BACHELOR OF ENGINEERING (FOUR YEARS DEGREE COURSE)

FACULTY OF ENGINEERING & TECHNOLOGY

COURSE AND EXAMINATION SCHEME WITH CHOICE BASED CREDIT SYSTEM

VII - SEMESTER B.E. ELECTRICAL (ELECTRONICS & POWER) ENGINEERING

Subject Code	Subject	Teaching Scheme				Examination Scheme									
		Hours per week			No. of Credits	Theory						Practical			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks	Max. Marks Sessional		Total	Min. Passing Marks	Max. Marks	Max. Marks	Total	Min. Passing Marks
							ESE	MSE	IE			TW	POE		
7BEEE01	Power Electronics	3	1	-	4	3	80	10	10	100	40	-	-	-	-
7BEEE02	Power System Protection & Switchgear	3	0	-	3	3	80	10	10	100	40	-	-	-	-
7BEEE03	Electrical Energy Utilization	3	0	0	3	3	80	10	10	100	40	-	-	-	-
7BEEE04	Control Systems - II	3	1	0	4	3	80	10	10	100	40	-	-	-	-
7BEEE05	Program Elective – III (PE-III)	3	0	0	3	3	80	10	10	100	40	-	-	-	-
Laboratories/ Practical															
7BEEE06	Power Electronics	-	-	2	1	-	-	-	-	-	-	25	25	50	25
7BEEE07	Power System Protection & Switchgear	-	-	2	1	-	-	-	-	-	-	25	25	50	25
7BEEE08	Major Project Seminar	-	-	2	1	-	-	-	-	-	-	25	-	25	13
TOTAL		15	02	06	20		500					125			
		23			**20**		**625**								

PROGRAM ELECTIVE – (PE – III): (1) EHV AC-DC Transmission (2) Modeling of Electrical Machines

GONDWANA UNIVERSITY, GADCHIROLI

COURSE: B.E. VII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 7BEEE01 **Title of Course: Power Electronics**

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	01	02	06	04+01=05	3	10	10	80	100

Course Objective:

1) To provide acquire knowledge about the design and development of power controller and controller design.
2) To provide design and implement of single phase and three phase converter, inverter,choper and cycloconverter.
3) To Understand the protection scheme,firing,of series and paraller connection of thyristor.
4)

Unit	Contents	Hours
UNIT I	**Basics in Power Electronics Engineering** Development of Power Controllers, Working Principle & Characteristics of different Power Controllers, Thyristor Family, Two Transistor model of SCR, Gate Characteristic, Turn On , Turn Off Mechanisms & other ratings of SCRs , Relaxation Oscillators using UJT, Basic Firing Circuits for SCR, Application of SCR in obtaining Logic Gates, Flip Flop and Circuit Breaker, AC Power control using TRIAC- DIAC, Basic Firing Circuits for SCR. Power Transistor, Power MOSFET & IGBT (Basic properties, characteristics, comparison & applications	**10**
UNIT II	**Phase Controlled Rectification** Principle of Phase Control, Line Commutation, Single phase half wave, Full wave mid – point, Fully controlled with & without freewheeling diode with different types of Loads, Effect of Source inductance, Half Controlled Bridge configurations, Development of expressions for mean current & voltage for different loads, Dual Converter. Three Phase fully controlled & half controlled bridge circuits , Development of expressions for mean	**10**
UNIT III	**Inverters** Principle of Inversion, Various Techniques of Forced Commutation & their designs, Single phase & Three phase series Inverter, Single Phase Parallel Inverter, Single phase bridge Inverter (All with commutation Circuits), Design of Filter. Three phase fully controlled bridge inverters in different modes (without commutation Circuit), Design of complete firing circuit for Three phase Power Control Circuits.	**10**
UNIT IV	Principle of Working ,Types of Choppers, Oscillating Chopper, Jones & Morgan's Chopper, Multi Phase Chopper, Step Up Chopper, AC Chopper, Need & Principle of Working of Cycloconverter using single phase bridge circuits	**08**
UNIT V	**Multiple Connection & Protection** Need & methods of multiple connections of SCRs, Design of Equalizing Circuits, Firing Circuits during multiple connection, Gate protection, Over current & over voltage protections of SCR, Design of Snubber Circuit, Converter Faults.	**07**
	Total	**45**

Course Outcome:

Upon successful completion of course student will be able to;

1) Apply various conventional and advanced techniques for Controller design.
2) Understand various power electronics device and their use in the industrial application.

3) Expose the general issues concerning the design, principle of operation and characteristics of power electronics device.
4) Understand the modeling ,analysis and Thyristor devices.
5) Develop skills for analysis of different types of converter topology,inverter topology,chopper
6) Different, protection scheme and design of firing circuit for different scheme. It will encourage the students to work in core electrical engineering field like testing, maintenance, installations etc

Text Books:

1) M.H. Rashid, "Power Electronics Circuits, Devives & Applications", Pearson Education
2) C.W. Lander, "Power Electronics", McGraw Hill
3) M. Ramamoorthy, " Thyristors & their Applications"
4) GK Dubey, Doradla, Singh, Joshi " Thyristorstorized Power Controllers", New Age International
5) Singh, Khanchandani, " Power Electronics", Tata McGraw Hill
6) SCR Manaual by General Electric

Reference Books

1) Philip T. Krein, "Elements of Power Electronics", Oxford University Press
2) Vedam Subrahmanyam, "Power Electronics", New Age International
3) MS Jamil Asghar, "Power Electronics", Prentice Hall of India
4) PC Sen, 'Modern Power Electronics", S. Chand Publishers
5) PS Bhimra, "Power Electronics", Khanna Publishers

GONDWANA UNIVERSITY, GADCHIROLI

COURSE: B.E. VII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 7BEEE02 Title of Course: Power System Protection and Switchgear

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	--	02	05	03+01=04	3	10	10	80	100

Course Objective:

1) To understand the need of protection.
2) To understand the operations of various types of circuit breakers and their ratings.

