loss of Prime Mover **Protection of Induction Motors** Various Faults and Abnormal Operating , Inter-turn Faults, Abnormal Operating Conditions from Supply Side and Mechanical Side, Overload. Fuse (wire and HRC).	6

Text Books				
SN	Title	Edition	Authors	Publisher
1	Protection and Switchgear	2012	R.P.Maheshwari, Nilesh G.Chothani, Bhavesh Bhalija	Oxford University Press
2	Switchgear and Protection	2003	S.R.Bhide and Y.G. Paithankar	PHI
3	Power System Protection and Switchgear	2007	Badri Ram	TMH.
4	Switchgear and Protection	**1990**	S. S. Rao Khanna	

Reference Books				
SN	Title	Edition	Authors	Publisher
1	The Art and science of protective relaying	**1992**	Russel, Mason	Wiley Eastern
2	Computer relaying for power system	2009	Arun G. Phadke and JamesThorpe	S John Wiley

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ELECTRICAL ENGINEERING

VII Semester
EL 2402 - Lab: Switchgear and Protection

Minimum 8 practicals to be performed

S.N	TITLE
1	Design a protection system to protect system for given fault currents & plot the characteristics of relay used *(IDMT)*
2	Design a protection system to protect system for fault direction & plot the characteristics of relay used
3	Design a protection system to protect system for Reactance fault only & plot the characteristics of relay used
4	Design a protection system to protect system for Impedance type fault & plot the characteristics of relay used
5	Plot the Characteristics of Numerical Relay L&T make *MC61C*
6	Study of Differential Protection Scheme
7	Study of Relay Test set & to verify Relay Characteristics of *ICM21N*
8	Identify Different Circuit Breaking Devices
9	To Study ANSI Device Numbers (ANSI - American National Standards Institute)
10	To study MICOM P430 distance protection relay.
11	To Study Minliec make SPPR & Overload Relay
12	To study Generator Protection Scheme*
13	To study Feeder Protection Scheme*
14	To Study Percentage biased Differential Protection

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ELECTRICAL ENGINEERING

VII Semester
EL2403 - High Voltage Engineering

Objective	Course Outcome
The course objective is understanding of high-voltage phenomena, and the basics of high voltage insulation design with the analytical and modern numerical tools available to high-voltage equipment designers. The areas covered comprise a short but fundamental introduction to dielectric properties of materials, non-destructive tests applicable also to on-site monitoring of power equipment. The purpose of this is to provide information on transient and temporary over voltages and currents in end-user AC power systems	**On completion of this course, the student will be able to** 1) Explain Breakdown of various dielectrics and calculate their breakdown voltage. 2) Explain causes of overvoltage's due to lightning and switching and protective devices used for the same. 3) Explain propagation of travelling waves along with insulation coordination. 4) Explain generation and measurement of high voltage and current. 5) Explain Non-destructive and high voltage testing of electrical apparatus.

CO	Statement	Mapped PO												PSO	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS 1	PS 2
CO	Explain Breakdown of various dielectrics and calculate their breakdown voltage	2	3	1	1								1	2	
CO	Explain causes of overvoltage's due to lightning and switching and protective devices used for the same.	2	3	1	1								1	2	
CO	Explain propagation of travelling waves along with insulation coordination.	2	3	3	1								2	2	
CO	Explain generation and measurement of high voltage and current	2	3	3	1								2	2	
CO	Explain Non-destructive and high voltage testing of electrical apparatus.	2	3	3	1								2	2	

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VII Semester
EL2403 - High Voltage Engineering

Unit No.	Contents	Max. Hrs.
1	**Breakdown Mechanism in Dielectrics** Ionisation process : Townsend"s criterion for breakdown, Break-down in electro-negative gases, Time -lag for breakdown, Streamer theory for breakdown in gases, Paschen's law, Breakdown in non-uniform fields, corona discharges and introduction of corona, post breakdown phenomenon and applications, practical considerations in using gases for insulation purposes, vacuum insulation, liquid as insulators, conduction and breakdown in pure and commercial liquids. Intrinsic electromechanical and thermal breakdown. Breakdown of solid dielectric in practice, breakdown in composite dielectric.	7
2	**Lightning and switching over voltages** Mechanism of lightning types of strokes, parameter and characteristics of lightning strokes, characteristics of switching surges; power frequency over voltages, control of over voltages due to switching. Protection of lines by ground wire, protection by Lightning Arrester (LA), gap type and gapless LA, selection of LA ratings, Surge absorbers.	7
3	**Travelling Waves and Insulation Co-ordination** Travelling waves on transmission lines, classifications of lines, attenuation and distortion of travelling waves, reflection and transmission of waves, behaviour of rectangular waves at transition points. Introduction to insulation co-ordination and associated terms, impulse wave-form, introduction to Basic Insulation Level (BIL), Reduced BIL and Switching Impulse Level (SIL).	6
4	**Generation of High Voltage and Currents** Generation of High D.C. voltages by rectifiers, voltage doubler and multiplier circuits (Derivation not required) electrostatic machines. Generation of high ac voltage by cascade transformers, resonant transformers. Generation of high impulse voltages: Standard impulse wave shapes, analyses of model and commercial impulse generation circuits, waveshape control, Marx Circuit, tripping and control of impulse generation, generation of switching surges, generation of impulse current.	7
5	**Measurement of High Voltage and Current** Measurement of high AC and DC voltages by micro ammeter, generating voltmeters, resistance and capacitance potential dividers, series impedance voltmeter, Capacitive Voltage Transformer (CVT), Magnetic type potential transformers, electrostatic voltmeter, peak reading AC voltmeters, sphere gap arrangement, measurement of impulse voltage by potential dividers and peak reading voltmeters. Measurement of High AC/DC currents: Measurement of high frequency and impulse current by resistive shunts (Bifilar strip shunt only).	7
6	**Non Destructive and High Voltage Testing of Electrical Apparatus** Non-destructive testing : Measurement of DC Resistivity, measurement of dielectric constant and loss-factor (low and power frequency only), Schering bridge for high voltage circuits, for high dissipation factor for three terminal measurements, transformer ratio arm bridges, partial discharge measurements by straight detector, balance detectors, calibration of detectors, discharge detection in power cables. High voltage testing: Testing of insulators, bushings, isolators, circuit breakers, cables, transformers, lightning arresters and power capacitors.	6

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VII Semester
EL2401 : Switchgear and Protection

Objective	Course Outcome
The student should be able to	On completion of this course, the student will be able to
1. The theory and applications of the main components used in power system Protection. 2. The protection systems used for electric machines, transformers, bus bars, Transmission lines. 3. The theory, construction, and applications of main types of circuit breakers. 4. To design the feasible protection systems needed for each main part of a power system.	1) Explain and define the various basic principles of protection system 2) Compare & apply overcurrent protection Principle 3) Develop , Compare & Solve the problems of distance protection. 4) Explain , Justify and Compare the types of circuit breaker 5) Explain, Determine and decide the Equipment Protection

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	Explain and define the various basic principles of protection system	1						1							
CO2	Compare & apply overcurrent protection Principle	1	1	2				1		1		1	1	2	1
CO3	Develop , Compare & Solve the problems of distance protection.	1	1	2				1		1		1	1	2	1
CO4	Explain , Justify and Compare the types of circuit breaker	1		1				1					1	2	
CO5	Explain, Determine and decide the Equipment Protection	1	1	1				1		1		1	1	2	1

Unit No.	Contents	Max. Hrs.
1	**Introduction** <u>General Philosophy of Protective Relaying:-</u> Protective Zones. Primary Protection, Back up protection. Primary and Local Back Up. Desirable properties of relay. <u>Introduction to Static relays: -</u> Comparison of static and electro-mechanical relays, two input amplitude and phase comparators. <u>Introduction to Numerical relays:-</u> Basic elements of digital protection, Signal conditioning subsystem, Conversion system subsystem & Digital processing relay subsystem.	7
2	**Overcurrent Protection** <u>Medium voltage Line Protection:</u> Overcurrent relaying, directional overcurrent relays.	7

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VII Semester
EL2403 - High Voltage Engineering

Text books:

SN	Title	Edition	Author	Publisher
1	EHV AC Transmission	2nd	R.D.Begamudre	New Age international Publisher
2	High Voltage Engineering	3rd -2006	M. S. Naidu and V. Kamaraju	Mc GrawHill Publisher
3	High Voltage Engineering	1st -1994	C.L. Wadhwa	New Age international Publisher

Reference Books

SN	Title	Edition	Authors	Publisher
1	Advances in High Voltage Engineering	2004	M.Haddat and Warne	IET

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VII Semester
EL2404 – Lab : High Voltage Engineering

Minimum 8 practicals to be performed

S.N	TITLE
1	Study of High Voltage Laboratory Equipments.
2	Calibration of Panel Voltmeter by Sphere Gap.
3	Study of Corona effect
4	Study of Movement of arc in horn gap
5	To determine Flash over voltage test: 11 kV pin type insulator.
6	Determination of string efficiency of suspension insulator
7	Determination of breakdown voltage for transformer oil sample
8	Determination of breakdown voltage for solid insulator
9	To study Cable Fault locator
10	Measurement of Resistivity of Transformer oil.
11	Measurement of dielectric constant of transformer oil.
12	Measurement of Loss Angle of transformer oil
13	Study of 100 kV AC/ 140 kV DC test set and calibration of Panel Voltmeter by Sphere gap.
14	Study of 150 kV, 225 Joules Impulse Generator and test on Pin type Insulator.

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ELECTRICAL ENGINEERING

VII Semester
EL2411- PEII: Fundamentals of Power Quality

Objective	Course Outcome
• To introduce students the power quality issues their causes, effects and solutions. • To familiarize students to the synthesis of voltage sag, principle operation, analysis and applications of passive power filter, active power filter and custom power devices. • To provide strong foundation for further study of power quality issues	**On completion of this course, the student will be able to** 1. Illustrate power quality disturbances and typical problems associated with it. 2. Analyse and evaluate the voltage sag. 3. Appraise the fundamentals of harmonics and develop solutions through filters to minimise the harmonic distortion. 4. Plan of mitigating the power quality events through custom power and network configuring devices with applying suitable control strategies

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	Illustrate power quality disturbances and typical problems associated with it	3												1	
CO2	Analyse and evaluate the voltage sag.	3	2											2	
CO3	Appraise the fundamentals of harmonics and develop solutions through filters to minimise the harmonic distortion	3	2	2										2	1
CO4	Appraise the fundamentals of harmonics and develop solutions through filters to minimise the harmonic distortion	3													1

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ELECTRICAL ENGINEERING

VII Semester
EL2411- PEII: Fundamentals of Power Quality

Unit No.	Contents	Max. Hrs.
1	**Overview and definition of power quality** Overview and definition of power quality (PQ): Sources of pollution and regulations, Power quality problems: rapid voltage fluctuations voltage unbalance, Voltage dips and voltage swells, Short duration outages, long duration variations, power acceptability curves.	6
2	**Voltage sag analysis** Definitions Voltage sag analysis: Sag caused by motor starting, Sag caused by utility fault clearing, Sag magnitude and duration calculations, RMS voltage, calculation in single phase systems, Computers, AC and DC drives etc. performance in presence of sag.	7
3	**Harmonics** Power system harmonics: Harmonic analysis, Harmonic sources and their effects, Introduction to power converters, Fourier analysis, Total harmonic distortion, rms & average value calculation, Effects of harmonic distortion on power factor.	7
4	**Filter Design** Filters: passive filters, active filters, hybrid filter design and working principles.	6
5	**Control of APF and configuring devices** Control of APF : Instantaneous reactive power theory (p-q theory) ,Synchronous reference frame theory(d-q theory), Synchronous detection theory, Regulation of DC link voltage and frequency domain control. Network configuring devices: Solid State Current Limiter (SSCL),Solid State Breaker(SSB),Solid State Transfer Switch(SSTS)	7
6	**Custom power devices** Introduction to custom power devices, Dynamic Voltage Restorer (DVR) ,Distribution Static Compensator (DSTATCOM) and Unified Power Quality Conditioner (UPQC), Control strategies, Applications.	7

Text Books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Electrical Power Systems Quality	2nd edition.	R. C. Dugan, M. F. Mcgranaghan	McGraw-Hill
2	Power Quality	1st edition 2002 E book 2017	C. Sankaran	CRC Press
3	Understanding Power Quality Problems: Voltage sag and interruptions	2011	M. H. Bollen Ledwich	Wiley India

Reference books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Power System Harmonics	2nd edition, 2003	J. S. Arillaga	Wiley
2	Power Quality Enhancement using custom power devices	2002	Arindam Ghosh Ledwich	Kluwer Academic Publishers

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VII Semester
EL2412- PEII: Electrical Installation Design

Objective	Course Outcome
The student should be able to To understand and design the methods used in electrical installation for commercial building and the tools used for it as per IE and IS Standards .	On completion of this course, the student will be able to 1) Classify, various techniques used to identify the load pattern. 2) Demonstrate, apply and evaluate the various wires and cables and their tests. 3) Demonstrate, apply and estimate the various types of luminaries and its calculation. 4) Explain, develop and determine the components involves in substation and their function.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	Classify, various techniques used to identify the load pattern.	1													1
CO2	Demonstrate, apply and evaluate the various wires and cables and their tests.	2	1										1		
CO3	Demonstrate, apply and estimate the various types of luminaries and its calculation.	1	2	3		1							2	1	
CO4	Explain, develop and determine the components involves in substation and their function.	3		1			1		1	1			2	2	1

Unit No.	Contents	Max. Hrs.
1	Load forecasting, regression analysis, numerical based on linear and exponential trends, Electrical installation for domestic, commercial and industrial consumers, calculation of connected load, selection of transformers, switchgears, cables and wires, single line diagram, special provisions for high rise buildings (IER-50-A), earthing requirements, megger and earth tests, use of earth leakage circuit breakers (special reference to be given to IER 2 (i, n, o, p, v, aa, aaa, aq, aqq, ar, av).	7
2	Cables: PVC and XLPE cables, their construction in brief, current ratings, specifications, derating factors, Megger and continuity test. Overhead distribution lines upto 33 kV, Line apparatus and basic construction, clearances, selection of AAC and ACSR conductors, voltage drop calculations, Selection of Insulators, earthing requirements. (Special reference to be given to IER 77, 79, 80, 81, 87, 89, 90, 91, 92)	7

