Electrical Engineering Technology - Higher National Diploma (HND)

Power Courses

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Electrical Power Systems III

PROGRAMME: HND IN ELECTRICAL/ELECTRONIC ENGINEERING TECHNOLOGY (POWER AND MACHINES OPTION)			
Course: ELECTRIC POWER SYSTEMS III		Course Code: EEE 326	Contact Hours: 75 HOURS
Course Specification: Theoretical Content			
	General Objective 1.0: Understand inter-connected systems.		
WEEK	Specific Learning Outcome:	Teachers Activities	Resources
1-5	On completion of this course the student should be able to:- Interconnected systems 1.1 Explain interconnected power systems. 1.2 State the advantages and disadvantages of interconnected power systems. 1.3 Explain the construction of power circle diagrams. 1.4 Explain the techniques for reducing interconnected systems to simple equivalents. 1.5 Solve problems involving 1.3 and 1.4 above. 1.6 Formulate the nodal admittance matrices of various networks. 1.7 Explain the need for load flow studies. 1.8 State load-flow problem. 1.9 Outline the variable (P; Q; V/S affecting load flow in a power system network. 1.10 Classify the variables in 1.9 into control independent and dependent variables. 1.11 Derive the general form of the load-flow equation in: i. Rectangular form; ii Polar form; 1.12 Know one method of load flow solution [ ] 1.13 Calculate load flow analysis of interconnected systems. 1.14 Explain the application of digital computers to load flow studies.	- Use demonstrative problems to assemble admittance matrix for a sample matrix. - Use network analysis to demonstrate solution of Load flow problems. - Encourage students to write simple programmes to set up an admittance matrix of a simple power system. - Demonstrate short circuit fault using a simple LC circuit. - Use problems to illustrate symmetrical and unsymmetrical faults. - Use demonstrative problems to illustrate disruptive critical voltage for an overhead line. - Use problems to show the application of the sunge velocity equation in a uniform line.	

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Course: ELECTRIC POWER SYSTEMS III		Course Code: EEE 326	Contact Hours: 75 HOURS
Course Specification: Theoretical Content			
	General Objective 1.0: Understand inter-connected systems.		
	1.15 Perform load flow analysis of interconnected systems, 1.16 Write a computer program to perform load flow analysis of a simple power network. 1.17 Execute item 1.6 in a computer.		
	General Objective 2.0: Understand the performance of fault analysis of interconnected systems.		
WEEK	Specific Learning Outcome:	Teachers Activities	Resources
	2.1 Explain the various types of faults that occur on generators and transformers. 2.2 State the various types of faults that occur on transmission lines. 2.3 Explain short circuit, open circuit and earth faults on lines. 2.4 Define transient and subtransient reactances. 2.5 Explain subtransient and transient reactances using the appropriate wave form of a faulted generator. 2.6 Draw typical wave forms of short circuit currents in power systems. 2.7 Define the peak short circuit current (dynamic) using the wave form of 2.6 above. 2.8 Explain a symmetrical fault. 2.9 Solve symmetrical fault problems using line diagrams and per unit method.	- Outline the remedies for the various faults	

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Course Specification: Theoretical Content			
	2.10 Explain positive, negative and zero sequence components. 2.11 Derive expressions for the symmetrical components mentioned in 2.14 in terms of the line values. 2.12 State the expression for power in symmetrical components. 2.13 Define unsymmetrical faults (single line to ground, double line to ground, etc.) 2.14 Explain unsymmetrical fault problems using the symmetrical component networks. 2.15 Identify the sequence impedances of power system components. 2.16 Find the sequence network for a given power system. 2.17 Solve unsymmetrical fault problems using the principles of symmetrical components. 2.18 Calculate the MVA fault level on typical power systems. 2.19 Explain methods of selecting switchgear, bus-bars, fuses for typical fault levels.		

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Course: ELECTRIC POWER SYSTEMS III		Course Code: EEE 326	Contact Hours: 75 HOURS
Course Specification: Theoretical Content			
	General Objective 3.0: Know the system Overvoltages and insulation requirements.		
WEEK	Specific Learning Outcome:	Teachers Activities	Resources
	3.1 Explain corona and factors affecting it. 3.2 State the various effects of corona 3.3 Derive a formula for the disruptive critical voltage for an overhead line. 3.4 Explain the causes of over-voltages in power systems. 3.5 Draw a typical surge wave form. 3.6 List the possible effects of a travelling wave on a transmission system. 3.7 Derive an equation for the surge velocity in a uniform line. 3.8 Solve, using 3.7, problems on:- a. Surge velocity in a single-phase overhead line in air. b. Surge velocity in a three-phase overhead line in air. c. Surge velocity in a single-phase concentric cable	State practical applications of corona effects	
	3.9 Deduce an expression for the surge impedance (Zo). 3.10 Explain the different types of terminations. 3.11 Deduce an expression for reflected surge voltage and current, and transmitted surge voltage and current. 3.12 Define the following: a. Reflecting factor of coefficient (p) b. Transmission factor of coefficient (t) 3.13 Solve problems on surges using 3.9 and 3.11 above. 3.14 Describe the protection of transmission lines against lightning surges. 3.15 Draw graph for voltage and current surges when R is greater than Zo and Explain the graph. 3.16 Draw graphs for voltage and current surges when R is less than Zo and explain the graph.		