Unit	Contents	Hours
UNIT I	**Fundamentals of Arc Interruption**: Current interruption in AC circuit breaker, high & low resistance principles, arc interruption theories, arc voltage, recovery voltage, restriking voltage and RRRV, current chopping, interruption of capacitive and inductive current, Circuit breakers: C.B. ratings, Different media of arc interruption, Overview of circuit breakers, construction and operation of air blast, SF6 and vacuum breakers.	**9**
UNIT II	**Fundamentals of Protective Relaying**: essential qualities of protective relaying. Trip, zones of protection. Attracted armature and Induction disc type electromagnetic relays. Operating principles of over current and directional over current relays, Various types of over current relays as per their time-current characteristics, Current and time settings,	**9**
UNIT III	**Introduction to distance protection**: impedance relay, reactance relay and mho relay, Methods of relay settings Connections of impedance, reactance and mho relays, Effect of arc resistance, Line length and source impedance and power swing on performance of distance relays.	**9**
UNIT IV	**Transformer Protection:** Types of faults in transformer. Percentage differential protection in transformers, Inrush phenomenon, percentage differential relay with harmonic restraint. Restricted E/F protection. Incipient faults, buchholz relay. **stator faults**- longitudinal percentage differential scheme and transverse percentage differential scheme. **Rotor faults-** abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation, protection against loss of excitation using offset Mho relay, loss of prime mover. Bus bar Protection: Differential protection of bus bars. High impedance differential relay. Protection of induction motor: Abnormal operating conditions and causes of failures in induction motor, Protection against overloads, unbalance and single phasing, stator fault protection.	**9**
UNIT V	**Introduction to static relay:** Comparison of static and electromechanical relays, two input amplitude and phase comparator and their duality. Microprocessor based Digital Relaying: Introduction, Digital logic communication, Direct relay to relay digital logic communication, Digital message security, Relay interface with utility, Microprocessor based over current, impedance, reactance and mho relay, Applications of Microprocessor based relays.	**9**
	Total	**45**

Course Outcome:

Upon successful completion of course student will be able to,

1) Ability to express oil C.B., ABCB, SF6 CB and ability to discus recovery and restriking .
2) Know about protective scheme how it works? Where it works?

3) Explain various methods distance protection ad their effects.
4) Ability to identify rotor stator fault, interturn fault and their protection.
5) Analyse the tripping characteristics of various relays and its application, also set their parameter.

Text Books –

1) Badri Ram, D. N. Vishwakarma, "Power System Protection and Switchgear", TMH
2) Y. G. Paithankar, S. R. Bhide, "Fundamentals of Power System Protection", Prentice Hall of India .
3) Ravindra P.Singh, "Switchgear and Power System Protection" Prentice Hall of India

Reference Books -

1) C.R.Mason, "Art and science of protective relaying"WileyEastern Ltd.
2) C.L.Wadhwa, Electrical Power Systems, New Age international (P) Limited, Publishers
3) B.L.Soni, Gupta, Bhatnagar, Chakrabarthy, A Text book on A course in electrical power.

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(Minimum Eight practical based on above syllabus)

GONDWANA UNIVERSITY, GADCHIROLI

COURSE: B.E. VII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 7BEEE03 Title of Course: Electrical Energy Utilisation

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	--	--	03	03	3	10	10	80	100

Course Objective:

To impart knowledge on:

1 Industrial applications of electric drives.
2 Principle and design of illumination systems and methods of heating and welding.
3 Electric traction systems and their performance.
4 Electrical energy utilisation, conservation and power quality.
5. Utilisation of electrical power by conventional and non–conventional methods.

Unit	Contents	Hours
UNIT I	**ELECTRIC DRIVES** Advantages of electric drives. Characteristics of different mechanical loads. Types of motors used in electric drive. Electric braking, Plugging, Rheostatic & Regenerative braking. Methods of power transfer by direct coupling using devices like belt drive, gears, pulley drives etc. Selection of motors for different types of loads: domestic, general workshop, textile mill, paper mill, steel mill, printing press, crane, lift etc. Specifications of commonly used different motors e.g. squirrel cage, slip ring induction motors, AC series motors.	**10**
UNIT II	**ELECTRIC HEATING** Need of electrical heating. Heating methods: Resistance heating – direct and indirect resistance heating, electric ovens and their temperature range, properties of resistance heating elements, domestic water heaters and other heating appliances, thermostat control circuit. Induction heating; principle of core type and coreless induction furnace. Electric arc heating; direct and indirect arc heating, construction, working and applications of arc furnace. Other heating methods: Dielectric heating, Infra-red heating, Microwave heating and their applications.	**08**
UNIT III	**ELECTRIC WELDING** Need of electric welding. Welding method. Principles of resistance welding, types: spot, projection, seam and butt welding and welding equipment use. Principle of arc production, electric arc welding, characteristics of arc, carbon arc, metal arc, hydrogen arc welding method and their applications. Power supply required. Advantages of using coated electrodes, comparison between AC and DC arc welding, Welding control circuits, Welding of aluminum and copper. Introduction of TIG, MIG Welding.	**08**
UNIT IV	**ILLUMINATION FUNDAMENTALS & METHODS** Nature of light, visibility spectrum curve of relative sensitivity of human eye and wave length of light. Definition: Luminous flux, solid angle, luminous intensity, illumination, luminous Efficiency, depreciation factor, coefficient of utilization, space to height ratio, reflection factor, glare, shadow, lux. Laws of illumination –simple numerical. Different type of lamps, construction and working of incandescent and discharge. lamps – their characteristics, fittings required for filament lamp, mercury vapour. Lamp, fluorescent lamp, metal halide lamp, neon lamp. Calculation of number of light points for interior illumination, calculation of illumination at different points, considerations involved in simple design problems. Illumination schemes; indoor and outdoor. Illumination levels. Main requirements of proper lighting; absence of glare, contrast and shadow. General	**09**