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ELECTRICAL ENGINEERING

VII Semester
EL2412:PEII: Electrical Installation Design

Unit No.	Contents	Max. Hrs.
3	Definitions, polar curves, simple calculations, working principles of fluorescent, sodium vapour and mercury vapour lamps, Capacitors and power factor improvement: Determination of rating and location of capacitors, calculation of payback period for additional capacitors.	6
4	Single line diagram, plan, elevation and clearances for 11 kV pole mounted, 11 kV plinth mounted (upto 1000 kVA and above 1000 kVA), 33 kV (upto 2500 kVA and above 2500 kVA) substations. Single line diagram for substation with two transformers in parallel, specifications of isolators, lightening arrestors, horn gap fuses, D.O. fuses, circuit breakers, instrument transformers, power transformers, LV HRC fuses, LV circuit breakers, (Special reference to be given to IER 31, 33, 35, 43, 44, 47, 48, 50, 51, 54, 58, 64, 64A, 67 and IS3043)	7
5	Determination of fault levels of various locations in substation, use of current limiting reactors, philosophy of protective relaying, over current, earth fault, REF protection, earth leakage protection, OTI, WTI, Buchholz relays, Firefighting equipments, restoration of a person affected by electric shock, Earthing: types, measurement of earth resistance.	6
6	Site testing of transformers (Visual, pre-commissioning tests like megger, magnetic balance, turns ratio), testing of oil, operational test for Buchholz, OTI, WTI, alarm and trip functions.	7

Text Books:

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Electric Power	2016	Soni, Gupta, Bhatnagar	Dhanpat Rai Publication
2	Electrical Installation Design	2012	Jain, Bajaj	Laxmi Publication
3	Power Electronics and AC Drives	2003	B.K. Bose	Pearson Education

Reference books:

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Electric Power Distribution Systems	2004	Pabla	McGraw Hill
2	Electrical Substation	1992	S. Rao	Khanna Publication
3	Electrical Engineering handbook	2018	C.L.Wadhwa	New Age International
4	IER (Latest edition)			

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ELECTRICAL ENGINEERING

VII Semester
EL2413- PEII: Electrical Machine Design

Course Objective	Course Outcome
The course will help the students to understand the step by step procedure for the complete design of electrical machine specificifically diameter,length,height aand such other parameters depending on application or requirement	On completion of this course, the student will be able to 1. Classify, select various materials used in construction of electrical machines and interpret their rating and performance 2. Demonstrate, apply and evaluate design parameters of transformer 3. Demonstrate, apply and estimate stator, rotor design of induction motor 4. Explain, develop and determine design parameters of synchronous machine

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO1	PO1	PSO	PSO
CO1	Classify, select various materials used in construction of electrical machines and interpret their rating and performance	3	2	1	1									1	
CO2	Demonstrate, apply and evaluate design parameters of transformer	3	2	1	1									2	
CO3	Demonstrate, apply and estimate stator, rotor design of induction motor	3	2	1	1									2	
CO4	Explain, develop and determine design parameters of synchronous machine	3	2	1	1									3	

Unit No.	Contents	Max. Hrs.
1	**Review of material used in construction of electrical machines** Magnetic material such as amorphous, ferrite etc. Classification of insulating materials depending upon permissible temperature rise, properties of transformer oil, standard specifications, C.M.R. and short time of machines, Heating and cooling characteristics.	6
2	**Transformer design : Main Dimensions** Output equation, equation for voltage per turn for power and distribution transformer, core design, overall dimensions of single phase and three phase transformer.	7

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ELECTRICAL ENGINEERING

VII Semester
EL2413 - PEII: Electrical Machine Design

Unit No.	Contents	Max. Hrs.
3	**Transformer design : Performance Characteristics** Resistance and leakage reactance of winding for concentric cylindrical and sandwich type winding, estimation of no load current , method of cooling and cooling tank design.	7
4	**Induction motors: Stator Design** Total loading, specific loading on the machine, output equation, main dimension, estimation of axial lengths and air gap diameter based on different design criterion, estimation of number of slots, area of slot, stator teeth and stator core dimensions, length of mean turn, stator winding.	7
5	**Induction motor rotor design** Air gap length, no. of rotor slots, cage rotor and wound rotor , Design of rotor bar and slots, design of end ring, design of wound rotor, rotor teeth and rotor core design, Calculation of no load current, stator and rotor resistance and other performance characteristics for design data.	7
6	**Synchronous machines** Types of synchronous machines, Output equation , specific loadings, Design of salient pole (Main dimensions, length of air gap, shape of pole face, armature design) and turbo alternators (Main dimensions , length of air gap, stator and rotor design), Effect of SCR on machine performance, ventilation of synchronous generator, cooling circuit design, Hydrogen and water as cooling media	6

Text Books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Performance and Design of A.C. Machine	1995	M.G. Say.	English L B S
2	Electrical Machine Design	2016	A.K. Sawhney	Dhanpat Rai & Sons, Delhi

Reference books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Electrical Machine Design	3rd	Balbir Singh	Brite Student Publication, Pune
2	Power Transformers	2nd	S.B.VasuBinsky	

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ELECTRICAL ENGINEERING

VII Semester
EL2421- PEII: Power System Operation and Control

Objective	Course Outcome
The student should be able to The student will understand the economic aspects of power system operation, methods of power frequency control, economic dispatch control, reactive power control and voltage control. .	**On completion of this course, the student will be able to** 1. Explain, analyse reserve requirement & load forecasting methods. 2. Analyse optimal scheduling of generating units, determine with the help of flowcharts. 3. Develop and illustrate optimal unit commitment problem & its solution methods. 4. Discuss various methods of voltage control & Load Frequency Control and design of reactive power compensation equipment used for transmission line.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO1	PO1	PSO	PSO
CO1	Explain, analyse reserve requirement & load forecasting methods		3	3									1	1	
CO2	Analyse optimal scheduling of generating units, determine with the help of flowcharts.		3	3									1	1	
CO3	Develop and illustrate optimal unit commitment problem & its solution methods		3	3	2								1	1	
CO4	Discuss various methods of voltage control & Load Frequency Control and design of reactive power compensation equipment used for transmission line.		1	1	2								1	1	

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ELECTRICAL ENGINEERING

VII Semester
EL2421:PEII: Power System Operation and Control

Unit No.	Contents	Max. Hrs.
1	**Economic Aspects** Introduction, system load characteristics curves-chronological load curves-load duration curves-energy time curves load factor utilization factor-diversity factor- coincidence factor- demand factor- reserve requirements installed reserve- spinning reserve- cold reserve- hot reserve – operational restrictions, load dispatching.	6
2	**Pre requisite of Load Dispatching** Load forecasting- components of system load- classification of base load- forecasting of the base load by method of least square fit introduction to unit commitment, unit commitment using priority ordering.	7
3	**Load Frequency Control (LFC)** Introduction, necessity of maintaining frequency constant, Load frequency Control, Governor Characteristics of single Generator, Adjustment of Governor Characteristic of Parallel Operating Unit, LFC (P-f control) Q-V Control, Generator Controller (P-f control & Q-V controllers), P-f control versus Q-V control, Dynamic Interaction between P- F and Q-V Loops, Speed-Governing System, Control Area Concept, Incremental Power Balance of Control Area, Requirements of the Control Strategy, Integral control, Concept of two area.	7
4	**Economic Dispatch Control** Incremental cost curve- co-ordination equations with loss included (No derivation of B_{mn} coefficient) solution of co- ordination equations using B_{mn} co-efficient by iteration method Base point & participation factors- Economic dispatch controller added to LFC.	7
5	**Reactive Power Control** Introduction, objective of load compensation, theory of load compensation, uncompensated transmission line, compensated transmission line, shunt compensator, series compensator, basic relationship for power flow control, Sub synchronous resonance, comparison of different types of compensating equipment for transmission systems,	6
6	**Voltage Control** Introduction, necessity of voltage control, generation and absorption of reactive power, location of voltage control equipment, methods of voltage control, rating of synchronous phase modifier.	7

Text Books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Power System Operation and control	1st edition	S. Sivanagarju and G. Srinivasan	Pearson Publisher
2	Power System Stability and control	1st edition	P. Kundur	TMH Publisher
3	Electrical Power system	6th edition	C. L. Wadhwa	New Age International Pvt Ltd Publisher
4	Economic Operation of power system studies	3rd edition 2010	L. K. Kirchmayer	Wiley Eastern India, New Delhi

Reference books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Power Generation, Operation and control	2nd Edition	A. J. Wood and B.F. Woolenberg	John Wiley & Sons
2	Power System: Operation & Control	1st edition, 2013	Dr. K. Uma Rao	Wiley

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ELECTRICAL ENGINEERING

VII Semester
EL2422- PEIII: FACTS Devices

Objective	Course Outcome
The student should be able to To understand the problems and constraints related with stability of large interconnected systems and to study their solutions using different FACTS Controllers, Shunt (SVC,STATCOM),Series (TCSC,GCSC,SSSC),Series Shunt(UPFC),Series Series(IPFC)	**On completion of this course, the student will be able to** 1. Define FACTS Concept, various FACTS Controllers, its classification and explain its applications in Transmission system. 2. Explain, show, implement and design different shunt and series compensators and its control schemes 3. Demonstrate, examine and apply voltage and phase angle regulators in power system 4. Extend, apply and analyze the FACTS concept using combine series-shunt and series-series controllers to evaluate the improved transmission system performance

CO	Statement	Mapped PO												PSO	
		PO 1	PO 2	PO 3	PO 4	PO	PO	PO	PO	PO	PO 10	PO 11	PO 12	PS 1	PS 2
1	Define FACTS Concept, various FACTS Controllers, its classification and explain its applications in Transmission system.	1												1	
2	Explain, show, implement and design different shunt and series compensators and its control schemes	1	2	2										3	
3	Demonstrate, examine and apply voltage and phase angle regulators in power system	1	2	2										3	
4	Extend, apply and analyze the FACTS concept using combine series-shunt and series-series controllers to evaluate the improved transmission system performance	1	2	2										3	

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VII Semester
EL2422- PEIII: FACTS Devices

Unit No.	Contents	Max. Hrs.
1	**Flexible AC Transmission Systems (FACTS)** FACTS concept and General System Consideration, Transmission interconnections, Flow of power in an AC System, factors affecting the Loading Capability, power flow and Dynamic Stability Consideration of Interconnected Transmission. Importance of controllable Parameters, FACTS Controller. HVDC and FACTS.	7
2	**Static shunt compensators** SVC and STATCOM, Objectives of Shunt Compensation, Methods of Controllable Var Generation, Static Var Compensators SVC and STATCOM,Control scheme for SVC and STATCOM ,Comparison between STATCOM and Static Var System (SVS).	7
3	**Static Series Compensators** GCSC, TSSC, TCSC and SSSC, Objectives of series Compensation, Variable Impedance Type Series compensators, Switching Converter Type Series Compensators, Control Schemes for GCSC,TSSC,TCSC and SSSC, External (System) Control for Series Reactive Compensators	6
4	**Static Voltage and Phase Angle Regulators** TCVR and TCPAR, Objectives of Voltage and phase angle regulators, Approaches to Thyristor Controlled Voltage Regulators (TCVR) and Thyristor Controlled Phase Angle Regulators (TCPAR), Switching Converter- Based Voltage and Phase Angle regulators, Hybrid Phase Angle Regulators.	7
5	**Shunt-Series Compensators:UPFC** Shunt series Compensators UPFC, Operating modes of UPFC, Basic control system for P and Q control,Comparison of UPFC to Series Compensators and Phase angle regulators.	6
6	**Other FACTS Controllers** Series –series compensators IPFC,Basic structure and operation,Thyristor controlled braking resistor	7

Text Books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Understanding FACTS	2001	Narayan G.Hingorani	Standard Publishers
2	FACTS : Controllers in Power	1st edition 2007	K. R. Padiyar	New Age International
3	Transmission & Distribution	1st edition 2002	R. Mohan Mathur, Rajiv K Verma	Wiley

Reference Books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Flexible AC Transmission System(FACTS)		Edited by Yong Hua and Johns	IEEE Press

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ELECTRICAL ENGINEERING

VII Semester
EL2423:PEIII: Electrical Energy Management And Audit

Objective	Course Outcome
The student should be able to Understand various operating characteristics of electrical equipments, its monitoring, tools used in comprehensive energy audit and its procedure to save the electricity with and without investment, calculation of energy saving, its global impact and its performance evaluation.	On completion of this course, the student will be able to 1. Classify, the energy sources, methods of energy conservation and its pattern, electricity act 2003. 2. Demonstrate, apply and evaluate different forms of electrical and thermal energy. 3. Demonstrate, apply and estimate the Energy Management, Energy Audit,Energy Monitoring and Targeting. 4. Evaluating the Performance of Electric Motor and variable Speed drivesand cogeneration systems.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS 1	PS 2
1	Classify, the energy sources, methods of energy conservation and its pattern, electricity act 2003.	1				1	1		1				2	1	1
2	Demonstrate, apply and evaluate different forms of electrical and thermal energy	1	1			1				1		1			1
3	Demonstrate, apply and estimate the Energy Management, Energy Audit,Energy Monitoring and Targeting	1	1	1		1	2			1			2	1	1
4	Evaluating the Performance of Electric Motor and variable Speed drivesand cogeneration systems.	1	1		3					2			2	1	2

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ELECTRICAL ENGINEERING

VII Semester
EL2423:PEIII: Electrical Energy Management And Audit

Unit No.	Contents	Max. Hrs.
1	**Energy Scenario** Commercial and Non-commercial energy, primary energy sources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance. Re-structuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features, Salient Features of Electricity Act 2003.	6
2	**Basics of Energy and its various forms** Electricity basics- DC & AC currents, electricity tariff, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion	7
3	**Energy Management & Audit** Definition, need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.	7
4	**Energy Monitoring and Targeting** Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques - energy consumption, production, cumulative sum of differences (CUSUM).	7
5	**Performance Evaluation of Electric Motor and variable Speed Drives** Methods for determining motor loading, methods of determining motor efficiency, evaluating performance of rewound motors, variable speed drive: principles and applications, factors for successful implementation of variable speed drive.	7
6	**Captive and Cogeneration Systems** Introduction, purpose of the performance test, performance terms and definitions, reference standards, field testing procedure, examples, Case study of bottoming cogeneration in industries.	6

Text Books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Principles of Energy Conversion		Archie,W Culp	McGraw Hill
2	Energy Management Handbook		Wayne C Turner	John Willey and Sons
3	Bureau of Energy Efficiency Study Material for Energy Managers and Auditors Examination			Bureau of Energy Efficiency www.beeindia.in

Reference books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Handbook on Energy Audit and Management		Amit Kumar Tyagi	

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ELECTRICAL ENGINEERING

VII Semester
EL2424 - PEIII: ADVANCED CONTROL SYSTEM

Objective	Course Outcome
The student should be able to elaborate concept of compensation in control system. Compensation design is explained. Optimal control and sample data control system is also discussed in this subject	On completion of this course, the student will be able to 1) Explain concept of lag and lead compensator design in time and frequency domain, theory of PI, PD and PID control in time domain and frequency domain. 2) Illustrate and apply state variable approach with solution of state models and concepts of controllability, observability and state variable feedback. 3) Classify and analyse non-Linear Control System, types of non-linearities, its characteristics. Students will also be able to demonstrate and apply different methods of evaluating non-linear control like describing function method and phase plane method for stability analysis. 4) Explain sample data control system, Stability analysis with Z-transforms and solution of discrete time systems.