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Course: ELECTRIC POWER SYSTEMS III		Course Code: EEE 326	Contact Hours: 75 HOURS
Course Specification: Theoretical Content			
	General Objective 3.0: Know the system Overvoltages and insulation requirements.		
	3.17 Explain the effect of a surge on an overhead line terminated by a transformer. 3.18 Deduce expressions for reflected voltage and current surges in an open circuited line and short-circuited line. 3.19 Solve problems involving line/cable junctions using the derived equations in 3.18 above. 3.20 Describe various types of overhead line insulators and state their uses. 3.21 Describe various methods of testing insulators. 3.22 Deduce an expression for the voltage distribution across an insulated string. 3.23 Solve problems on voltage distribution and string efficiency of insulators. 3.24 Explain insulation co-ordination in overhead lines. 3.25 Explain the operation of an impulse generator. 3.26 Explain the wave shape obtained from an impulse generator		
	ASSESSMENT: Course work 10%; Course tests 10%; Practical 20%; Examination 60%.		

EXPERIMENTS ON ELECTRIC POWER SYSTEM III

1. Experiments on characteristics of impulse generator
2. Test insulators using various methods.

Electrical Power Systems IV

PROGRAMME: HND IN ELECTRICAL/ELECTRONIC ENGINEERING TECHNOLOGY (POWER AND MACHINES OPTION)			
Course: ELECTRIC POWER SYSTEMS IV		Course Code: EEP 436	Contact Hours: 2/3
Course Specification: Theoretical Content			
	General Objective: 1.0 Understand different types of Substations and their equipment		
WEEK	Specific Learning Outcome:	Teachers Activities	Resources
1 - 4	1.1 Define a substation 1.2 Sketch a typical layout of a substation 1.3 Explain the following: a. Grid Substation b. Distribution substation c. Industrial substation d. Switching substation. e. Domestic substation. 1.4 State advantages and disadvantages of outdoor substations as compared to indoor substations. 1.5 List factors to be taken into consideration when deciding the siting of a substation. 1.6 Demonstrate the understanding of the following in a substation: a. Switch gears b. HRC Fuse links c. Reactors d. Lightning arrestors 1.7 Draw a single line diagram of the following systems:- a. Single bus-bar b. Sectionalised bus-bar c. Duplicate bus-bar d. Duplicate bus-bar with tie-bar reactors e. Back-to-back duplicate bus-bar with tie-bar reactors.	- Arrange a visit to a typical sub-station. - Show students typical switch gear, HRC fuses, reactors and lighting ameston. - Show students bus-bar arrangements: Sectionalised bus-bar, duplicate bus-bar, duplicate bus-bar with tie-bar reactors, bus-bar with tie-bar reactors. - Arrange a visit to the National Control center. - Show students different types of relays.	

PROGRAMME: HND IN ELECTRICAL/ELECTRONIC ENGINEERING TECHNOLOGY (POWER AND MACHINES OPTION)			
Course: ELECTRIC POWER SYSTEMS IV		Course Code: EEP 436	Contact Hours: 2/3
Course Specification: Theoretical Content			
	General Objective: 1.0 Understand different types of Substations and their equipment		
4 - 8	1.8 Describe the phenomena and control in electric circuit breaker 1.9 Explain the phenomena and control in circuit breakers. 1.10 Sketch the wave form of arc extinction 1.11 Explain the following: a. Restriking voltage; b. Recovery transient c. Current Chopping. 1.12 Describe Rupturing Capacity, Making Capacity, Short-time rating as applied to circuit breakers. 1.13 Describe with the aid of fully labelled diagram the operation of each of the following. a. Oil circuit breaker b. Air blast circuit breaker c. SF6 circuit breaker d. Vacuum circuit breaker e. HRC fuse f. Fused Switch g. Isolator h. Lightning Arrestors.		