	ideas about street lighting, flood lighting, monument lighting and decorative lighting, light characteristics.	
UNIT V	**ELECTRIC TRACTION** Advantages of electric traction. Different electric traction systems: DC and AC systems, diesel electric system, types of services – urban, sub-urban, and main lines and their speed-time curves. Accessories for track electrification; overhead capacitor wire, conductor rail system, current collector-pantograph. Special features of traction motor. Train movement mechanics. Crest, average and schedule speed, Speed-time curves for different services – trapezoidal and quadrilateral speed time curves. Calculations of tractive effort, power, specific energy consumption for given run. Effect of varying acceleration and braking retardation, adhesive weight and braking retardation adhesive weight and coefficient of adhesion. Introduction to EMU and metro railways. Train movement mechanism. Digital logic communication, Digital message security, Relay interface with utility, Microprocessor based over current, impedance, reactance and mho relay, Applications of Microprocessor based relays.	**10**
	Total	**45**

Course Outcome:

Upon successful completion of course student will be able to:

1) Understand efficient role of drives.
2) Know the importance & purpose of heating.
3) Know & recognize welding activities
4) Understand and analyze role of illumination
5) Acquainted with Electric Traction

TEXT BOOKS:

1. A First Course in Electrical Drives by S. K. Pillai, New Age International.
2. Art & Science of Utilization of electrical Energy – by H. Partab, Dhanpat Rai & Sons.
3. Utilization of Electrical Energy by JB Gupta, Kataria Publications, Ludhiana.
4. A. Text Book. of Electrical Power by Dr. SL Uppal, Khanna Publications, Delhi
5. Modern Electric Traction by H Partap, Dhanpat Rai & Sons, Delhi

REFERENCE BOOKS:

1. Utilization of Electric Energy in SI Units by E.O.Taylor , Orient Longman Ltd.
2. Utilization of Electrical Power including Electric drives and Electric traction – by N.V.Suryanarayana, New Age International (P) Limited, Publishers, 1996.

GONDWANA UNIVERSITY, GADCHIROLI

COURSE: B.E. VII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 7BEEE04 **Title of Course: Control System - II**

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	01	--	04	04	3	10	10	80	100

Course Objective:

1) To introduce different types of compensator, Analysis of compensator in time and frequency domains and identify the needs of different types of compensator to ascertain the required response from the system
2) To employ state variable approach for the analysis of single input single output system and multi input multi output system
3) Formulate different types of analysis in time domain and frequency domain to explain the nature of stability of the system.

Unit	Contents	Hours
UNIT I	**Compensation Technique** Approaches and Preliminary consideration. Need for compensation. Common compensating network. Transfer function of Lag, Lead and Simple Lag-Lead network. Analysis of compensator in time and frequency domain Bode Plot. Physical realization of compensators using Active and Passive elements	**8**
UNIT II	**State Space Analysis** Review of state space analysis. Concept of diagonalization. Eigen values, Eigen vector, Diagonalization of system matrix with distinct and repeated Eigen values. Vander Monde matrix. Solution of homogenous and non-homogenous state equation. State transition matrix, Its properties, Various methods to determine State transition matrix.	**10**
UNIT III	**Design of Control System Using State Space Technique** Definition of controllability & observability, controllability & observability matrices, condition for controllability & observability from the system matrices in canonical form, Jordan canonical form, effect of pole zero cancellation on the controllability & observability of the system, duality property. Pole placement design by state feedback. State observer, design of full order observer	**7**
UNIT IV	**Non linear System Analysis** Introduction , Types of non-linearities, Characteristics of non linear control systems, Inherent & intentional non linearities, Introduction to describing function, Describing function of some common non-linearities. Stability anlaysis, Limit cycle & stability of limit cycles. **Stability of Non Linear System** Introduction to phase plane method, Singular point. Stability from nature of singular point, Construction of trajectory by Isoline & Delta method. Computation of time	**10**
UNIT V	**Sampled Data Control Systems** Representation of SDCS. Sample & Hold circuit, Z-Transform. Inverse Z-Transform & solution of difference equation. 'Z' &'S' domain relationship. Stability by Bi-linear transformation & Jury's test. Discrimination of continuous time state equation. Solution of Discrete time equation ,Controllability & Observability of Discrete time system	**10**
	Total	**45**

Course Outcome:

Upon successful completion of course student will be able to:

1) Apply various conventional and advanced techniques for Controller design.
2) Understand various compensating techniques and their use in the industrial application.
3) Expose the general issues concerning the design, principle of operation and characteristics of

Linear and Non Linear system.

4) Understand the modeling ,analysis and stability of different types Linear and Non-Linear systems, hence Students will able to use the knowledge of mathematics and engineering..
5) Develop skills for analysis of different types of non-linearities and its describing functions.Stability anlaysis by using Isocline and delta method.
6) Study and design of sample data control system.It will help the students to find controllability and observability and stability of Sample data control system It will encourage the students to work in core electrical engineering field like testing, maintenance, installations etc.