CO	Statement	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	Explain concept of lag and lead compensator design in time and frequency domain, theory of PI, PD and PID control in time domain and frequency domain.	2	1	1	1								1	1	3
2	Illustrate and apply state variable approach with solution of state models and concepts of controllability, observability and state variable feedback.	3	2	1											3
3	Classify and analyse non-Linear Control System, types of non-linearities, its characteristics. Students will also be able to demonstrate and apply different methods of evaluating non-linear control like describing function method and phase plane method for stability analysis.	3	2		1									1	3
4	Explain sample data control system, Stability analysis with Z-transforms and solution of discrete time systems.	3	2		1										3

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ELECTRICAL ENGINEERING

VII Semester
EL2424:PEIII: ADVANCED CONTROL SYSTEM

Unit No.	Contents	Max. Hrs.
1	**UNIT-1: Compensation** Compensation: - Review of performance Analysis of type O, type 1 & type 2 systems. Need for compensation. Performance Analysis of Compensators in time & frequency domain, Bode Plots and Design of Compensators.	6
2	**Design of PID Controller:** Fixed configuration design, theory of PI, PD and PID control in time domain and frequency domain, Zeigler Nichol"s method of PID tuning.	7
3	**State variable Feedback** Design by State variable Feedback: Review of state variable representations. Solution of state equation Controllability & observability, Design of State Feedback.	7
4	**Non Linear control system (NLCS)** Non Linear Control System: Types of non-linearities, characteristics of NLCS. Inherent & intentional non- linearities. Describing function method for Analysis Describing functions of some common non-linearities. Stability analysis. Limit cycles & stability of limit cycles.	7
5	**Phase -Plane Method** Phase -Plane Method:Singular points stability from nature of singular points Construction of trajectory by Isocline and Delta Method Computation of time.	6
6	**Sample Data control System (SDCS)** Sample Data control System; - Representation of SDCS, Sample and Hold Circuit Z-Transform, Inverse Z- Transform & solution of difference equation "Z" & "S" domain relationship. Stability by Bi-linear transformation & Jury"s test. Discretization of continuous time state equation.	7

Text Books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Control Systems Analysis	4th edition2008	I.J.Nagrath, M.Gopal	
2	Modern Control Theory	2014	M.Gopal	New Age International Private Limited

Reference books

S.N	TITLE	EDITION	AUTHOR	PUBLICATION
1	Modern Control Engineering	4th	Katsuhiko Ogata	Prentice Hall Pearson Edcation International
2	Automatic Control Systems	9th	B C..Kuo Farid Golnaraghi	WILEY
3	Modern Control System		B.C.Kuo	2003

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VII Semester
EL 2425 - PEIII: ARTIFICIAL INTELLIGENCE BASED SYSTEM

Objective	Course Outcome
The student should be able to understand the concept of fuzzy logic and neural network and the basic concepts and mathematical models of fuzzy and neural network are covered	On completion of this course, the student will be able to 1) Recall, explain, solve and analyse the principles of fuzzy logic and control. 2) Explain and discuss adaptive fuzzy control. 3) Explain, analyse and solve problems in basic neural networks and associative memories 4) Explain, analyse and solve problems on recurrent networks and neural control.

CO	Statement	Mapped PO												PSO	
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	Recall, explain, solve and analyse the principles of fuzzy logic and control.	3	3	2	1									3	3
2	Explain and discuss adaptive fuzzy control.	3	3	2	1									3	3
3	Explain, analyse and solve problems in basic neural networks and associative memories	3	3	2	1									3	3
4	Explain, analyse and solve problems on recurrent networks and neural control.	3	3	2	1									3	3

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ELECTRICAL ENGINEERING

VII Semester
EL 2425 - PEIII: ARTIFICIAL INTELLIGENCE BASED SYSTEM

Unit No.	Contents	Max. Hrs.
1	**Introduction:-** Fundamental concepts of fuzzy systems Fuzzy sets, Approximate reasoning Representing set of rules. Fuzzy knowledge based (FKBC) parameters. Introduction rule and data base inference engine, choice of fuzzification and defuzzification processes.	6
2	**Nonlinear fuzzy control** Introduction, Control problem, FKBC as nonlinear transfer element, types of FKBC.	7
3	**Adaptive Fuzzy control** Introduction, design and performance evaluation, main approach to design.	7
4	**Artificial Neural Network** Fundamental concept of ANN. Model of artificial neural network (ANN), Learning & adaptation learning rules. **Feed forward networks:** Classification Model, features & decision, regions, Minimum distance classification, perceptron, delta learning rules for multi perceptron layer, generalized learning rules, back propagation algorithm, back propagation training, learning factors.	7
5	**Recurrent networks** Mathematical foundation of discrete time & gradient type Hopfield networks, transient response & relaxation modeling.	7
6	**Associative memories, self-organizing networks and Neural Control** Basic concept & recurrent associative memory, Bi-directional associative memory, Hamming net & MAXNET Unsupervised learning of clusters, , feature mapping, self-organizing feature maps, Basics of Neural Network Control, Predictive Control.	6

Text books

S.N	Title	Year/Edition	Author	Publisher
1	Introduction of Artificial Neural Networks	1992	Jacek Zurada	JPH
2	An Introduction to Fuzzy Control	2010	D. Drianko	Springer
3	Design of Neural Networks	2nd edition	Hagen,Demuth,Beale	Cengage Learning,ISBN-10:0-9717321-1-6,ISBN-13:978-0-9717321-1-7

Reference books

S.N	Title	Year/Edition	Author	Publisher
1	Neural Network & Fuzzy Systems	1992	Bart Kosko	Prentice Hall of India
2	Neural Networks	2009	Simon Haykin	(Maxwell) Macmillan Canada Inc.)
3	Fuzzy ets:Uncertainty and information	1988	Klir and Folger	Prentice Hall of India
4	MATLAB Toolbox			

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ELECTRICAL ENGINEERING

VII Semester
EL 2431 - PEIV: ADVANCED ELECTRICAL DRIVES

Objective	Course Outcome
The student should be able 1) To study the converter and Chopper control of DC drives. 2) To study the semiconductor based control of Induction and Synchronous motors. 3) To learn the basics of Switched reluctance motor and Brushless DC motor. 4) To Study the non-conventional and renewable energy based drives	On completion of this course, the student will be able to 1) Analyse and determine the converter parameters of bridge and chopper controlled DC drives. 2) Analyse the various schemes for Induction motor control and estimate the parameters of converters for Induction motor drives. 3) Explain synchronous motor, stepper motor and switched reluctance motor drives. 4) Explain and compare the various drives used in electrical traction and explain solar and battery powered drives.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	Analyse and determine the converter parameters of bridge and chopper controlled DC drives	3	2	2	1										2
CO2	Analyse the various schemes for Induction motor control and estimate the parameters of converters for Induction motor drives	3	2	2	1										2
CO3	Explain synchronous motor, stepper motor and switched reluctance motor drives	3	2	2	1										2
CO4	Explain and compare the various drives used in electrical traction and explain solar and battery powered drives.	3	2	2	1										2

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ELECTRICAL ENGINEERING

VII Semester
EL 2431 - PE IV: ADVANCED ELECTRICAL DRIVES

Unit No.	Contents	Max. Hrs.
1	**Introduction to Electric Drives** Dynamics of electric drives and control of electric drives, Fundamental Torque equation, Control Schemes, Power modulator, Four Quadrant operation, Energy conservation in electric drives.	6
2	**D.C. Drives** Controlled rectifier fed D.C. drives, single phase and three phase rectifier control of Separately excited D.C. motor; Dual Converter control of separately excited D.C. motor; Power factor, supply harmonics and ripples in motor current; Chopper controlled of separately excited dc motor; chopper control of series motor; source current harmonics.	7
3	**Induction Motor Drives** Stator voltage control, V/f control, static rotor resistance control, slip power recovery schemes, variable frequency control using voltage source inverter. Current sources inverter and cyclo converter, Introduction to vector control of Induction motor	7
4	**Synchronous Motor Drives** Starting and Braking of Synchronous motor; variable frequency control; self-controlled synchronous motor drive employing load commutated thyristor inverter , Introduction of Cyclo-converter control of Synchronous motor; starting of large synchronous motors.	7
5	**Special Motors Drives** Brush less dc motor, stepper motor switched reluctance motor drives and eddy current drives. Introduction to solar and battery powered drives.	7
6	**Traction Drives** DC and AC traction drives, semiconductor converter controlled Drives; 25 KV AC traction using semi conductor converter controlled DC motor; DC traction using semiconductor chopper controlled dc motors; polyphase AC motors for traction drives.	6

Text books

S.N	Title	Year/Edition	Author	Publisher
1	Fudamentals of Electric drives	2nd Edition	G. K.Dubey	Narosa Publications
2	Modern Electric Traction	2003	H.Pratap	Dhanpat Rai & Company
3	Electric drives concepts and applications	2005	V.Subramaniam	Tata McGraw Hill
4	Electric Motor Drives	2001	R. Krishnan	Prentice Hall India

Reference books

S.N	Title	Year/Edition	Author	Publisher
1	Electrical Machines Drives and Power Systems	6th edition 2008	Theodore Wildi	Pearson Education

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ELECTRICAL ENGINEERING

VII Semester
EL 2432 - PE IV: FUNDAMENTALS OF SMARTGRID

Course Objectives	Course Outcomes
- To introduce the students with basics of Smart Grid. - To inform about components and communication tools of smart grid. - To explain methodology to identify computational tools and performance analysis of smart grid. - Knowledge about Strategic issues related with sustainable development, storage and renewable energy.	**The student should be able to:** 1. To compare conventional and smart grid and illustrate role of stake holders and functions of smart grid. 2. To identify components and computational tools for smooth functioning of smart grid. 3. To determine the performance of smart grid based on congestion, security and contingency studies for optimal solutions. 4. To discuss designing of smart grid with options like automation, sustainable energy and storage.

CO	Statement	Mapped PO												PSO	
		PO	PO	PO	PO	PO	PO	PO	PO	PO	PO 10	PO 11	PO 12	PS 1	PS 2
1	To compare conventional and smart grid and illustrate role of stake holders and functions of smart grid	2	1				1							3	
2	To identify components and computational tools for smooth functioning of smart grid	2				2	3						1	2	
3	To determine the performance of smart grid based on congestion, security and contingency studies for optimal solutions.	3	2		2	2	2						1	2	
4	To discuss designing of smart grid with options like automation, sustainable energy and storage.	2		3	2	2	1	3	1		1	1	1	3	

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VII Semester
EL 2432 - PE IV: FUNDAMENTALS OF SMARTGRID

Unit No.	Contents	Max. Hrs.
1	**Introduction to Smart Grid & Power System Enhancement:** Introduction to smart grid, Comparison between Present grid and Smart grid, Electricity Act 2003, Energy Conservation Act 2001, Energy Independence and Security, computation intelligence, Communication Standards, Environment and Economics. General view of the Smart grid market drivers, Function and role of stakeholder, Smart grid based performance measures, Representative Architecture, Functions of smart grid components	6
2	**Smartgrid Communications :** Communication and measurement, Monitoring, PMU, Smart meters, Measurement technologies, GIS and Google mapping tools, multi agent technology, microgrid and smart grid comparison.	7
3	**Performance Analysis Tools for Smart grid Design** Congestion management effect, load flow for smart grid design, Static Security assessment (SSA) and contingencies, Contingencies and their classification, contingency studies for smart grid.	7
4	**Computational Tools for Smart grid Design** Introduction to computational tools, Decision support Tools (DS), Heuristic Optimization, Evolutionary Computational Techniques, Adaptive Dynamic Programming Techniques, Hybridizing optimization techniques and applications to the smart grid, Computational Challenges.	7
5	**Pathway for designing Smart grid:** Introduction to Smart Grid Pathway Design, Barriers and Solutions to Smart Grid Development, General Level Automation, Bulk Power Systems Automation of the Smart Grid, Distribution System Automation Requirement of the Power Grid, End User/Appliance Level of the Smart Grid, Applications for Adaptive Control and Optimization.	7
6	**Renewable Energy and Storage:** Sustainable energy options for the smart grid, Penetration and variability issues associated with sustainable energy technology, Demand-response issue, Electric vehicles and Plug-in Hybrids, PHEV Technology, Environmental Implications, Storage Technologies, Tax Credits.	6

Text books:

	TITLE	YEAR	AUTHOR	PUBLICATION
1	Smart Grid: Fundamentals of Design and Analysis	2012	James Momoh	Wiley

Reference books:

	TITLE	YEAR	AUTHOR	PUBLICATION
1	Smart Grid: Technology and Applications	March 2012	JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama	Wiley

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VII Semester

EL 2433 - PE IV: COMPUTER METHODS IN POWER SYSTEM

Course Objectives	Course Outcomes
The student should be able to 1. The theory and applications of the main components used in power system Protection. 2. The protection systems used for electric machines, transformers, bus bars, Transmission lines. 3. The theory, construction, and applications of main types of circuit breakers. 4. To design the feasible protection systems needed for each main part of a power system.	**The student should be able to:** 1) Explain, different types of Matrix using graph theory , Apply different methods to Build & Develop the A, B, C, K and Bus Impedance Matrix 2) Classify, Compare, Make use of different methods and Analyze Load Flow studies 3) Analyze & Inspect the system for different types of faults 4) Analyze & make use of different methods for Transient Stability Studies

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	Explain, different types of Matrix using graph theory , Apply different methods to Build & Develop the A, B, C, K and Bus Impedance Matrix	1	1	2		1				1			1		
2	Classify, Compare, Make use of different methods and Analyze Load Flow studies	1	1	2		1				1			1	2	1
3	Analyze & Inspect the system for different types of faults	1	1	2		1		1	1				1	2	1
4	Analyze & make use of different methods for Transient Stability Studies	1	1	1		1		1	1				1	2	

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VII Semester
EL 2433 - PE IV: COMPUTER METHODS IN POWER SYSTEM

Unit No.	Contents	Max. Hrs.
1	**UNIT-1: Incidence and network matrices** Incidence and network matrices: - Graph incidence Matrices, Primitive network, formation of network matrices by singular transformations	6
2	**Algorithm for single phase network** Algorithm for formation of Bus Impedance and Bus Admittance matrix for system without mutual coupling	7
3	**Three Phase Networks** Three Phase Networks: - Three phase balance network elements with balanced and unbalanced excitation incidence and network matrices for three phase element Algorithm for formation of three phase bus impedance matrices without mutual coupling	6
4	**Short circuit studies** Short circuit studies: Three phase network short circuit calculations using bus impendence matrix for balanced and unbalanced faults. Computer programme for short circuit studies on simple system	7
5	**Transient stability studies** Transient stability studies: Modelling of synchronous machine, power system network for transient stability studies. Numerical solution of swing equation by modified Euler and Runge Kutta 4th order method..	7
6	**Load Flow Studies** Load Flow Studies: Power system load flow equation, solution technique: Gauss Seidal , Newton Raphson and fast decoupled technique with and without (voltage) control buses. Representation of tap changing and phase shifting transformers. Elementary load flow programmes	7

Text books:

S.N	TITLE	EDITION	AUTHOR	PUBLISHER
1	Computer Methods in Power Systems	1st 1968	Stag and El – Abiad	Mc Graw Hill
2	Elements of Power System Analysis	1982	William D.Stevenson	Mc Graw Hill

Reference books:

	TITLE	EDITION	AUTHOR	PUBLISHER
1	Computer Analysis in Power System Modern Power System Analysis	1982	R.N.Dhar	Mc Graw Hill
2	Modern Power System Analysis	3rd-2006	D.P.Kothari and I.J.Nagrath	TMH

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ELECTRICAL ENGINEERING

VII Semester
EL 2434 - PE IV: EHVAC-HVDC TRANSMISION

Objective	Course Outcome
The student should be able The student will understand the various aspects of transmission system, systems for power flow control, design parameters of filters and layout of HVDC power plant .	On completion of this course, the student will be able to 1) Design and analyse Power handling capacity of EHVAC Transmission systems. 2) Explain and analyse Corona, the concept of Electrostatic and electromagnetics, Electrical safety. 3) Demonstrate , Classify HVDC Transmission system , Analyse the methods of HVDC Control. 4) Design of Harmonic filters and reactive power configuration, HVDC Circuit breaker and Types and applications.