PROGRAMME: HND IN ELECTRICAL/ELECTRONIC ENGINEERING TECHNOLOGY (POWER AND MACHINES OPTION)			
Course: ELECTRIC POWER SYSTEMS IV		Course Code: EEP 436	Contact Hours: 2/3
Course Specification: Theoretical Content			
	General Objective: Understand the principle of operation of power system protection and its applications.		
WEEK	Specific Learning Outcome:	Teachers Activities	Resources
9 - 12	2.1 Explain the need for a protective scheme in a power system. 2.2 State the requirements of a protective scheme namely: a. Reliability b. Discrimination c. Sensitivity d. Selectivity e. Simplicity and economy. 2.3 Explain zones of protection of a protection system highlighting the need for overlapping. 2.4 Describe the operation of the components of a protective system viz relays CTS & PTS 2.5 Classify relays as static and electro-magnetic types. 2.6 State the merits and demerits of each in 2.5 above. 2.7 Describe various types of electro-mechanical relays. 2.8 Sketch the circuit connection for a sequence filter for producing zero, positive and negative sequence components. 2.9 Analyse the circuits of 2.8 to obtain the components. 2.10 Sketch a schematic diagram of a two-input relay comperator circuit. 2.11 Derive expressions for the comparator input voltages. 2.12 Derive expressions for the operation condition of a relay comparator in:- a. Amplitude comparison mode b. Phase comparison mode. State parameter choices for obtaining the ohm, mho and impedance relay characteristics obtained in 2.13 above.	State Practical application of protective scheme	

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Course: ELECTRIC POWER SYSTEMS IV		Course Code: EEP 436	Contact Hours: 2/3
Course Specification: Theoretical Content			
	General Objective: Understand the principle of operation of power system protection and its applications.		
13 - 15	2.13 Sketch the characteristics obtained in 2.13 above on R - X diagrams. 2.14 Explain with the aid of diagrams the following:- a. Overcurrent relay b. Distance relay c. Directional overcurrent relay, etc. 2.15 Explain differential protection. 2.16 Explain, with the aid of diagrams main protective schemes for generators, power transformers, feeders and bus-bars. 2.17 Explain inverse-time overcurrent relay. 2.18 Explain the current (plug) setting and line-setting multipliers for over current relays. 2.19 Use I.D.M.T.L. characteristics curves to solve problems relating to over current relays 2.20 Select relay settings to protect various system configurations. 2.21 Solve problems on power system protection.		
	ASSESSMENT: Course work 10%; course tests 10%; Practical 20%; Examination 60%.		

ELECTRICAL POWER IV (POWER OPTION)

GENERAL OBJECTIVES

1. Demonstrate the knowledge of understanding different types of substations and their equipment.
2. Understand the principles of operation of power system protection and its application.
3. Understand the principles and operation of power systems
4. Describe the various factors affecting power system stability

PRACTICAL/LABORATORY EXPERIMENTS VISITS(EXCURSIONS)

1. Write reports on the visits made to:
(i) power generating station
(ii) Grid substation (Oshogbo or Jebba)
(iii) Local substation/industrial substations or consumer substation

LABORATORY EXPERIMENTS

1. Experiments on characteristics impedance
2. Experiments on phase sequence operation on systems
3. Experiments on a three-phase protective devices for system symmetry
4. Experiment on NO-LOAD tap changing transformer
5. It is necessary to have Network Analyser.

Electrical Power System V

PROGRAMME: HND ELECTRICAL/ELECTRONICS TECHNOLOGY			
Course: ELECTRIC POWER SYSTEM V		Course Code: EEP 446	Contact Hours: 3 tiers lecture
Course Specification: Theoretical Content			
	General Objective 1.0 Understand the principles and operation of power system.		
Week	Specific Learning Outcome:	Teachers Activities	Resources
1 - 4	System Operation 1.1 Explain power system operation tasks viz: a. Operations planning b. Operations control c. Operations data acquisition an analysis 1.2 Explain the role of automation 1.3 List factors affection voltage and frequency of a synchronous machine 1.4 Explain governor action with relation to machine speed. 1.5 Explain the variation of voltage with change in excitation. 1.6 Explain the principles and effects of: a. Synchronous phase modifier b. Static shunt and series capacitors c. Tap-charging transformers 1.7 Sketch typical input-output curve for a thermal unit 1.8 Sketch the typical incremental heat curve for 1.9. 1.9 Reproduce an expression representing a model of the fuel cost for power generation	- Show students tag - changing a typical power transformer. - Use problems to illustrate the principle of unit commitment. - Use problems to illustrate the principle of stability (Equal Area Criteria)	
5	1.10 Explain incremental cost of power delivered by a power plant. 1.11 Derive an equation representing the equal incremental cost loading principle 1.11 Represent the principle in 1.11 graphically. 1.12 Discuss optional operation of power systems. 1.13 Explain load forecasting.		