Text Books –

1. I.J. Nagrath ,M.Gopal "Contorl System Engineering", 5th Edition, New Age International Publishers.

Reference Books -

1. Benjamin C. Kuo, "Automatic Control Engineering", Prentice Hall of India Pvt. Ltd.
2. K. Ogata' " Modern Control Engineering", Prentice Hall of India Pvt. Ltd.
3. M. Gopal' "Digital Control Engineering", Wiley Eastern, 1988
4. M. N. Bandyopadhyan, " Control Engineering – Theory and Practice", Prentice Hall of India Ltd. Delhi

GONDWANA UNIVERSITY, GADCHIROLI

COURSE: B.E. VII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 7BEEE05A, Program Elective – III (PE – III)
Title of Course: A. EHV AC-DC Transmission

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	--	--	03	03	3	10	10	80	100

Course Objective:

1) To deal with the importance of EHV AC-DC Transmission system.
2) To deal with power conversion between AC to DC and DC to AC.
3) To deal with power flow control in HVDC system.
4) To deal with Reactive power control of HVDC system.
5) To deal with the protection of HVDC system.

Unit	Contents	Hours
UNIT I	Need of EHV transmission lines, Power handling capacities. Voltages gradients: Electric field of point charge, sphere gap line-charge. Single and three phase lines, and bundled conductors. Maxwell's potential coefficients, Mangoldt Formula.	08
UNIT II	Electrostatic and electromagnetic fields of EHV lines, electric shock and Threshold current Effect of high electrostatic field, measurement of electrostatic field, Induced voltages in insulated ground wires, electromagnetic interference. Corona: Types, critical disruptive voltages: Factors affecting corona, Methods for reducing corona power loss, corona current wave form, charge voltage diagram, audible noise and radio interference.	**08**
UNIT III	Comparison for EHVAC and HVDC systems. Conversion from AC to DC, Rectifiers, conversion from DC to AC, Inverters. Kind of DC link. Earth electrode and earth returns: - Introduction, objectives, location and configuration, Resistance of electrodes means of reducing earth electrode resistance, troubles caused by earth current and remedies. Multi-terminal HVDC system: Introduction, 2 pole transmission, MTDC system with series and parallels connected converters, advantages and parallel connected converters, advantages and applications, configurations and types.	**10**
UNIT IV	Power flow control in HVDC system:- Constant current. Constant voltage, constant ignition and excitation angle control, control characteristics. Parallel operation of AC and DC links (Synchronous and Asynchronous links.) Reactive power requirement of HVDC Converter	**09**
UNIT V	HVDC circuit breakers: Introduction, construction, principle, switching energy, interruption of DC current, application of MRTB, Type of HVDC C.B, capability and characteristics of HVDC circuit breakers. HVDC Substation protection against short-circuits: Introduction, fault clearing, protective zones, and protection symbol, HVDC line pole protections (fault clearing and re- energizing). HVDC Sub-station Protection against over-voltages. Difference between insulation co-ordination of AC and DC systems.	**10**
	Total	**45**

Course Outcome:

Upon s upon successful completion of course student will be able to,

1) C405.1 -Elicit the advantages of EHV-AC transmission system.
2) C405.2 -Mould the students to acquire the knowledge about power handling capacities of EHV AC Transmission line.
3) C405.3 -To acquire the knowledge about HVDC transmission system.
4) C 405.4 - The course gives idea about modern trends in HVDC transmission and its applications.
5) C405.5 -To acquire the knowledge about HVDC protection against over voltages.

Text Books –

1) Rakesh Das Begmudre, Extra High Voltage AC Transmission Engineering, Wiley Eastern Limited.
2) S. Rao , EHVAC and DC transmission , Khanna Publications.
3) K.R. Padiyar , HVDC Transmission, System Wiley eastern Limited.
4) S Kamakshaiah and V Kamaraju,HVDC Transmission, Tata McGraw-Hill publications

Reference Books -

1) P. Kundur, HVDC Transmission, McGraw-Hill publications.
2) C.L. Wadhwa , Electrical Power Systems, New age International Pvt Limited.

GONDWANA UNIVERSITY, GADCHIROLI

COURSE: B.E. VII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 7BEEE05B, Program Elective – III (PE – III)
Title of Course: B. Modelling of Electrical Machines

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	--	--	03	03	3	10	10	80	100

Course Objective:

1) To master the various fundamentals, machine design, machine modeling of various types of electrical machines.
2) To help the students to gain knowledge and to do research in the area of electrical machine modeling

Unit	Contents	Hours
UNIT I	**Elements of Generalized Machines Theory :** Conventions, Basic two-pole machine, Per unit system, transformer and speed voltages, Kron's primitive machine analysis.	**09**
UNIT II	**Linear transformations in Machines :** Invariance of power, Transformation from three-phases to. two phases, transformation from rotating axes to stationary axes, transformed impedance matrix.' Electrical Torque.	**09**
UNIT III	**D. C. Machines :** Separately excited d. c. generators; Sudden short-circuit analysis, separately excited d. c. motor; Sudden application of inertia load, Transfer functions of d. c. machines; separately excited d. c. generator and d. c. motor and d. c. Compound machines; d.c. series motors, d. c. shunt machines (motor operation, generator operation at no load and on load). Linearization techniques for small perturbations.	**09**
UNIT IV	**Polyphone Synchronous Machines :** Equations in arbitrary reference frame - Park's transformation - derivation of *dq0* model for a salient pole synchronous machine with damper windings - torque expression of a salient pole synchronous machine with damper windings and identification of various components.	09
UNIT V	**Polyphase Induction Machines & Transformer:** Voltage and torque in machine variables - derivation of *dq0* model for a symmetrical induction machine - voltage and torque equation in arbitrary reference frame variables - analysis of steady- state operation - state-space model of induction machine in '*d-q'* variables	**09**
	Total	**45**

Course Outcome:

Upon successful completion of course student will be able to,

1) CO1: To learn about the basic concepts of AC/ DC machine modeling.
2) CO2: To study about the dynamic modeling and phase transformation
3) CO3: To analyze various methodologies in small signal machine modeling.
4) CO4: To understand the modeling of synchronous machine modeling.
5) CO4: To understand the modeling of synchronous machine modeling.