CO	Statement	Mapped PO												PSO	
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	Design and analyse Power handling capacity of EHVAC Transmission systems	3	2	1									1	1	
CO2	Explain and analyse Corona, the concept of Electrostatic and electromagnetics, Electrical safety	3	2				3						1		
CO3	Demonstrate , Classify HVDC Transmission system , Analyse the methods of HVDC Control	2	3										1		
CO4	Design of Harmonic filters and reactive power configuration, HVDC Circuit breaker and Types and applications	3	2	2									1		1

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ELECTRICAL ENGINEERING

VII Semester
EL 2434 - PE IV: EHVAC-HVDC TRANSMISION

Unit No.	Contents	Max. Hrs.
1	**Power handling and voltage gradient** 1) Power handling capacities of EHV AC transmission lines. 2) Voltages gradients: Electric field of point charge, sphere gap line-charge. Single and three phase lines, and bundled conductors. Maxwell"s potentials coefficients.	6
2	**Electrostatic and electromagnetic fields of EHV lines & corona** 1) Electrostatic and electromagnetic fields of EHV lines, electric shock and Threshold current , calculation of electrostatic field of A.C. lines (3 phase single and double circuit lines only). Effect of high electrostatic field. 2) Corona: Types, critical disruptive voltages, Factors affecting corona, Methods for reducing corona power loss (empirical formula), corona current waveform, audible noise and radio interference.	7
3	**HVDC Power transmission** DC Power transmission technology: Introduction, comparison of AC and DC Transmission, application of DC transmission, Description of DC transmission system, configuration, planning for HVDC transmission, types of DC link. Introduction to HVDC light, Earth electrode and earth returns. Introduction, objectives, location and configuration, resistance of electrodes, means of reducing earth electrode resistance	7
4	**Analysis of HVDC converters** Analysis of HVDC converters: Pulse number, choice of converter configuration, simplified Graetz circuit, converter bridge characteristics, characteristics of twelve pulse converter Power flow control in HVDC system :- Constant current. Constant voltage, constant ignition and excitation angle control, control characteristics.	7
5	**Harmonic Filters & Reactive power compensation** Harmonic Filters :- Introduction, Filters, surge capacitors and damping circuits, shunt filters, series filters, AC filters, design of AC filters and tuned filters, double frequency and damped filters, cost considerations and ratings. Harmonics on D.C side of converters. DC Harmonics filters. - Reactive power requirement of HVDC converters, substations.	6
6	**HVDC circuit breakers** HVDC circuit breakers: - Introduction, construction and principle of operation. Interruption of DC current, application of MRTB, Type of HVDC circuit breaker, capability and characteristics of HVDC circuit breakers	7

Text books:

	Title	Edition	Author	Publication
1.	EHV AC & HVDC Transmission & Distribution	3rd-2006	S. Rao	Khanna
2.	EHV AC Transmission	2nd	Begamudre	New Age international Publisher
3.	Power system Stability and Control	2nd - 2006	P. Kundur	Publisher

Reference books:

1	HVDC Power Transmission System	1982	R.N.Dhar	Publisher

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VIII Semester
EL2451 - Major Project

COURSE OBJECTIVES	COURSE OUTCOME
1. To apply knowledge of mathematics, science and engineering in a global, economic, environmental and societal context and engage in life-long learning. 2. To design a model, a system or components considering environmental, economic, social, political, ethical and sustainability and analyze and interpret the data. 3. To work on multidisciplinary teams, tackle engineering problems, understand professional and ethical responsibility and communicate effectively. 4. To apply knowledge of contemporary issues and use the techniques, skills, and modern engineering tools necessary for engineering practices. 5. To analyze and design RCC & steel structures, draw and prepare cost estimates of civil engineering structures.	On successful completion of the course students will be able to: 1. Demonstrate a sound technical knowledge of their selected project topic. 2. Undertake problem identification, formulation and solution. 3. Design engineering solutions to complex problems utilizing a systems approach including ability to work in a team. 4. Communicate effectively to discuss and solve engineering problems.

Mapped Program Outcomes : 1,2,3,4,5,6,7,8,9,10,11,12 **PSO** : i,ii,iii

The group of students will continue to work for the project allotted previously and will submit a project report based on their studies. Evaluation will be done continuously and viva voce conducted at the end of the semester.

VIII Semester
EL2452 - Extra-Curricular Activity Evaluation

COURSE OBJECTIVES	COURSE OUTCOME
1. To expose to culture and tradition. 2. To provide opportunity for student to perform and present their hidden talent, still and art. 3. To nurture hobbies. 4. To organize co-curricular activities to make competitive spirit, cooperation, leadership, diligence, punctuality, team spirits. 5. To develop creative talent, self-confidence, sense of achievement. 6. To be able to design process on environmental, social, political, ethical, health and safety. 7. To develop broad education to understand the impact of engineering solution in a global economic, environmental, society.	1. An ability to work initially as well as part of team to achieve set goals. 2. An ability to work to serve society and for betterment of society. 3. An ability to communicate with people at large.
Mapped Program Outcomes : 5,6,7,9,10,11	

Due credits will be given to the students based on their performance and involvement in different extra and co-curricular activities conducted within the college or by other organizations/ institutions. Due credit will also be given to the student if they are successful in different competitive examinations conducted by different organizations. The guidelines as given in academic regulations will be followed for evaluation.

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ELECTRONICS & COMMUNICATION ENGINEERING

VII Semester
ET2412 – PE III: Data compression and encryption

Course Objective	Course Outcome
Students should be able to	Students will be able to
1. Understand text, audio and video compression techniques.	1. Implement text, audio and video compression techniques.
2. Understand data security issues	2. Describe data security issues
3. Understand Symmetric and Asymmetric Key Cryptography schemes.	3. Implement Symmetric and Asymmetric Key Cryptography schemes.
4. Understand network security.	4. Describe network security issues.

Unit 1. Introduction to Data Compression

Data Compression : Modelling and Coding, Statstical Modelling, Dictionary Schemes, LZ, Lossy Compression

Shannon – Fano Algorithm, Huffman Algorithm, Adaptive Huffman Coding

Difficulties in Huffman Coding, Arithmetic Coding – Decoding, Dictionary Based Compression, Sliding Window

Compression: LZ-77, LZ-78, LZW   **(6 hours)**

Unit2. Image Compression

DCT, JPEG, JPEG – LS, Differential Lossless Compression, DPCM, JPEG – 2000 Standards   **(6 hours)**

Unit 3. Video and Audio Compression

Analog Video, Digital Video, MPEG – 2, H – 261 Encoder and Decoder Sound, Digital Audio, μ-Law and A-Law

Companding, MPEG – 1 Audio Layer (MP3 Audio Format)   **(6 hours)**

Unit 4. Data Security

Security Goals, Cryptographic Attacks, Techniques Symmetric Key: Substitution Cipher, Transposition Cipher ,

Stream and Block Cipher DES, AES   **(6 hours)**

Unit 5. Number Theory and Asymmetric Key Cryptography

Prime Numbers, Fermat's and Euler's Theorem, Chinese Remainder Theorem, Discreet Logarithms

Principles of Public Key Crypto System, RSA Key Management, Deffie-Hellman Key Exchange

Message Integrity, Message Authentication and Hash Functions, SHA, H MAC, Digital Signature Standards

(6 hours)

Unit 6. Network Security

Email, PGP, S/MIME, Intrusion Detection System Web Security Considerations, SSL Architecture, SSL Message

Formats, TLS, Secure Electronic Transactions Kerberos, X.509 Authentication Service, Public Key Infrastructure

(6 hours)

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VII Semester
ET2412 – PE III: Data compression and encryption

Text books:

1	The Data Compression Book	Mark Nelson, Jean-Loup Gailly	2nd edition	BPB Publications
2	Cryptography and Network Security Principles and Practices	William Stallings	5th Edition	Pearson Education.
3	Introduction to Data Compression		2nd edition	Morgan Kaufmann

Reference books:

1	Cryptography and Network Security, Tata McGraw-Hill.	BehrouzA. Forouzan	2nd edition	Tata McGraw-Hill.

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YCCE-ET-10

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VII Semester
ET 2413 –PE III : Analog VLSI Design

Prerequisites	-----------
Course Objective Students should be able to 1. Understand the concept and basics of small signal model of MOS transistor &Perform analysis of single stage amplifiers with or without load 2. Understand small signal parameters of Differential Amplifier. 3. Understand current mirrors as bias element and single stage amplifiers in frequency domain 4. Study Performance parameters of CMOS op amp	**Course Outcome** Students will be able to 1. Analyze small signal model of MOS transistor &Perform analysis of single stage amplifiers with or without load. 2. Analyze small signal parameters of Differential Amplifier. 3. Analyze Performance parameters of CMOS op amp. 4. Analyze Performance parameters of converters.

UNIT-1 Basic MOS Device Physics

Threshold voltage, Derivation of I/V characteristics, second order effects, MOS device capacitance, MOS small signal models, MOS SPICE models

(06 Hours)

UNIT-2: Single stage amplifiers

Basic concept, common source, common source stage with resistive load, CS stage with source degeneration, source follower, common gate. **(06 Hours)**

UNIT-3: Differential amplifiers

Single ended & differential operation, Basic differential pair, qualitative and quantitative analysis, Common mode response.

(06 Hours)

UNIT 4: Operational amplifiers

Performance parameters, one stage op amp, Gain boosting, Noise in op amp

(06 Hours)

Unit 5:   ADC converter and DAC converter

Converting Analog Signals to Digital Signals, Sample-and-Hold (S/H) Characteristics, Digital-to-Analog Converter (DAC) Specifications, Analog-to-Digital Converter (ADC) Specifications.   **(06 Hours)**

Unit 6: Sigma Delta Converter

The Oversampling ADC, The First-Order **Sigma Delta** Modulator , The Higher Order **Sigma Delta** Modulators.

(06 Hours)

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VII Semester

ET 2413 –PE III : Analog VLSI Design

Text books:				
1	Design of Analog CMOS Integrated circuits	Ninteenth reprint 2010	BehzadRazavi	Mc-graw-Hill

Reference books:				
1	CMOS circuit design, layout, and Simulation'	Second edition, reprint 2009.	Jacob Baker	WSE
2	CMOS Analog Circuit Design	second edition, 2010	P.E.Allen, D.R.Holdberg	Oxford univ. press
3	Analysis and Design of Analog Integrated Circuits	fifth edition, reprint 2010	Paul B Gray , Hurst , Lewis, Meyer	John Wiley & sons

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VII Semester
ET 2414 – PE III: Error Correcting Code

Prerequisites	-----------
Course Objective Students should be able to 1) Understand the concept and basics of information theory and the basics of source and channel coding/decoding. 2) Understand various mathematical tools: groups and finite fields, Linear algebra in the development of codes and sequences and explain the conventional digital communication system with error control codes like block code, Linear code 3) Understand the properties of error control codes like Cyclic code, BCH code. 4) Understand various error control techniques for Convolutional codes.	**Course Outcome** Students will be able to 1. Apply the concept and basics of information theory and the basics of source and channel coding/decoding. 2. Apply various mathematical tools: groups and finite fields, Linear algebra in the development of codes and sequences and explain the conventional digital communication system with error control codes like block code, Linear code 3. Analyze the properties of error control codes like Cyclic code, BCH code. 4. Demonstrate competence in analyzing and evaluating the practice of different error control techniques for Convolutional codes.