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Course: ELECTRIC POWER SYSTEM V		Course Code: EEP 446	Contact Hours: 3 tiers lecture
Course Specification: Theoretical Content			
	General Objective 1.0 Understand the principles and operation of power system.		
6 - 7	15 Describe some methods of load forecasting 1.16 Explain with the aid of characteristics tie-line, and load frequency control 1.17 Determine Area Control Error (ACE) for a system		
8 - 9	1.18 State the units of ACE. 1.19 Explain supervisory control 1.20 Explain telementry 1.21 Explain with suitable diagrams, carrier communication on transmission lines 1.22 State the advantages of 1.21		
	General Objective 2.0: Know the various factors that affect poor system stability		
Week	Specific Learning Outcome:	Teachers Activities	Resources
10 - 11	2.1 Define power system stability 2.2 Define power limit or stability limit 2.3 Distinguish between steady state, transient and dynamic stability 2.4 State the power relation for stable operation 2.5 Establish that angular displacement between voltages necessary for the transfer of real power. 2.6 Explain the dynamics of the rotor of machine subjected to a disturbance.	- Use problems to show the application of power system stability.	
12 - 13	2.7 Derive the power angle equation 2.8 Derive the swing equation 2.9 Explain the M and H constants 2.10 Explain the swing curve 2.11 Sketch typical swing curves 2.12 Derive the power-angle equations for a machine connected to an infinite through a network represented by its ABCD parameters. 2.13 Sketch the power-angle curves for 2.12 2.14 Sketch the relative location of maximum angular shifts for input power from		

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Course: ELECTRIC POWER SYSTEM V		Course Code: EEP 446	Contact Hours: 3 tiers lecture
Course Specification: Theoretical Content			
	General Objective 2.0: Know the various factors that affect poor system stability		
14 - 15	2.15 Explain concepts in transient stability 2.16 Establish stable and unstable equilibrium points on a power angle curve. 2.17 Explain the equal area method for stability assessment 2.18 State the equal area criterion 2.19 Define critical clearing angle 2.19 Explain various methods of improving the stability of a system. 2.20 Solve problems on power system stability using the formulae derived in 2.7, 2.8 and 2.12		
	ASSESSMENT: Course work 10%; Course tests 10%; Practical 20%; Examination 60%.		

Electrical Maintenance and Repairs

SEMESTERS 3 AND 4

General Objectives

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

1. Know record keeping and methods of determining spare parts requirement.
2. Demonstrate ability to maintain equipment and supervise personnel
3. Know how to use and test and commission equipment.

PRACTICAL WORK

1. Carry out electrical installation work in the workshops and laboratories
2. Strip down an electrical motor, carry out some repair/routine service work.
3. Carry out cleaning exercises in the Laboratories and workshop
4. Visit some Industries for more exposure
5. Run a four-wire three phase system.

PROGRAMME: HND ELECTRICAL/ELECTRONICS TECHNOLOGY			
COURSE: ELECTRICAL MAINTENANCE AND REPAIRS		COURSE CODE: EEP 444/	CONTACT HRS: 1/3
Course Specification: Theoretical Content			
	General Objective: On completion of this course, the students should be able to:		
WEEK	Specific Learning Outcome	Teachers Activities	Resources
1 - 5	1.1 Explain the need for keeping records of tools and equipment. 1.2 Explain the need for keeping records of materials. 1.3 Explain the need to prepare ordering schedule for replenishing materials and tools used. 1.4 Explain methods of checking stock materials (pin cards, stock card, computer method etc.)	- Use practical examples to illustrate record and stock keeping	- Record and stock keeping book

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COURSE: ELECTRICAL MAINTENANCE AND REPAIRS		COURSE CODE: EEP 444/	CONTACT HRS: 1/3
Course Specification: Theoretical Content			
	General Objective: On completion of this course, the students should be able to:		
6 - 10	2.1 Explain the need for keeping in order the instruction manuals, maintenance manual and drawings. 2.2 Explain the need to prepare maintenance schedule and programme for maintenance work. 2.3 Prepare the routine maintenance schedule. 2.4 Explain the need for proper supervision of maintenance work. 2.5 Explain the need for proper recording of maintenance work done.	- Explain by practical approach.	
11 - 15	3.1 Identify equipment for different test: a. Insulation resistance test b. Dielectric strength test c. Murray loop test for earth fault etc. 3.2 Explain the method of carrying out the required test, using equipment in 3.1 above in the following: a. Motor b. Transformer; c. Generator d. Electrical Installation e. Starters f. Appliances g. Cookers, etc. 3.3 Explain the need to observe the safety precaution when testing equipment 3.4 Give certificate of completion after tests are satisfactory. 3.5 Test items listed in 3.2 3.6 Service items listed in 3.2 3.7 Repair items listed in 3.2	- Show students the various equipment used for testing.	
	ASSESSMENT: Course work 10%; Course tests 10%; Practical 20%; Examination 60%.		