Text Books -

1) Generalised Theory of Electrical Machines, P. S. Bimbhara, II Edition, Khanna Publishers, Delhi, 1980.

2) The General Theory of Electrical Machines, Adkins B , John Wiley Sons, 1957

Reference Books -

1) Electric Machinery : Fitzgerald, Kingsley and Kushko-V Edition, McGraw Hill.
2) Introduction to Generalized Electrical Machines Theory : D. O. Kelly and Simons, McGraw Hill, 1968.
3) Electric motor drives: modeling, analysis, and control, Prentice Hall, 2001, Rama Krishnan
4) Analysis of Electric Machinery & Drive systems, Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff - IEEE Press, 2002

BACHELOR OF ENGINEERING (FOUR YEARS DEGREE COURSE)

FACULTY OF ENGINEERING & TECHNOLOGY

COURSE AND EXAMINATION SCHEME WITH CHOICE BASED CREDIT SYSTEM

VIII - SEMESTER B.E. ELECTRICAL (ELECTRONICS & POWER) ENGINEERING

Subject Code	Subject	Teaching Scheme				Examination Scheme									
		Hours per week			No. of Credits	Theory						Practical			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks	Max. Marks Sessional		Total	Min. Passing Marks	Max. Marks	Max. Marks	Total	Min. Passing Marks
							ESE	MSE	IE			TW	POE		
8BEEE01	Advanced Electrical Drives	3	1	0	4	3	80	10	10	100	40	-	-	-	-
8BEEE02	Computer Applications in Power system	3	1	0	4	3	80	10	10	100	40				
8BEEE03	Program Elective – IV (PE – IV)	3	0	0	3	3	80	10	10	100	40	-	-	-	-
8BEEE04	Open Elective (OE)	3	0	0	3	3	80	10	10	100	40				
Laboratories/ Practical															
8BEEE05	Computer Applications in Power system	-	-	2	1	-	-	-	-	-	-	25	25	50	25
8BEEE06	Major Project	-	-	6	6	-	-	-	-	-	-	75	75	150	75
8BEEE07	Industrial Training **	-	-	1	1	-	-	-	-	-	-	25	-	25	13
TOTAL		12	02	9	22		400					225			
		23			**22**		**625**								

PROGRAM ELECTIVE – IV (PE – IV): (1) Power System Operations & Control, (2) Flexible AC Transmission System

Open Elective (OE): (1) Artificial Intelligence, 2) Internet of Things

Industrial Training : Every student shall undergo relevant Industrial Training of TWO WEEKS and shall submit a comprehensive report, signed by the Competent Authority from the concerned Industry. This Training may be taken up by the students preferably at the end of V OR VI – Semester of their Course. One separate period (as practical) is allotted to facilitate proper assessment of industrial training by the staff.

GONDWANA UNIVERSITY, GADCHIROLI

COURSE: B.E. VIII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 8BEEE01 **Title of Course: Advanced Electrical Drives**

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	01	--	04	04	3	10	10	80	100

Course Objective:

The course objectives are:

1. Introduction to different types of drives and its applications in various industries.
2. To know the characteristics of various motors and loads.
3. Gain the knowledge about operation of DC motor speed control using converters and choppers
4. To acquire the knowledge of different speed control methods in AC motors using thyristors based control schemes.
5. To understand the modes of operation of a drive in various applications.
6. To enable the students identify the need and choice for various drives.

Unit	Contents	Hours
UNIT I	Introduction to electric drives: Advantages of Electric drives, Choice of Electric Drives and Losses. Latest trends in DC & AC Drives, Dynamics, Equivalent values of drive parameters, Load Torque: component , Natures and classification, steady state stability, Speed-torque characteristics, criteria load equalization.	**09**
UNIT II	Starting, Braking, Speed control of DC motors using single phase fully controlled and half-controlled rectifiers. Three phases fully controlled and half-controlled converter fed DC motor drives. Chopper controlled DC drives.	**09**
UNIT III	Three phase induction motor drives - ac voltage controlled drives –- VSI fed induction motor drive – stator side control – scalar control and vector control – rotor side control - slip power recovery scheme - CSI controlled induction motor drives. Regeneration in drives: dynamic braking, regenerative braking, dc injection, plugging. Basic concepts of synchronous motor drives, switched reluctance motor drives and permanent magnet motor drives.	**10**
UNIT IV	Drive for rolling mills,(four quadrant operation), Machine tools(constant torque application), Textile mills , sugar mills, paper mill, Cement mill.	**07**
UNIT V	Steady state & dynamic stability limits of synchronous motor drives, True synchronous & self synchronous modes of operation, Variable frequency control of multiple synchronous motors, Self-controlled synchronous motor drive employing load commutated thruster inverter, Starting of large synchronous machines, Self-controlled synchronous motor drive employing cycloconverters, Brush less D.C. Motor drives. Important features & applications.	**10**
	Total	**45**

Course Outcome:

Upon successful completion of course student will be able to,

1. Able to choose their electric drive system based on the applications.
2. Understand the principles of single and multiquadrant operation of electrical drive.
3. Acquire the knowledge of dynamics of an electrical drives & able to prepare Equivalent motor load system model from given multi load system drive.\
4. To provide solid foundation in controlling method of different electrical Drives using semiconductor devices.
5. Articulate power electronics applications in control of speed, torque and other components.