UNIT-1 : CHANNEL CAPACITY AND CODING
Introduction, Channel Models, Channel Capacity, Channel Coding, Information Capacity Theorem, The Shannon Limit, Random Selection Of Codes, Hamming Distance, Few Points Of Information Theory. **(06 Hours)**

UNIT-2: BLOCK CODES
Coding for reliable digital transmission and storage. Groups, Rings, Vector Spaces, Galois Fields, Polynomial rings The Digital Communication Channel, Introduction To Block Codes, Single Parity Check Codes, Product Codes, Repetition Codes, Hamming Codes, Minimum Distance Of Block Codes, Soft – Decision Decoding, Automatic Repeat Request Schemes **(06 Hours)**

UNIT-3: LINEAR CODES
Definition of Linear Codes, Generator Matrices, The Standard Array, Parity - Check Matrices, Error Syndromes, Error Detection And Correction, Shortened And Extended Linear Codes.. **(06 Hours)**

UNIT 4: CYCLIC CODES
Definition Of Cyclic Codes, Polynomials, Generator Polynomials, Encoding Cyclic Codes, Decoding Cyclic Codes, Factors Of XN +1, Parity-Check Polynomials, Dual Cyclic Codes, Generator And Parity-Check Matrices Of Cyclic Codes **(06 Hours)**

Unit 5: BCH CODES
Linear Algebra, Galois Field, Definition and Construction of Binary BCH Codes, Error Syndromes In Finite Fields, Decoding SEC and DEC, Reed- Solomen Codes, LDPC codes **(06 Hours)**

Unit 6: CONVOLUTION CODES
Convolution, Encoding Convolutional Codes, Generator Matrices For Convolutional Codes, Generator Polynomials For Convolutional Codes, Graphical Representation Of Convolutional Codes, The Viterbi Decoder. Concept Of Interleaver And Puncture Coding, Applications of error control coding
(06 Hours)

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VII Semester
ET 2414 – PE III: Error Correcting Code

Text books:

1	Introduction to Error Control Codes	Gravano Salvatore	1st Ed., 2007.	Oxford University Press,
2	Error Correction Coding Mathematical Methods and Algorithms	Moon Tood K	, 1st Ed., 2006	Wiley- Interscience
3	Digital Communications - Fundamentals and Applications	Sklar Bernard	2nd Ed., 2009.	Pearson Education-LPE,

Reference books:

1	Information Theory, Coding and Cryptography	Bose Ranjan	, 1st Ed., 2007.	Tata McGraw-Hill
2	Error Control Coding- Fundamentals and Applications	-Shu Lin, Daniel J. Costello		Prentice Hall, Inc.

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VII Semester
ET 2423 – PE IV: Switching Theory

Course Objective	Course Outcomes
Students should be able to	Students will be able to
1) Understand various sequential logic design methods, Analysis of logic circuits and optimization techniques to minimize gate count. 2) Learn fault diagnosis, Threshold logic, analysis and design of sequential machines.	1) Design and Analyze multilevel logic Network and Threshold logic for nanotechnologies. 2) Analyze testing of combinational circuits, Fault Models 3) Design and analyze the synchronous and asynchronous sequential circuits. 4) Identify and test the sequential machines with experiments.

UNIT-1

Multi-level logic synthesis, Technology-independent synthesis: Factoring, Decomposition, Extraction, Substitution, and Technology mapping: steps in technology mapping **(06 Hours)**

UNIT-2:

Threshold logic for nanotechnologies, threshold elements, synthesis of threshold networks: Unate function, Identification & Realization of threshold function. **(06 Hours)**

UNIT-3:

Testing of combinational circuits, Fault models, Structural testing, IDDQ testing, Delay fault testing, Synthesis for testability, Testing for nanotechnologies. **(06 Hours)**

UNIT 4:

Synchronous sequential circuits and iterative networks, memory elements and their excitation functions, synthesis of synchronous sequential circuits, Moore and Mealy machines, finite state machine flow charts, tables **(06 Hours)**

Unit 5:

State-identification experiments and testing of sequential circuits, Experiments, Homing experiments, Distinguishing experiments, Machine identification, Checking experiments, Built-in self-test (BIST). ,New topic to be announced time to time **(06 Hours)**

Unit 6

Asynchronous sequential circuits, Modes of operation, Hazards, Synthesis of SIC fundamental-mode circuits. **(06 Hours)**

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VII Semester
ET 2423 – PE IV: Switching Theory

Text books:

1	Switching & Finite Automata Theory	Zvi Kohavi, Niraja K. Jha	Third Edition 2010	Cambridge University Press
2	Fundamentals of Digital Logic With VHDL Design	Stephen Brown	Second Edition, 2007	TMH

Reference books:

1	Modern Switching Theory and Digital Design	Lee S.C		PHI Edition
2	Digital Logic and Computer Design	M.Morris Mano		PHI Edition

		June 2021	1.00	Applicable for AY 2021-22 Onwards
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VII Semester
ET 2424 – PE IV: Topics in Machine Learning

Prerequisites	Basic probability and statistics, linear algebra and calculus
Course Objective Students should be able to 1) Understand the concepts of machine learning and regression models 2) Understand the concept of classification for model evaluation. 3) Learn Supervised and unsupervised learning algorithms. 4) Learn the concept of artificial neural network and deep networks	**Course Outcome** Students will be able to 1) Apply and analyze the model using regression. 2) Apply and evaluate the performance of system for classification. 3) Apply Supervised and unsupervised learning for problem solving. 4) Apply neural network algorithms for classification. 5) Describe and evaluate deep neural network with computational complexity.

UNIT-1 Regression

Supervised and Unsupervised Learning, Regression, Model and Cost Function, Gradient Descent, Multivariate Linear Regression, Feature Scaling, Gradient Descent for multivariable   **(06 Hours)**

UNIT-2: Classification

Classification, Hypothesis Representation, Decision Boundary, Cost function and Gradient Descent, Multi-classification, Regularization, Model Evaluation   **(06 Hours)**

UNIT-3: Supervised Learning

KNN, SVM, Decision tree, Naive Bayes Classifiers, Random Forest   **(06 Hours)**

UNIT 4: Unsupervised learning

K-means clustering, Hierarchical Clustering, DBSCAN Clustering, PCA, Anomaly Detection, Recommender System   **(06 Hours)**

Unit 5: Artificial Neural Network

Introduction to neural network, Activation Functions, Perceptron rule, backpropagation   **(06 Hours)**

Unit 6: Deep Learning

Introduction to deep learning, building blocks of CNN, Computational Complexity, case studies based on CNN architectures, **New topics to be announced time to time.**   **(06 Hours)**

Text books:				
1	Understanding Machine Learning. https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/copy.html	2017	Shai Shalev-Shwartz and Shai Ben-David.	Cambridge University Press.
2	The Elements of Statistical Learning. https://web.stanford.edu/~hastie/ElemStatLearn/	2009	Trevor Hastie, Robert Tibshirani and Jerome Friedman.	Second Edition
3	Pattern Recognition and Machine Learning. https://www.microsoft.com/en-us/research/people/cmbishop/downloads/	2006	Christopher Bishop.	Springer

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VII Semester
ET 2424 – PE IV: Topics in Machine Learning

Reference books:				
1	Foundations of Data Science.	2017	Avrim Blum, John Hopcroft and Ravindran Kannan.	
2	Learning, Part II, http://www.deeplearningbook.org/	2016	Goodfellow, I., Bengio, Y., Courville, A.	MIT Press
3	Machine Learning: A Probabilistic Perspective	2012	Kevin P. Murphy	MIT Press

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		Date of Release	Version	

YCCE-ET-24

VII Semester
ET 2434 -PE V: Wireless Sensor Networks

Prerequisites	-----------
Course Objective Students should be able to: 1. To Understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology 2. Understand the medium access control protocols and address physical layer issues 3. Learn key routing protocols,transport layer protocols for sensor networks, and design requirements 4. Understand the Sensor management ,sensor network middleware, operating systems.	**Course Outcome** Students will be able to: 1. Understand and explain common wireless sensor node architectures. 2. Carry out simple analysis and planning of WSNs. 3. Demonstrate knowledge of MAC protocols, routing protocols developed for WSN. 4. Demonstrate knowledge of mobile data-centric networking principles.

UNIT-1:
Characteristics Of WSN: Characteristic requirements for WSN - Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BTnodes, TelosB, Sunspot -Physical layer and transceiver design considerations in WSNs,

(06 Hours)

UNIT-2:
Network architecture-optimization goal and figure of merit-design principles for WSN, service interface of WSN, Gateway concept challenges of WSN, comparison with other network.

(06 Hours)

UNIT-3
Medium Access Control Protocols: Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contention- based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol

(06 Hours)

UNIT-4:
 Routing And Data Gathering Protocols Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

(06 Hours)

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VII Semester
ET 2434 -PE V: Wireless Sensor Networks

UNIT-5

Naming and addressing, Time synchronization, Properties of Localization and positioning procedures, single hop localization, positioning in multihop environments, and impact of anchor placement.

(06 Hours)

UNIT-6:

Applications Of WSN: WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking .

(06 Hours)

Text books:				
1	Protocols and architecture for Wireless sensor Networks Wiley	2007	Holger Karl, Andreas Willig,	Wiley Publications
2	Wireless Sensor Network Designs,	2003	Anna Hac	Wiley Publications
3	Handbook of Algorithms for Wireless Networking and Mobile Computing	2006	Azzedine Boukerche	Chapman & Hall/CRC Publications

Reference books:				
1	Wireless Sensor Networks : A systems perspective	August 2005	NirupamaBulusu and Sanjay Jha,	Artech House Publications
2	Wireless Sensor Networks : Architecture and Protocols	2003, 2003.	Jr., Edgar H. Callaway,	Auerbach Publications
3	Wireless Sensor Networks	2005 C.S.	Raghavendra, Krishna M. Sivalingam and TaiebZnati	Springer Publications

		June 2021	1.00	Applicable for AY 2021-22 Onwards
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VII Semester
ET2442– PE VI: Digital Image Analysis for Remote Sensing

Prerequisites	Principles of Image Analysis
Course Objective Students should be able to 1) Understand Remote Sensing & sensor Concepts 2) Understand the fundamentals and image characteristics of remote sensing. 3) Learn image enhancement techniques 4) Study image classification technique and hyperspectral image analysis	**Course Outcome** Students will be able to 1) Comprehend the basic and applied principles of remote sensing, RS image characteristics 2) Understand and evaluate image spatial and spectral transforms and their effect on image quality and data integrity 3) Apply the image correction techniques and classification algorithms on remote sensing images 4) Analyze high-dimensional remote sensing imagery with appropriate remote sensing data and processing methods.

UNIT-1: Remote Sensing Concepts

Review of Remote Sensing Concepts: spatial and radiometric characteristics – spectral and temporal characteristics, Optical Radiation Model: The wave/ particle models - energy/matter interaction – Radiometric Correction–Atmospheric Correction, Image sensors

(06 Hours)

UNIT-2: Digital Image Formation and Characteristics

Digital Image Formation: point spread functions – sampling and quantization

Digital Image Characteristics: Univariate and multivariate image statistics – noise models- power spectral density- co-occurrence matrix

(06 Hours)

UNIT-3: Image Enhancement and Spectral Transforms

Contrast enhancement – band rationing – principal component analysis – vegetation transforms – texture transforms, Spatial Transforms: convolution concept - low and high pass filtering – spatial transformations – Fourier transform – wavelet transforms.

(06 Hours)

UNIT 4: Geometric Correction

Sensor geometry and empirical models for geometric corrections techniques.

(06 Hours)

Unit 5: RS Image Classification

Thematic Information Extraction: review of supervised and unsupervised Image classification – Maximum Likelihood and Bayesian classification, Non-parametric & parametric classification.

(06 Hours)

Unit 6: High Dimension Image Analysis

Subpixel classification: Linear mixing model, fuzzy set classification, Hyperspectral Image Analysis: Feature extraction, classification algorithms for hyperspectral data, Applications of Remote Sensing, **New topic to be announced time to time** **(06 Hours)**

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VII Semester

ET2442– PE VI: Digital Image Analysis for Remote Sensing

Text books:

1	Remote Sensing: Models and Methods for Image Processing	Third Edition, 2007	Robert A. Schowengerdt	Elsevier
2	Remote Sensing Digital Image Analysis	4th Edition, 2006	John A. Richards, Xiuping Jia	Springer

Reference books:

1	Introductory Digital Image Processing: A Remote Sensing Perspective	Fourth Edition, 2016	Jhon R. Jensen	Pearson Series
2	Physical Principles of Remote Sensing	Third Edition, 2012	W.G. Rees	Cambridge University Press

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ELECTRONICS & COMMUNICATION ENGINEERING

VII Semester
ET2446 – PE VI: PLCs & SCADA

Prerequisites	----------
Course Objective **Students should be able to:**	**Course Outcome** **Students will be able to:**
1) Understand the fundamentals of Automation and their applications, systems used in industry such as PLC, Memory devices, Input /Output system and Relays. 2) Understand the working of Timing Circuits, Programming techniques with Input/Output Instructions and Addressing, overview of PLC timers and their application in industrial control. 3) Understand the PLC Counters, Data Comparators Instructions and application of sequencers based on these systems 4) Understand the networking using PLC systems and peripherals advanced PLC programming languages which are widely used in industrial automation.	1) Describe automation, its importance, expectations from automation and applications in industry. 2) Describe and analyze Timing Circuits and Program PLC using ladder diagram for various applications. 3) Analyze and apply various instructions of PLC, PLC counters. 4) Explain the basic concepts of networking using PLC systems and peripherals

UNIT-1 :-

Introduction to Programmable Controllers

Definition , A Historical Background , Principles of Operation , PLCs Versus Other Types of Controls , PLC Product Application Ranges, Ladder Diagrams and the PLC , Advantages of PLCs, PLC Sizes and Scopes of Applications

Processors, the Power Supply, and Memory

Introduction , Processors, Processor Scan , The System Power Supply , Programming Devices, Memory Overview , Memory Types, Memory Structure and Capacity. Configuring the PLC Memory—I/O Addressing.

The Input/Output System

Introduction to Discrete I/O Systems , I/O Rack Enclosures and Table Mapping , Remote I/O Systems PLC Instructions for Discrete Inputs, Types of Discrete Modules, PLC Instructions for Discrete Outputs Overview of Analog Input Signals , Analog Input Connections, Special Analog, Temperature, and PID Interfaces.

(06Hours)

UNIT-2:

Introduction to Programming Languages

Types of PLC Languages, Ladder Diagram Format , Ladder Relay Instructions , Ladder Relay Programming, IEC 1131-3 Programming Languages – FBD/ST/IL/SFC, Control Task Definition, Control Strategy , Implementation Guidelines.

Programming Instructions

NO-NC & coil based instructions(Relay based Instructions), Timers, Counters, Compare, Mathematics, Jump and Subroutines, Scaling (Analog Instructions).

Installation & Wiring

I/O Installation, Wiring, and Precautions ,PLC Start-Up and Checking Procedures.

(06 Hours)

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VII Semester
ET2446 – PE VI: PLCs & SCADA

UNIT-3:
Introduction to SCADA
Introduction and brief history of SCADA, Fundamental principles of modern SCADA systems, the components of a SCADA system, Types of SCADA,

SCADA Programming
Graphics Building & Simulation, Tag types & Management, Tools, Programming techniques, Alarms & Trends Configuration, Screen Navigation, Properties, Scripts, Security.

Database & Controller Connectivity
Using Spreadsheets to Create Points Lists, ODBC Server, Excel communication, Creating Records for data, PLC connectivity through interface and protocols.

(06 Hours)

UNIT 4:
Introduction to HMI
FOUNDATIONS OF HMI: The Human: History of User Interface Designing, Types, Features, General architecture ,Conventional & current HMI systems, Difference between HMI & SCADA, HMI Hardware interfaces, Practical uses in Industries.