6. Able to understand & to apply control techniques for DC motor by Single phase & Three Phase converters & Choppers.
7. Able to understand & to apply control techniques for AC motor drives through Stator Sideas well as rotor side control.
8. Able to understand the various process involved in different industries. And able to select suitable drives for each.

Text Books :

1. "Fundamentals of Electric Drives", by G K Dubey ,Narosa Publications.
2. "Power Electronic Circuits, Devices and applications", by M.H.Rashid, Prentice Hall of India
3. "Modern Power Electronics and AC Drive", by B.K. Bose ,Pearson Education
4. "Electric Drives", N. K. De, P. K. Sen, Prentice Hall of India Eastern Economy Edition

Reference Books

1. "Thyristor Control of Electric drives" by Vedam Subramanyam, Tata McGraw Hill Publilcations.
2. "A First course on Electrical Drives", by S K Pillai, New Age International(P) Ltd. 2
3. "Electric Drives", by S.K.Pillai, University Press India, 1993
4. "Control of electrical drives", by Werner Leonhard, Springer, 1995.
5. "Electric Drives: Concepts & Application", by V. Subramanyam ,Tata Mc-Graw Hill
6. "Power semiconductor Drives", S. B. Dewan & G. R. Stemon& A. Straughen, Wiley Inter Science
   "Power Electronics, Devices,Circuits and Industrial Applications", V.R. Moorthi,
   "OxfordUniversity Press, 2005

GONDWANA UNIVERSITY, GADCHIROLI

COURSE: B.E. VIII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 8BEEE02 Title of Course: Computer Applications in Power System

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	01	02	06	04+01=05	3	10	10	80	100

Course Objective:

1) To gain the knowledge on formation of suitable mathematical model of a given power system network.
2) To select suitable method and mathematical model for short circuit and load flow studies.
3) To select suitable method and mathematical model for transient stability analysis.
4) To analyze the given power system network under normal and fault conditions.

Unit	Contents	Hours
UNIT I	**Incidence and Network Matrices** Graphs, Incidence Matrices, Primitive Network, Formation of network matrices by singular transformation.	**09**
UNIT II	**Algorithms for formation of network matrices** Algorithm for formation of bus impedance matrix, modification of the bus impedance matrix for changes in the network. Numericals without mutual coupling. **Three Phase Networks** Three-phase network elements, three-phase balanced network elements, transformation matrices, three-phase unbalanced network elements, Incidence and network matrices for three-phase networks, Algorithm for formation of three-phase bus impedance matrix, Modification of three-phase bus impedance matrix for changes in the network. Numericals without mutual coupling.	**10**
UNIT III	**Load Flow Studies** Power flow equation, classification of buses. Algorithm and flow chart for Gauss-Seidel method, Modification of algorithm to include P-V buses, Q-limit violations, acceleration of convergence. Newton-Raphson method in Rectangular and Polar co-ordinates form, load flow solution with and without P-V buses. Derivation of Jacobean elements, algorithm and flow chart.	**10**
UNIT IV	**Short circuit studies** Short circuit calculations using Z_{BUS}, System representation, fault currents and voltages. Short circuit calculations for balanced three phase network using Z_{BUS}: Transformation to symmetrical components. Three phase to ground fault, Line to line fault, Line to ground fault.	**09**
UNIT V	**Transient stability studies** Swing equation, Solution techniques: Modified Euler method and Runge-Kutta fourth order method.	**07**
	Total	**45**

Course Outcome:

Upon successful completion of course student will be able to use:

1) Recent techniques and computer applications for modeling of practical and large interconnected power system networks.

2) Recent methodologies for simulation and analysis of power system networks like real and reactive power flows,short circuit and transient stability analysis.
3) Algorithms required to find out parameters for monitoring and control of power system in real time from actual measurement data.
4) Computer algorithms to solve algebro-differential equations pertaining to power system to assess the stability performance of power systems.

Text Books -

1) Computer methods in power systems analysis by G.W. Stagg, Ahmed H. Ei-Abiad, McGraw-Hill International Editions.
2) Computer techniques in power system analysis by M.A.Pai,Tata McGraw –Hill Publishing company Ltd. New Delhi.
3) Computer techniques and models in power systems by K. Uma Rao,I.K. International publishing house Pvt. Ltd., New Delhi.

Reference Books -

1) Modern power system analysis by D.P. Kothari and I.J. Nagrath Tata McGraw –Hill Education Pvt. Ltd., New Delhi.
2) Computer aided power system operation and analysis by R.N. Dhar,Tata McGraw –Hill, New Delhi.
3) Computer aided power system analysis by George L. Kusic,Prentice Hall of India(P) Ltd., New Delhi.

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(Minimum Eight practicals based on above syllabus)

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COURSE: B.E. VIII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 8BEEE03A, Program Elective – IV (PE-IV)
Title of Course: A. Power System Operations and Control

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	--	--	03	03	3	10	10	80	100

Course Objective:

1) To understand real power control and operation.
2) To know the importance of frequency control.
3) To analyze different methods to control reactive power.
4) To understand unit commitment problem and importance of economic load dispatch.
5) To understand real time control of power systems.