Programming HMI
Software Description, Tools Handling, Screen Developments, HMI objects & Object Libraries, Alarms generation, Trends Plotting & its usages, Security & Recipe Management. HMI interfacing with PLC's.

(06 Hours)

Unit 5:
Data comparison instructions & PLC sequencers
Data comparison instructions such as EQU, LES, and GRT,. Introduction to the principles of Data Transfer, Move Instruction, Introduction to Shift Registers & Its types.Purpose and application of PLC Sequencers, Masking techniques and the various types of Sequencers, SQO and SQC instructions.

(06 Hours)

Unit 6:
Distributed Control System:
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

(06 Hours)

Text books:				
1	Introduction to Programmable Logic controllers		Gary Duning	Delmar Thomson Learning
2	SCADA: Supervisory Control and Data Acquisition	Fourth Edition	Stuart A Boyer	ISA 1999

Reference books:				
1	Programmable Logic Controllers	W.Bolton	Elsevier Publisher	

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V Semester
ET2325 /ET2400– OE II/ OE IV: PLCs and SCADA

Prerequisites	-----------
Course Objectives **Students should be able to:**	**Course Outcomes** **Students will be able to:**
1) Understand the fundamentals of Automation and their applications, systems used in industry such as PLC, Memory devices, Input /Output system and Relays. 2) Understand the working of Timing Circuits, Programming techniques with Input/Output Instructions and Addressing, overview of PLC timers and their application in industrial control. 3) Understand the PLC Counters, Data Comparators Instructions and application of sequencers based on these systems 4) Understand the networking using PLC systems and peripherals advanced PLC programming languages which are widely used in industrial automation.	1) Describe automation, its importance, expectations from automation and applications in industry. 2) Describe and analyze Timing Circuits and Program PLC using ladder diagram for various applications. 3) Analyze and apply various instructions of PLC, PLC counters. 4) Explain the basic concepts of networking using PLC systems and peripherals

Unit No.	Contents	Max. Hrs.
1	**Introduction to Programmable Controllers** Definition , A Historical Background , Principles of Operation , PLCs Versus Other Types of Controls , PLC Product Application Ranges, Ladder Diagrams and the PLC , Advantages of PLCs, PLC Sizes and Scopes of Applications **Processors, the Power Supply, and Memory** Introduction, Processors, Processor Scan, The System Power Supply , Programming Devices, Memory Overview , Memory Types, Memory Structure and Capacity. Configuring the PLC Memory—I/O Addressing. **The Input/Output System** Introduction to Discrete I/O Systems , I/O Rack Enclosures and Table Mapping , Remote I/O Systems PLC Instructions for Discrete Inputs, Types of Discrete Modules, PLC Instructions for Discrete Outputs Overview of Analog Input Signals , Analog Input Connections, Special Analog, Temperature, and PID Interfaces	6
2	**Introduction to Programming Languages** Types of PLC Languages, Ladder Diagram Format , Ladder Relay Instructions , Ladder Relay Programming, IEC 1131-3 Programming Languages – FBD/ST/IL/SFC, Control Task Definition, Control Strategy , Implementation Guidelines. **Programming Instructions** NO-NC & coil based instructions(Relay based Instructions), Timers, Counters, Compare, Mathematics, Jump and Subroutines, Scaling (Analog Instructions). **Installation & Wiring** I/O Installation, Wiring, and Precautions ,PLC Start-Up and Checking Procedures.	6

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3	**Introduction to SCADA** Introduction and brief history of SCADA, Fundamental principles of modern SCADA systems, the components of a SCADA system, Types of SCADA, **SCADA Programming** Graphics Building & Simulation, Tag types & Management, Tools, Programming techniques, Alarms & Trends Configuration, Screen Navigation, Properties, Scripts, Security. **Database & Controller Connectivity** Using Spreadsheets to Create Points Lists, ODBC Server, Excel communication, Creating Records for data, PLC connectivity through interface and protocols.	6
4	**Introduction to HMI** FOUNDATIONS OF HMI: The Human: History of User Interface Designing, Types, Features, General architecture , Conventional & current HMI systems, Difference between HMI & SCADA, HMI Hardware interfaces, Practical uses in Industries. **Programming HMI** Software Description, Tools Handling, Screen Developments, HMI objects & Object Libraries, Alarms generation, Trends Plotting & its usages, Security & Recipe Management. HMI interfacing with PLC's.	6
5	**Data comparison instructions & PLC sequencers** Data comparison instructions such as EQU, LES, and GRT,.Introduction to the principles of Data Transfer, Move Instruction, Introduction to Shift Registers & Its types.Purpose and application of PLC Sequencers, Masking techniques and the various types of Sequencers, SQO and SQC instructions.	6
6	**Distributed Control System**: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.	6

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V Semester
ET2325 /ET2400– OE II/ OE IV: PLCs and SCADA

Text Books

SN	Title	Edition	Authors	Publisher
1	Introduction to Programmable Logic controllers		Gary Duning	Delmar Thomson Learning
2	SCADA: Supervisory Control and Data Acquisition	Fourth Edition	Stuart A Boyer	ISA 1999

Reference Books

SN	Title	Edition	Authors	Publisher
1	Programmable logic controller		W. Bolton	Elsevier Publisher

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(Revised Scheme of Examination w.e.f. 2020-21 onward)
Electronics & Telecommunication Engineering

SoE No.

VI Semester
ET2381- PE II : Internet of Things (IoT)

Course Learning Objective Students should be able	Course Outcomes Students will be able to
1. To understand the physical and Logical design of IoT. 2. To study the M2M and NETCONF. 3. To understand python programming. 4. To understand physical servers and cloud offerings.	1. Explore the physical and Logical design of IoT. 2. Explore the M2M and NETCONF. 3. Explore python programming. 4. Apply basic skills of IoT to solve real life problems.

UNIT-1: **5 Hrs.**
Introduction & Concepts: Introduction to Internet of Things, Physical Design of IOT, Logical Design of IOT, IOT Enabling Technologies, IOT Levels.

UNIT-2: **6Hrs**
Domain Specific IOTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Life Style.

UNIT-3: **7Hrs**
M2M & System Management with NETCONF-YANG: M2M, Difference between IOT and M2M, SDN and NFV for IOT, Software defined Networking, Network Function Virtualization, Need for IOT Systems Management, Simple Network Management Protocol, Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IOT Systems management with NETCONF-YANG.

UNIT-4: **6Hrs**
Developing Internet of Things & Logical Design using Python: Introduction, IOT Design Methodology, Installing Python, Python Data Types & Data Structures, Control Flow, Functions,

UNIT-5: **6Hrs**
Python Modules, Packages, File Handling, Date/ Time Operations, Classes, Python Packages, Iot Device-Raspberry Pi, Programming Raspberry pi with Python

UNIT-6: **7Hrs**
IoT physical servers and cloud offerings, Introduction to cloud storage models and communication APIs, Python web application frame work-Django, Amezon web service for IoT
New topic to be announced time to time

Text books:				
1	Internet of Things: A Hands-On Approach	1st edition 2015	by Arshdeep Bahga, Vijay Madisetti	Orient Blackswan Private Limited - New Delhi
Reference books:				
1	Designing the Internet of Things	1st edition	By Adrian McEwen	Wiley
2	Python for Everybody		Charles R. Severance	

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				AY 2020-21 Onwards
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Electronics & Telecommunication Engineering

SoE
No.

VI Semester
ET2382- PE II : Lab. Internet of Things (IoT)

Expt. No.	Name of Experiment
01	Add ten natural numbers in python
02	Experiment on functions in python
03	Experiment on string manipulation in python
04	Interfacing LED with Raspberry pi.
05	Interfacing DHT11 sensor with Raspberry pi.
06	File handling using Python.
07	Reading data from server.
08	Experiment on python Django.
09	Experiment on python Django.
10	Preparing complete IoT system using AWS server
11	Mini-project

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(Revised Scheme of Examination w.e.f. 2020-21 onward)

| SoE No. |
| ET-201 |

Electronics & Telecommunication Engineering

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
				TOTAL FIRST & SECOND SEM						47				
				Third Semester										
1	3	BS	GE2201	Engineering Mathematics III	T	3	0	0	3	3	30	30	40	3 Hours
2	3	PC	ET2201	Electronic Devices and Circuits	T	3	1	0	4	4	30	30	40	3 Hours
3	3	PC	ET2202	Lab: Electronic Devices and Circuits	P	0	0	2	2	1		60	40	
4	3	PC	ET2203	Digital Circuits and Fundamentals of Microprocessor.	T	3	0	0	3	3	30	30	40	3 Hours
5	3	PC	ET2204	**Lab:** Digital Circuits and Fundamentals of Microprocessor.	P	0	0	2	2	1		60	40	.
6	3	PC	ET2205	Electronic Measurement and Instrumentation	T	3	0	0	3	3	30	30	40	3 Hours
7	3	PC	ET2206	Lab: Electronic Measurement and Instrumentation	P	0	0	2	2	1		60	40	
8	3	PC	ET2207	Network Analysis	T	3	0	0	3	3	30	30	40	3 Hours
				TOTAL THIRD SEM		15	1	6	22	19				
				Fourth Semster										
1	4	BS	GE2204	Advance Mathematical Techniques	T	3	0	0	3	3	30	30	40	3 Hours
2	4	PC	ET2251	Electromagnetic Fields	T	3	1	0	4	4	30	30	40	3 Hours
3	4	PC	ET2252	Microcontroller and Interfacing	T	3	0	0	3	3	30	30	40	3 Hours
4	4	PC	ET2253	Lab: Microcontroller and Interfacing	P	0	0	2	2	1		60	40	
5	4	PC	ET2254	Analog Communication	T	3	0	0	3	3	30	30	40	3 Hours
6	4	PC	ET2255	Lab: Analog Communication	P	0	0	2	2	1		60	40	
7	4	PC	ET2256	Control Systems	T	3	0	0	3	3	30	30	40	3 Hours
8	4	PC	ET2257	Lab.: Control Systems	P	0	0	2	2	1		60	40	
				TOTAL FOURTH SEM		15	1	6	22	19				

List of Audit Courses

| 1 | 3 | HS | GE2121 | Env Studies for 3 Sem. EL,ET,CT | A | 3 | 0 | 0 | 3 | 0 | | | | |

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA** = for Practical : MSPA will be 15 marks each

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SoE No.
ET-201

B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f. 2020-21 onward)
Electronics & Telecommunication Engineering

SN	Sem	Type	Sub. Code	Subject	T/P	L	T	P	Hrs	Credits	MSEs*	TA**	ESE	ESE Duration Hours
						Contact Hours					% Weightage			
				Fifth Semester										
1	5	HS	GE2312	Fundamental of Economics	T	3	0	0	3	3	30	30	40	3 Hours
2	5	PC	ET2301	Analog Integrated circuits	T	3	0	0	3	3	30	30	40	3 Hours
3	5	PC	ET2302	Lab: Analog Integrated circuits	P	0	0	2	2	1		60	40	
4	5	PC	ET2303	Fields & Radiating Systems	T	3	1	0	4	4	30	30	40	3 Hours
5	5	PC	ET2304	Signals & Systems	T	3	0	0	3	3	30	30	40	3 Hours
6	5	PC	ET2305	Lab. :Signals & Systems	P	0	0	2	2	1		60	40	
7	5	OE		Open Elective - I *	T	3	0	0	3	3	30	30	40	3 Hours
8	5	OE		Open Elective - II *	T	3	0	0	3	3	30	30	40	3 Hours
9	5		ET2306	Lab.: Electronics Workshop	P	0	0	2	2	1		60	40	
10	5/6	STR	ET2310	Industry Visit and its report	P	0	0	0	0	1		100		
				TOTAL FIFTH SEM		18	1	6	25	23				

Audit Courses

1	5	IT	IT1121	Industrial Programmin Language	A	3	0	0	3	0				

Open Electives -I

1	5	OE 1	ET2311	OE I : Microcontroller & Embedded Systems
2	5	OE 1	ET2312	OE I : Principles of Communication Engineering
3	5	OE 1	ET2313	OE I : Fundamentals of Image Processing

Open Electives -II

4	5	OE 2	ET2321	OE II : Soft computing
5	5	OE 2	ET2322	OE II : Industrial Instrumentation
6	5	OE 2	ET2323	OE II : Medical Electronics
7	5	OE 2	ET2324	OE II : Display Technology & Applications
7	5	OE 2	ET2325	OE II : PLCs and SCADA

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

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TA** = for Practical : MSPA will be 15 marks each

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Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

**SoE No.
ET-201**

B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f. 2020-21 onward)

Electronics & Telecommunication Engineering

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
				Sixth Semester										
1	6	HS	GE2311	Fundamental of Management	T	3	0	0	3	3	30	30	40	3 Hours
2	6	PC	ET2351	Digital Signal Processing	T	3	0	0	3	3	30	30	40	3 Hours
3	6	PC	ET2352	Lab: Digital Signal Processing	P	0	0	2	2	1		60	40	
4	6	PE		Professional Elective I	T	3	0	0	3	3	30	30	40	3 Hours
5	6	PE		Lab. : Professional Elective I	P	0	0	2	2	1		60	40	
6	6	PE		Professional Elective II	T	3	0	0	3	3	30	30	40	3 Hours
7	6	PE		Lab. : Professional Elective II	P	0	0	2	2	1		60	40	
8	6	OE		Open Elective - III **	T	3	0	0	3	3	30	30	40	3 Hours
9	6	OE		Open Elective - IV **	T	3	0	0	3	3	30	30	40	3 Hours
				TOTAL SIXTH SEM		18	0	6	24	21				

Professional Electives -I

1	6	PE I	ET2361	PE I : Object Oriented Programming
2	6	PE I	ET2362	PE I : Lab. Object Oriented Programming
3	6	PE I	ET2363	PE I : Discrete Structures
4	6	PE I	ET2364	PE I : Lab. Discrete Structures
5	6	PE I	ET2365	PE I : Microprocessors and Peripherals
6	6	PE I	ET2366	PE I : Lab. Microprocessors and Peripherals
7	6	PE I	ET2367	PE I : Electronic Instrumentation
8	6	PE I	ET2368	PE I :Lab Electronic Instrumentation
9	6	PE I	ET2371	PE I : Fundamentals of Computing
10	6	PE I	ET2372	PE I : Lab Fundamentals of Computing
11	6	PE I	ET2373	PE I : Algorithms and data structures
12	6	PE I	ET2374	PE I :Lab Algorithms and data structures

Professional Electives -II

1	6	PE II	ET2377	PE II : Antenna Theory & Design
2	6	PE II	ET2378	PE II : Lab. Antenna Theory & Design
3	6	PE II	ET2379	PE II : Digital system Design
4	6	PE II	ET2380	PE II : Lab. Digital system Design
5	6	PE II	ET2381	PE II : Internet of Things (IoT)
6	6	PE II	ET2382	PE II : Lab. Internet of Things (IoT)
7	6	PE II	ET2383	PE II : Optical Communication
8	6	PE II	ET2384	PE II : Lab. Optical Communication
9	6	PE II	ET2385	PE II :Principles of image processing
10	6	PE II	ET2386	PE II : Lab. Principles of image processing
11	6	PE II	ET2387	PE II : TV & Video Engineering
12	6	PE II	ET2388	PE II : Lab. TV & Video Engineering

Open Electives -III

1	6	OE 3	ET2391	OE III : Microcontroller & Embedded Systems
2	6	OE 3	ET2392	OE III : Principles of Communication Engineering
3	6	OE 3	ET2393	OE III : Fundamentals of Image Processing

Open Electives -IV

4	6	OE 4	ET2396	OE IV : Soft computing
5	6	OE 4	ET2397	OE IV : Industrial Instrumentation
6	6	OE 4	ET2398	OE IV : Medical Electronics
7	6	OE 4	ET2399	OE IV : Display Technology & Applications
7	6	OE 4	ET2400	OE IV : PLCs & SCADA

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TA** = for Practical : MSPA will be 15 marks each

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Chairperson	Dean (Acad. Matters)	Date of Release	Version	

Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)
B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f, 2020-21 onward)
Electronics & Telecommunication Engineering

SoE No.
ET-201

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
					Seventh Semester									
1	7	PC	ET2401	RF & Microwave	T	3	0	0	3	3	30	30	40	3 Hours
2	7	PC	ET2402	Lab: RF & Microwave	P	0	0	2	2	1		60	40	
3	7	PC	ET2403	Digital Communication	T	3	0	0	3	3	30	30	40	3 Hours
4	7	PC	ET2404	Lab: Digital Communication	P	0	0	2	2	1		60	40	
5	7	PE		Professional Elective III	T	3	0	0	3	3	30	30	40	3 Hours
6	7	PE		Professional Elective IV	T	3	0	0	3	3	30	30	40	3 Hours
7	7	PE		Professional Elective V	T	3	0	0	3	3	30	30	40	3 Hours
8	7	PE		Professional Elective VI	T	3	0	0	3	3	30	30	40	3 Hours
9	7	STR	ET2409	Mini Project	P	0	0	4	4	2		60	40	
10	7	STR	ET2410	Campus Recrutment Training (CRT)	P	0	0	0	0	2		100		
				TOTAL SEVENTH SEM		18	0	8	26	24				

Professional Electives -III

1	7	PE	ET2411	PE III : Power Electronics
2	7	PE	ET2412	PE III : Data Compression & Encryption
3	7	PE	ET2413	PE III : Analog VLSI
4	7	PE	ET2414	PE III : Error Correcting Codes
5	7	PE	ET2415	PE III : Wireless Mobile Communication Systems

Professional Electives -IV

6	7	PE	ET2421	PE IV : Satellite Communication & RADAR Engineering
7	7	PE	ET2422	PE IV : Embedded System
8	7	PE	ET2423	PE IV : Switching Theory
9	7	PE	ET2424	PE IV : Topics in Machine Learning
10	7	PE	ET2425	PE IV : Multimedia Communications

Professional Electives -V

11	7	PE	ET2431	PE V : Display Technology
12	7	PE	ET2432	PE V : Biomedical Instrumentation
13	7	PE	ET2433	PE V : Fuzzy Logic & Neural Network
14	7	PE	ET2434	PE V : Wireless Sensor Networks
15	7	PE	ET2435	PE V : RF Circuit Design

Professional Electives -VI

16	7	PE	ET2441	PE VI : CMOS VLSI Design
17	7	PE	ET2442	PE VI : Digital Image Analysis for Remote Sensing
18	7	PE	ET2443	PE VI : Microwave Integrated circuits
19	7	PE	ET2444	PE VI : Communication Networks
20	7	PE	ET2445	PE VI : Computer Architecture and Organization
20	7	PE	ET2446	PE VI : PLCs & SCADA

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TA** = for Practical : MSPA will be 15 marks each

		June 2020	**1.02**	**Applicable for AY 2021-22 Onwards**
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(Revised Scheme of Examination w.e.f. 2020-21 onward)
Electronics & Telecommunication Engineering

SoE No.
ET-201

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
				Eigth Semester										
1	8	STR	ET2451	Major Project	P	0	0	12	12	9		60	40	
2	8	STR	ET2452	Extra curricular Activity Evaluation	P	0	0	0	0	1		100		
					TOTAL	0	0	12	12	10				
					GRAND TOTAL	84	3	44	131	163				

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Bachelor of Engineering
SoE & Syllabus 2018
3rd to 8th Semester
Computer Technology

Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
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B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f. 2020-21 onward)

SoE No.
CT-201

Computer Technology

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
				TOTAL FIRST & SECOND SEM						47				

Third Semester

SN	Sem	Type	Sub. Code	Subject	T/P	L	T	P	Hrs	Credits	MSEs*	TA**	ESE	ESE Duration Hours
1	3	BS	GE2201	Engineering Mathematics III	T	3	0	0	3	3	30	30	40	3 Hours
2	3	PC	CT2201	Computer Architecture & Organisation	T	4	0	0	4	4	30	30	40	3 Hours
3	3	PC	CT2202	Object Oriented Programming	T	3	0	0	3	3	30	30	40	3 Hours
4	3	PC	CT2203	Lab: Object Oriented Programming	P	0	0	2	2	1		60	40	
5	3	PC	CT2204	Data Structures	T	4	0	0	4	4	30	30	40	3 Hours
6	3	PC	CT2205	Lab: Data Structures	P	0	0	2	2	1		60	40	
7	3	PC	CT2206	Lab: Python Programming	P	0	0	2	2	1		60	40	
8	3	PC	CT2207	Lab: Web Technology	P	0	0	2	2	1		60	40	
				TOTAL		14	0	8	22	18				

Fourth Semster

SN	Sem	Type	Sub. Code	Subject	T/P	L	T	P	Hrs	Credits	MSEs*	TA**	ESE	ESE Duration Hours
1	4	BS	GE2206	Discrete Mathematics and Probability Theory	T	3	0	0	3	3	30	30	40	3 Hours
2	4	PC	CT2251	Operating Systems	T	3	0	0	3	3	30	30	40	3 Hours
3	4	PC	CT2252	Lab:Operating Systems	P	0	0	2	2	1		60	40	
4	4	PC	CT2253	Advanced Data Structures	T	4	0	0	4	4	30	30	40	3 Hours
5	4	PC	CT2254	Lab: Advanced Data Structures	P	0	0	2	2	1		60	40	
6	4	PC	CT2255	Mathematical Foundations for Data Analysis	T	3	0	0	3	3	30	30	40	3 Hours
7	4	PC	CT2256	Lab: Mathematical Foundations for Data Analysis	P	0	0	2	2	1		60	40	
8	4	PC	CT2257	Database Management Systems	T	3	0	0	3	3	30	30	40	3 Hours
9	4	PC	CT2258	Lab: Database Management Systems	P	0	0	2	2	1		60	40	
				TOTAL		16	0	8	24	20				

Audit Courses

SN	Sem	Type	Sub. Code	Subject	T/P	L	T	P	Hrs	Credits	MSEs*	TA**	ESE	ESE Duration Hours
1	3	HS	GE2121	Env Studies for 3 Sem. EL,ET,CT	A	3	0	0	3	0				

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TA = for Practical : MSPA will be 15 marks each**

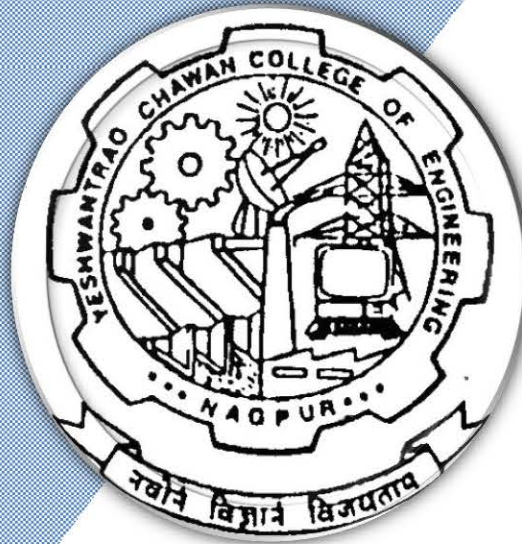|		June 2020	1.02	Applicable for AY 2020-21 Onwards
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Yeshwantrao Chavan College of Engineering
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B.E. SCHEME OF EXAMINATION 2018-19
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Computer Technology

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
				Fifth Semester										
1	5	HS	GE2312	Fundamentals of Economics	T	3	0	0	3	3	30	30	40	3 Hours
2	5	PC	CT2301	Computer Networks	T	3	0	0	3	3	30	30	40	3 Hours
3	5	PC	CT2302	Lab: Computer Networks	P	0	0	2	2	1		60	40	
4	5	PC	CT2303	Theoretical Foundations of Computer Science	T	4	0	0	4	4	30	30	40	3 Hours
5	5	PE		Professional Elective-I	T	3	0	0	3	3	30	30	40	3 Hours
6	5	PE		Lab: Professional Elective-I	P	0	0	2	2	1		60	40	
7	5	OE		Open Elective - I *	T	3	0	0	3	3	30	30	40	3 Hours
8	5	OE		Open Elective - II *	T	3	0	0	3	3	30	30	40	3 Hours
9	5/6	STR	CT2310	IND VISIT and its report	P	0	0	0	0	1		100		
				TOTAL		19	0	4	23	22				

Professional Electives -I

1	5	PE-I	CT2311	PE I: Randomized Algorithm
	5	PE-I	CT2312	PE I: Lab Randomized Algorithm
2	5	PE-I	CT2313	PE I: Mobile Operating System
	5	PE-I	CT2314	PE I: Lab: Mobile Operating System
3	5	PE-I	CT2315	PE I: Advanced Web Technologies
	5	PE-I	CT2316	PE I: Lab: Advanced Web Technologies
4	5	PE-I	CT2317	PE I: Introduction to Geographical Information System
	5	PE-I	CT2318	PE I: Lab: Introduction to Geographical Information System
5	5	PE-I	CT2319	PE I: Computer Graphics
	5	PE-I	CT2320	PE I: Lab: Computer Graphics
6	5	PE-I	CT2321	PE I: Realtime Systems
	5	PE-I	CT2322	PE I: Lab:Realtime Systems
7	5	PE-I	CT2323	PEI : Privacy and Security in Online Social Networks
	5	PE-I	CT2324	PEI : Lab: Privacy and Security in Online Social Networks

Open Electives -I

1	5	OE-I	CT2325	OE I: Introduction to DBMS
2	5	OE-I	CT2326	OE I: Essentials of IT
3	5	OE-I	CT2327	OE I: Image Processing
4	5	OE-I	CT2328	OE I: Operating System Concepts
5	5	OE-I	CT2329	OE-I Introduction to Salesforce

Open Electives -II

1	5	OE-I	CT2331	OE II: Soft Computing
2	5	OE-I	CT2332	OE II: Software Testing
3	5	OE-I	CT2333	OE II: Internet Technology
4	5	OE-I	CT2334	OE II: Multimedia and Animation
5	5	OE-I	CT2335	OE II: Current Trends and Technologies

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CT-201

Computer Technology

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
Sixth Semester														

SN	Sem	Type	Sub. Code	Subject	T/P	L	T	P	Hrs	Credits	MSEs*	TA**	ESE	ESE Duration Hours
1	6	HS	GE2311	Fundamentals of Management	T	3	0	0	3	3	30	30	40	3 Hours
2	6	PC	CT2351	Design & Analysis of Algorithms	T	3	0	0	3	3	30	30	40	3 Hours
3	6	PC	CT2352	Lab: Design & Analysis of Algorithms	P	0	0	2	2	1		60	40	
4	6	PC	CT2353	Language Processor	T	3	0	0	3	3	30	30	40	3 Hours
5	6	PC	CT2354	Lab: Language Processor	P	0	0	2	2	1		60	40	
6	6	PC	CT2355	Software Engineering	T	3	0	0	3	3	30	30	40	3 Hours
7	6	PC	CT2356	Lab: Software Engineering	P	0	0	2	2	1		60	40	
8	6	PE		Professional Elective-II	T	3	0	0	3	3	30	30	40	3 Hours
9	6	PE		Lab: Professional Elective-II	P	0	0	2	2	1		60	40	
10	6	OE		Open Elective - III **	T	3	0	0	3	3	30	30	40	3 Hours
11	6	OE		Open Elective - IV **	T	3	0	0	3	3	30	30	40	3 Hours
				TOTAL		21	0	8	29	25				

Professional Electives -II

1	6	PE-II	CT2361	PE II: Digital Image Processing
	6	PE-II	CT2362	PE II: Lab: Digital Image Processing
2	6	PE-II	CT2363	PE II: Internet of Things
	6	PE-II	CT2364	PE II: Lab: Internet of Things
3	6	PE-II	CT2365	PE II: Business Intelligence
	6	PE-II	CT2366	PE II: Lab: Business Intelligence
4	6	PE-II	CT2367	PE II: Introduction to Natural Language Processing
	6	PE-II	CT2368	PE II: Lab:Introduction to Natural Language Processing
5	6	PE-II	CT2369	PE II: Customer Relationship Management
	6	PE-II	CT2370	PE II: Lab: Customer Relationship Management

Open Electives -III

1	6	OE-III	CT2371	OE III: Introduction to DBMS
2	6	OE-III	CT2372	OE III: Essestials of IT
3	6	OE-III	CT2373	OE III: Image Processing
4	6	OE-III	CT2374	OE III: Operating System Concepts
5	6	OE-III	CT2375	OE III: Introduction to Salesforce

Open Electives -IV

1	6	OE-IV	CT2381	OE IV: Soft Computing
2	6	OE-IV	CT2382	OE IV: Software Testing
3	6	OE-IV	CT2383	OE IV: Internet Technology
4	6	OE-IV	CT2384	OE IV: Multimedia and Animation
5	6	OE-IV	CT2385	OE IV: Current Trends and Technologies