Unit	Contents	Hours
UNIT I	Introduction to stability, dynamics of synchronous machine, swing equation, power angle equation and curve, types of power system stability (concepts of steady state, transient, dynamic stability), equal area criterion, applications of equal area criterion (sudden change in mechanical input, effect of clearing time on stability, critical clearing angle, short circuit at one end of line, short circuit away from line ends and recloser), solution of swing equation by point by point method, concept of multi-machine stability, methods to improve steady state and transient stability, numerical based on equal area criteria.	**10**
UNIT II	**Reactive Power management** Necessity of reactive power control, reactive power generation by a synchronous machine, effect of excitation, loading capability curve of a generator, compensation in power system (series and shunt compensation using capacitors and reactors), concept of sub synchronous resonance, synchronous condensor	**10**
UNIT III	Understand the **FACTs Technology** Problems of AC transmission system, evolution of FACTs technology, principle of operation, circuit diagram and applications of SVC, TCSC, STATCOM and UPFC.	**08**
UNIT IV	**Economic load dispatch and unit commitment** A) Economic load dispatch: Introduction ,revision of cost curve of thermal and hydropower plant, plant scheduling method, equal incremental cost method, method of LaGrange multiplier (neglecting transmission losses), Economic scheduling of thermal plant considering effect of transmission losses, penalty factor, numerical. B) Unit commitment:- Concept of unit commitment, constraints on unit commitment – spinning reserve, thermal and hydro constraints, methods of unit commitment – priority list and dynamic	**10**
UNIT V	**Automatic generation and control** Concept of AGC, complete block diagram representation of load-frequency control of an isolated power system, steady state and dynamic response, control area concept, two area load frequency control, load frequency control with generation rate constraints (G.R.C.S.), effect of speed governor dead band on A.G.C., digital load frequency controller.	**07**
	Total	**45**

Course Outcome:

Upon successful completion of course student will be able to:

1) understand concept of the power systems stability, stability condition and transient stability under various fault condition

2) **C**oncept of reactive power, voltage control and excitation methods
3) Understand the importance of controllable parameters and benefits of facts controllers.
4) **O**ptimum unit commitment for a power system
5) To acquire the knowledge about load frequency control and speed governing system

Text Books:

1) Abhijit Chakrabarti, SunitaHalder, "Power System Analysis Operation and Control", Prentice Hall of India
2) I. J. Nagrath, D. P. Kothari, "Modern Power System Analysis", Tata McGraw Hill Publishing Co. Ltd.
3) P. S. R. Murthy, "Power System Operation & Control", Tata McGraw Hill Publishing Co. Ltd.
4) P. S. R. Murthy, "Operation & Control in Power System", B. S. Publication

Reference Books:

1) Allen J. Wood, Bruce F. Wollenberg "Power Generation, Operation, and Control", Wiley India Edition. "Electrical Power System Handbook", IEEE Press Hingorani, "Understanding FACTs" IEEE Press
2) Olle I. Elgerd, "Electrical Energy System Theory", 2nd Edition, Tata McGraw Hill Publishing Co. Ltd. PrabhaKundur " Power system stability and control" Tata McGraw Hill
3) R. Mohan Mathur, Rajiv K. Varma, "Thyrister based FACTs controller for Electrical transmission system', John Wiley & Sons Inc.

GONDWANA UNIVERSITY, GADCHIROLI

COURSE: B.E. VIII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 8BEEE03B, Program Elective – IV
Title of Course: B. Flexible AC Transmission System (FACTS)

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	--	--	03	03	3	10	10	80	100

Course Objective:

1) To understand the fundamentals of FACTS Controllers,
2) To know the importance of controllable parameters and types of FACTS controllers & their benefits
3) To understand the objectives of Shunt and Series compensation
4) To Control STATCOM and SVC and their comparison and the regulation of STATCOM, Functioning and control of GCSC, TSSC and TCSC

Unit	Contents	Hours
UNIT I	Facts Concepts: Transmission interconnections power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, and benefits from FACTS controllers.	**8**
UNIT II	Voltage Source Converters: Single phase, three phase full wave bridge converters transformer connections for 12 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.	**10**
UNIT III	Static Shunt Compensation: Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, Methods of controllable var generation, variable impedance type static var generators, switching converter type var generators and hybrid var generators.	**10**
UNIT IV	SVC and STATCOM: SVC: FC-TCR and TSC-TCR. STATCOM: The regulation and slope. Comparison between SVC and STATCOM	**7**
UNIT V	Static Series Compensators: Objectives of Series compensation, concept of series capacitive compensation, GTO thyristor controlled series capacitor (GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC) control schemes for GSC TSSC and TCSC.	**10**
	Total	**45**

Course Outcome:

After completion of this course the student is able to:

1) Choose proper controller for the specific application based on system requirements.
2) Understand various systems thoroughly and their requirements.
3) Understand the control circuits of Shunt Controllers SVC & STATCOM for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping.
4) Understand the Power and control circuits of Series Controllers GCSC, TSSC and TCSC

Text Books:

1) "N.G. Hingorani and L. Guygi", Understanding FACTS Devices, IEEE Press Publications 2000.
2) "Yong- Hua Song, Allan Johns", Flexible AC Transmission System, IEE Press 1999.

Reference Books -

1) "Kalyan K. Sen and Meylingsen", Introduction to FACTS Controllers, John wiley& sons, Inc., Mohamed E.EI – Hawary Series editor, 2009.

2) “K. R Padiyar, Motilal”,FACTS controllers in power transmission and distribution UK Books of India 2007.