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Computer Technology

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
Seventh Semester														
1	7	PC	CT2401	Artificial Intelligence	T	3	0	0	3	3	30	30	40	3 Hours
2	7	PC	CT2402	Lab: Artificial Intelligence	P	0	0	2	2	1		60	40	
3	7	PC	CT2403	Network Security	T	3	0	0	3	3	30	30	40	3 Hours
4	7	PE		Professional Elective-III	T	3	0	0	3	3	30	30	40	3 Hours
5	7	PE		Professional Elective-IV	T	3	0	0	3	3	30	30	40	3 Hours
6	7	PE		Lab:Professional Elective-IV	P	0	0	2	2	1		60	40	
7	7	PE		Professional Elective-V	T	3	0	0	3	3	30	30	40	3 Hours
8	7	STR	CT2409	Mini Project	P	0	0	4	4	2		100		
9	7	STR	CT2410	CRT	P	0	0	0	0	2		100		
					TOTAL	15	0	8	23	21				

Professional Electives -III

1	7	PE-III	CT2411	PE III: Neural Network & Fuzzy Logic
2	7	PE-III	CT2412	PE III: Adhoc Wireless Network
3	7	PE-III	CT2413	PE III: Information Retrival System
4	7	PE-III	CT2414	PE III: Human Computer Interaction

Professional Electives -IV

1	7	PE-IV	CT2421	PE IV: Pattern Recognization
	7	PE-IV	CT2422	PE IV: Lab: Pattern Recognization
2	7	PE-IV	CT2423	PE IV: Cyber Forensic
	7	PE-IV	CT2424	PE IV: Lab: Cyber Forensic
3	7	PE-IV	CT2425	PE IV: Machine Learning
	7	PE-IV	CT2426	PE IV: Lab: Machine Learning
4	7	PE-IV	CT2427	PE IV: Design Patterns
	7	PE-IV	CT2428	PE IV: Lab: Design Patterns
5	7	PE-IV	CT2429	PE IV: Mobile Communication
	7	PE-IV	CT2430	PE IV: Lab: Mobile Communication
6	7	PE-IV	CT2431	PE IV: Software Project Management
	7	PE-IV	CT2432	PE IV: Lab: Software Project Management
7	7	PE-IV	CT2433	PE IV: Numerical Computing
	7	PE-IV	CT2434	PE IV: Lab: Numerical Computing

Professional Electives -V

1	7	PE-V	CT2435	PE V: Cloud Computing
2	7	PE-V	CT2436	PE V: Parallel Programming
3	7	PE-V	CT2437	PE V: Data Mining
4	7	PE-V	CT2438	PE V: Embedded Systems
5	7	PE-V	CT2439	PE V: Operations Research
5	7	PE-V	CT2440	PE V: Bioinformatics

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Yeshwantrao Chavan College of Engineering
(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)
B.E. SCHEME OF EXAMINATION 2018-19
(Revised Scheme of Examination w.e.f. 2020-21 onward)

SoE No.
CT-201

Computer Technology

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
Eigth Semester														
1	8	STR	CT2451	Major Project	P	0	0	12	12	9		60	40	
2	8	STR	CT2452	Extra curricular Activity Evaluation	P	0	0	0	0	1		100		
					TOTAL	0	0	12	12	10				

				GRAND TOTAL	85	0	48	133	163		

MSEs* = Two MSEs of 15 Marks each will conducted and marks of of these 2 MSEs will be considered for Continuous Assessment

TA ** = for Theory : 12 marks on lecture quizzes, 12 marks on two TA2 activitied decided by course teacher, 2 marks on class attendance and 4 marks on TA4 activities

TA** = for Practical : MSPA will be 15 marks each

Gmolofarker	*signature*	June 2020	1.02	Applicable for AY 2021-22 Onwards
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**	

Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
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BE SoE and Syllabus 2018
(Revised Scheme of Examination w.e.f. 2021-22 onward)
Computer Technology

VII Semester
CT2440 – PE V: Bioinformatics

Objective	Course Outcome
1. To understand various kinds of biological data	1. To interpret various kinds of biological data for understanding etiology of disease
2. To provide concepts of mathematics and statistics for handling biological data	2. To develop algorithms for handling biological data
3. To understand working computational algorithms and biological tools	3. To use various biological tools for handling biological data

Unit No.	Contents	MaxHrs.
Prerequisite: Basic knowledge of Biology, Mathematics and Statistics		
1	Introduction to molecular biology, Probability and theoretical distributions, various biological database and tools in computational biology (NCBI, EMBL etc.), data acquisition for computational analysis.	6
2	Introduction to computational algorithms, sequence alignment, Smith-Waterman algorithm (local alignment), Needleman-Wunsch algorithm (global alignment), one-to-one sequence alignment, one-to-many sequence alignment, many-to-many sequence alignment	7
3	BLAST (online/offline), BioEdit software, BLASTZ, MUMmer for genome alignment, Phylogentic tree analysis, DNA pattern search using suffix-tree analysis, longest common substring search, introduction to online tools like ClustalW, clustal omega for multiple sequence alignment and phylogenetic tree construction	7
4	Computational analysis of next generation sequencing (NGS) data, alignment of NGS reads, identification and annotation of mutations, software tools for variant identification, differentially expressed gene analysis using RNAseq data.	8
5	Basic concepts in Statistical Genetics, mutation models, principal component analysis in genetics, linear mixed models in genetics, major public data source like HapMap	5
6	Case study for various biological tools	6

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Computer Technology

SN	Title	Authors	Publisher
1	Fundamentals of Bioinformatics	Harisha S.	Wiley
2	A Textbook of Bioinformatics Information-theoretic Perspectives of Bioengineering and Biological Complexes	Perambur S Neelakanta	World Scientific

Reference Books

SN	Title	Authors	Publisher
1	https://www.ncbi.nlm.nih.gov/		
2	Bioinformatics : Sequence and Genome Analysis	David W. Mount	CBS Publishers

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GE-2369	Introduction to Spanish Language			L=3	T=0	P=0	Credits =3
Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration		
	30	30	40	100	3 Hrs		

Objectives	Course Outcomes : Students will be able to
Learning Basic Vocabulary	Alphabets, Numbers, Days of the Week, Months of the Year, Seasons, Greetings, Professions
Building on Basic Grammar Skills	Gender of the words, Articles, Subject pronouns, Verbs, Sentence building using Verbs and nouns
Learn to build very simple Sentences	Very basic sentences like self-introduction – Name, Age, Profession etc. Ordering food at restaurants.
Describing people, house, places	Learning Adjectives, Demonstrative adjectives to describe people, house and other places.
Write about hobbies, likes and dislikes, daily routine	Learning to write about leisure activities, what are the likes and dislikes and describing daily routine activities.
Speaking, Listening and Practical Exercises	Playing Videos to practice listening skills. Conversation practice and Role play to enhance speaking skills.

Unit-I : Introduction and basic grammar - 6 hours

- Learning about Alphabets, Numbers
- Days of the week, Months of the year, Seasons
- Common expressions, Professions, Colors
- Subject Pronouns, SER verb
- Articles, Adjectives, Demonstrative Adjectives

Unit-II : Learning to build simple sentences- 6 hours

- ESTAR verb to describe placements
- Prepositions of place
- SER ESTAR differences and application
- Using Hay for description
- Build simple sentences about yourself, your friends, classroom objects, household objects

Unit-III : Question words, Plurals, Present Tense and Present Continuous Tense of AR verbs - 7 hours

- Question words of What, who, where, which, why, when, how
- Build conversation skills by answering questions
- Making plurals of sentences
- Learning conjugations of AR verbs in Present Tense
- Learning Present continuous tense of AR Verbs
- Learning to Present oneself

Unit- IV : ER Verbs, Stem Changing Verbs and Tener - 7 hours

- Learning conjugations of ER verbs in Present Tense
- Learning Present continuous tense of ER Verbs
- Learning Food vocabulary
- Learning Basic Conversation at restaurant
- Stem changing Verbs conjugations
- Tener Verb to talk about age, describe family

Unit-V : SaberConocer, Time, IR Verbs, Leisure activities- 7 hours

- Saber Conocer to talk about abilities and personal acquaintance
- Learn to say Time in Spanish and Time related expressions
- Learning conjugations of IR verbs in Present Tense
- Learning Present continuous tense of IR Verbs
- Speak about activities what you do in leisure using all groups of verbs.

Unit-VI : Obligations, Prepositions, Possessive Adjectives, Gustar, Possessive Pronouns and Daily routine with reflexive verbs - 7 hours
- Talk about what has to be or should be done
- Learn prepositions for connecting sentences
- possessive adjectives to learn about my, your, his her, our.
- Learn likes and dislikes with Gustar
- Possessive pronouns to learn about mine, yours, ours.
- Reflexive verbs to Speak about daily routine.

Text Books & Reference Books:
Clan 7, Listos
Aula1, Chicoschicas

Dr.Manjusha P.Gandhi
Chairman,Board of Studies,General Engineering

GE-2370	Introduction to French Language		L=3	T=0	P=0	Credits =3
Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration	
	30	30	40	100	3 Hrs	

Objectives	Course Outcome: At the end of the course students will be able to:
The objective of this course is to impart preliminary knowledge about the French language and civilization and is therefore of an elementary level. At the end of the one year course, the student is expected to acquire the following skills: 1) Elementary communication skills, based on aural and written comprehension of common words and simple sentences in French. 2) Simple oral and written expression.	a) Understand simple words and expressions spoken slowly and distinctly in French and used in day-to-day situations related to the student's immediate environment. b) Read and understand common words and sentences in French. c) Say a few words in French in conversations related to simple day-to-day situations.

Unit-I : Grammar I – 6 hours
- French alphabets
- Pronunciation Guide
- Indefinite and definite articles
- Present tense: -er verbs (regular)

Unit-II : Grammar II – 6 hours
- etre, avoir (irregular verbs)
- Nouns (singular & plural)
- Adjectives
- Pronouns (subject)

Unit-III : Vocabulary – 6 hours
- Numbers (1-100)
- Days of the week
- Months of the year
- Nationalities
- Colours
- Adjectives words for common use used

- o Nouns words for common use used

Unit-IV : Communication skills I – 7 hours
- o Greetings
- o Presentation, introduction
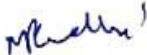
Unit-V : Communication skills II – 7 hours
- o Interrogation relating to everyday situations
- o Replying to simple questions.

Unit-VI : Civilization – 7 hours
- o Day to day life, eg.
- o Classroom
- o Friends
- o Family
- o School
- o Vacations
- o Introduction to France: Geography.

Text Books:

1) Ranjit, Mahita& Singh, Monica . `Apprenons le frangais', Part 1. Saraswati House Pvt. Ltd., New Delhi. Second Revised Edition, 2007.

2) Ranjit, Mahitha&Batra, Simran. 'Cahier d'exercices', (Apprenons le francais) 1. Saraswati Book House Pvt. Ltd., New Delhi, 2007.

Dr.Manjusha P.Gandhi
Chairman,Board of Studies,General Engineering

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Accredited 'A' Grade by NAAC
Hingna Road, Wanadongri, Nagpur-441110
2020-21
VI Semester
GE-2368 - Corrosion Engineering

GE-2368	Corrosion Engineering			L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSEs	TA	ESE	Total	ESE Duration		
	30	30	40	100	3 Hrs		

Objective	Outcomes
	Students will be able to
1. To asses, analyze summarize the corrosion events on the basis of mixed potential theory. 2. To provide rational thinking in suggesting solution on corrosion events and break down of machinery due to corrosion. 3. To offer preventive / minimizing methods to protect valuable structures. 4. To offer the benign processes to combat with corrosion 5. To provide strong viable technology enforcing with basic sciences.	1. Solve the problems based on corrosion events 2. Offer suitable method of prevention of corrosion 3. Develop tailor – made materials to combat with corrosion

Unit 1: Understanding corrosion engineering

Corrosion, basic concept metal corrosion, Corrosion Science and Corrosion Engineering, ingredients of corrosion, basic forms of corrosion, world scenarios of losses due to corrosion, Corrosion rate expression, Electrochemical aspect, Electrochemical Polarization, Activation and concentration polarization, Electro-chemical polarization and concentration polarization, Tafel equation(**7 hours**)

Unit II: Corrosion and Mixed potential theory

Helmholtz double layer, current density, Nernst equation, Boundary layer thickness, limiting current density and mixed potential theory, Activation and concentration polarization, mixed potential theory (MPT), numerical case study, Concentration polarization and MPT
Explanation of corrosion processes on the basis of MPT: evolution of corrosion events on the basis of mixed potential theory
Explanation of corrosion processes on the basis of MPT: Number of cathodic and anodic reactions, effect of impurities on dissolution of Zn(**6 hours**)

Unit III:

Mixed potential theory and numerical analysis

Effect of exchange current density and rate of an active metal effect of exchange current density on the corrosion of active component and depolarization
Area effect on the cathodic and anodic component, Morphology of perlite, Galvanic coupling, (zinc in dearated and pure HCl).
Explanation of corrosion events on the basis of MPT, numerical analysis(**7 hours**)

UNIT IV:
Mixed potential theory and protection methods
Galvanic coupling between two active metals
Theory of sacrificial anode for the protection of steel object
Effect of two active metals on iron corrosion when they are galvanically coupled
Corrosion metals when cathodic protection is concentration controlled
Effect of velocity on the corrosion rate of an active metal
Concentration polarization and activation polarization and numerical analysis**(6 hours)**

UNIT V:
Passivation ,Pourbiaxdigram and numerical analysis
Theory of passivation, Active passive transition and spontaneous passivity, factors affecting passivity, ennoblement, Numerical analysispassivation potential, passive and critical current density, pourbiax diagram, trans-passivity,Anodization, parameters for attainment of passivation
Interaction of anodic polarization with an active – passive metal, Faraday experiment of passivation, effect of velocity , Effect of galvanic coupling between active – passive metals and a noble metal, Passivation and MPTand cases studies **(7 hours)**

Unit VI:
Mixed potential theory and thermodynamics of oxidation
Anodic protection of an active – passive metal and an introduction of linear polarization
Cathodic polarization, cathodic loop, interactive passivation and mixed potential theory, influence of critical current density and effect of of concentration passivation and case study
Linear polarization and understanding relative corrosion resistance of a metal
Pilling Bed worth ratio of different metal oxides, Thermodynamics of oxidation**(6 hours)**

Text Books:

SN	Title	Edition	Authors	Publisher
1	Corrosion Engineering	McGraw – Hill International Editions	Mars G. Fontana	McGraw – Hill International Editions
2	Electrochemical kinetics		Yetter K. J	Academic Press New York
3	Chemistry	Fifth edition	John E McMurry and Robert C Fay	

Reference Books:

SN	Title	Edition	Authors	Publisher
1	A text Book of Engineering Chemistry	13 th edition	S SDara	, S Chand and Compony
2	Theory and Pracices in prevention of corrosion	On line	Riggs O L and C E Locker	

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Declaration by Head of Institute

I hereby declared that the data, information and support documents attached herewith are genuine and correct to my knowledge.

Dr. U. P. Waghe

(Principal)

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