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COURSE: B.E. VIII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 8BEEE04A, Open Elective (OE)
Title of Course: A. Artificial Intelligence

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	--	--	03	03	3	10	10	80	100

Course Objective:

1) To introduce the students to the fundamental concepts of artificial intelligence and provide them the ability to analyze and design intelligent systems.
2) Have a thorough understanding of classical and modern AI applications.
3) Be able to assess the potential of AI in research and real-world environments

Unit	Contents	Hours
UNIT I	Artificial Intelligence systems Introduction to artificial intelligence system, History of AI, Neural network, Fuzzy logic, Genetic Algorithms.	**05**
UNIT II	Fuzzy Logic Fuzzy set theory : Fuzzy vs crisp, Crisp sets, Operation and properties on Crisp set, Partition and covering, Fuzzy Sets : Membership Function. Basic fuzzy set operation, Properties of fuzzy set, Crisp Relations, Cartesian Product, Other crisp Relations, operation on Relations, Fuzzy Relations, Fuzzy Cartesian Product, Operation on Fuzzy relations**.**	**10**
UNIT III	Fuzzy System Crisp logic, Laws of Propositional logic, Inference in Propositional logic, Predicate Logic, Interpretation of Predicate Logic formula, Inference in Predicate logic, Fuzzy Logic, Fuzzy Quantifiers, Fuzzy Inference, Fuzzy rule based system, Defuzzification methods	**10**
UNIT IV	Neural Networks Basic concepts of neural network, Neural Processing, Human Brain, Model of an Artificial Neural networks, Historical Development of neural network, Neural network architecture, Characteristics of NN, Learning method, Artificial neural network terminologies	**10**
UNIT V	Models of Artificial Neural Networks Fundamental models of artificial neural networks, Perceptron networks, Adaline and Madaline Networks, Feedback Networks, Feed Forward Networks,Associative memory network. Fundamentals of Genetic Algorithms, Genetic modelling.	**10**
	Total	**45**

Course Outcome:

Upon successful completion of course student will be able to,

1) Analyze and apply search techniques;
2) Analyze and apply adversarial search techniques;
3) Identify constraint satisfaction problems;
4) Describe, analyze and apply techniques for constraint satisfaction problems;
5) Describe and explain learning algorithms;
6) Design an application of artificial intelligence (AI)

Text Books:

1) S. Russell and P. Norvig. Artificial Intelligence: A Modern Approach. Prentice Hall, Second Edition (2003).

Reference Books:

1) P. H. Winston. Artificial Intelligence. Addison Wesley. Third Edition (1992).
2) T. Dean, J. Allen and Y. Aloimonos. Artificial Intelligence: Theory and Practice. Benjamin/Cummings,
3) N. J. Nilsson. Artificial Intelligence: A New Synthesis. Morgan Kauffman, San Francisco (1998).
4) S.Rajesekaran and G.A. Vijayalakshmi Pai Neural Networks, Fuzzy Logic and Genetic Algorithms Synthesis and applications Prentice-Hall of India Pvt.Ltd.
5) S.N.Sivanandam, S Sumathi and S N Deepa Introduction to Neural Networks using Matlab 6.0 Tata Mcrraw hill

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COURSE: B.E. VIII SEMESTER (ELECTRICAL/ E&P/EEE), With Choice Based Credit System

Course code: 8BEEE04B, Open Elective (OE)
Title of Course: B. Internet of Things

Course Scheme					Course Scheme Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
03	--	--	03	03	3	10	10	80	100

Course Objective:

1) Students will be explored to the inter connection and integration of the physical world and the cyber space.

Unit	Contents	Hours
UNIT I	**Unit-I: IoT Web Technology** Introduction to the Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization.	**09**
UNIT II	**Unit-II: IoT Applications for Value Creation** Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in Business to Master IoT, Value Creation from Big Data and Serialization, Opinions on IoT Application and Value for Industry, Home Management, eHealth.	**09**
UNIT III	**Unit-III: Internet of Things Privacy, Security and Governance** Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smarty Approach. Data Aggregation for the IoT in Smart Cities, Security	**09**
UNIT IV	**Unit-IV: Architectural Approach for IoT Empowerment** Introduction, Defining a Common Architectural Ground, IoT Standardization,M2M Service Layer Standardization, OGC Sensor Web for IoT, IEEE, IETF and ITU-T Standardization activities, Interoperability Challenges, Physical vs. Virtual, Solve the Basic First, Data Interoperability, Semantic Interoperability, Organizational Interoperability, Eternal Interoperability, Importance of Standardization, Plan for Validation and testing, Semantic as an Interoperability Enabler and related work.	**09**
UNIT V	**Unit-V: Identity Management Models in IoT** Introduction, Vulnerabilities of IoT, Security requirements, Challenges for a secure Internet of Things, identity management, Identity portrayal, Different identity Management model: Local identity, Network identity, Federated identity, Global web identity, Identity management in Internet of Things, User-centric identity management, Device-centric identity management, Hybrid identity management.	**09**
	Total	**45**

Course Outcome:

Upon successful completion of course student will be able to,

1) Understand the introduction, building blocks of IOT and its characteristics.
2) Understand application areas of IOT
3) realize IOT Privacy, Security and Governance issues
4) understand IOT Standardization and various interoperability
5) understand Identity Management Models in IOT
6) realize there volition of Internet in Mobile Devices, Cloud & Sensor Networks

Text Books / Reference Books:

1) Olivier Hersent,DavidBoswarthick, Omar Elloumi, "The Internet of Things key applications and protocols", Wiley
2) Michael Miller "The Internet of Things" Pearson
3) Adrian McEwen,HakinCassimally, "Designing the Internet of Things" Wiley India