Level 6 Graduate and Level 7 Post-Graduate Diplomas in Engineering (9210-01/02)

Assessment Pack

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August 2012
Version 3.0

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1 About this document

This document contains the practical assessment recording forms for the units that have a practical element and overall guidance for administering the Project.

Unit 102 Mechanics of Solids and Basic Structural Analysis

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to:

1: Rigid Beam experiment-
Determine the spring stiffness of two similar springs. [ ]

2: Simple Roof Truss-
Determine the forces developed in a triangular roof truss. [ ]

3: Buckling of struts-
Investigate the stability of axially loaded struts. [ ]

4: Torsion of circular bars-
Examine and observe the torsional behaviour of circular bars. [ ]

5: Tensile strength of Metals-
Observe the nature of the stress-strain behaviour of metals. [ ]

6: Variation of deflection of a simply supported beam-
(a) Study the variation of deflection of a simply supported beam in respect of load, thickness and material. [ ]
(b) Verify the theory of simple bending applied to a beam which is subjected to bending only in the plane of the applied moment. [ ]

7: Verification of the theory of pure bending-
Obtain an expression for the deflection of a beam in terms of beam constants using the geometry of the beam after deflection and verify the theory of pure bending. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Unit 103 Hydraulics and Hydrology

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to:

1: Bernoulli apparatus

Carry out an investigation in order to understand the Bernoulli principle and observe the variation of energy in steady pipe flow. [ ]

2: Pipe friction

Carry out an investigation in order understand and describe the relationship between 'head loss' and 'average velocity' in pipe flow and determine the friction factor and Reynolds's number. [ ]

3: Circular orifice

Determine by laboratory investigation the coefficient of contraction, coefficient of area, and coefficient of discharge of a circular orifice. [ ]

4: Flow measurement devices

Determine the coefficient of discharge and calibrate flow measurement devices. [ ]

5: Open channel

Estimate by laboratory investigation the Manning's coefficient of an open channel. [ ]

6: Pumps

Establish the relationship between pump discharge, pump head and pump efficiency in a centrifugal pump. [ ]

7: Catchment model study I

Understand by means of an investigation the process of runoff generation by observing the variation of discharge with time, in a physical model of a catchment. [ ]

8: Catchment model study II

Understand by means of an investigation the processes of infiltration and ground water flow by observing the variation of ground water flow, in a physical model of a catchment. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

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Tutor/Assessor name _____

Completion date _____

Unit 104 Engineering Surveying

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

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Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to:

1: Traverses using total station instruments

Plan and carry out surveys using modern instruments in order to prepare detailed engineering survey plans needed for different type of civil engineering construction work. [ ]

2: Principles of triangulation survey using electronic measuring instruments

Understand and appreciate the principles of triangulation and its relevance to civil engineering applications by means of a laboratory investigation. [ ]

3: Applications of Levelling

Plan and carry out longitudinal sections, cross sections, contouring, and any other type of assignments in levelling needed for different types of civil engineering construction work. [ ]

4: Photogrammetry

Understand the principles of photogrammetry and it uses in civil engineering applications by means of a laboratory exercises. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

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Tutor/Assessor name _____

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Unit 105 Soil Mechanics and Engineering Geology

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to:

Section one - Soil Mechanics

Carry out laboratory exercises in order to understand the engineering properties of soils and learn the standard methods of testing soil in the analysis and design of engineering situations.

1: Visual classification of soils to BS1377

Identify and classify fine grained soils. [ ]

2: Sieve analysis

Plot the particle size distribution of a coarse grained soil and to compute per cent fractions of soil groups. [ ]

3: Atterberg limits- liquid limit test and plastic limit test

Observe how consistency of a clay soil changes with moisture; determine liquid limit, plastic limit; classify a fine grained soil using Casagrande's Plasticity Chart. [ ]

4: Particle Size distribution- Hydrometer method

Perform the hydrometer test to assess particle size distribution of a fine grained soil; to plot the particle size distribution of a given fine grained soil. [ ]

5: Moisture Unit Weight relationship

Plot the variation of dry density with moisture content and to determine the optimum moisture content and the corresponding maximum dry density. [ ]

6: Unconfined Compression Test

Observe stress-strain behaviour of a clayey soil sample and discuss; to explain representation of failure stresses and compute the theoretical failure plane based on Mohr's circle of stress at failure; to draw the failure envelope and compute undrained compressive strength. [ ]

7: Permeability test using Constant Head Permeameter

Compute hydraulic head across a soil sample; to verify Darcy's law for soils and compute coefficient of permeability of a sample of sand. [ ]

8: Permeability test using the Falling Head Permeameter

Compute the coefficient of permeability of a clayey soil. [ ]

9: Sand Cone Test

Compute in-situ moisture content, bulk density and dry density. [ ]

10: Consolidation: Oedometer test; One Dimensional Consolidation test

Observe the settlement rate with time for each load increment; to compute the variation of void ratio with stress and discuss stress history of specimen; to compute design soil parameters associated with settlement and rate of settlement. [ ]

Section two - Engineering Geology

11: Rocks and rock forming minerals

Identify the main rock forming minerals samples; identify rock samples: igneous, - sedimentary and metamorphic rocks. [ ]

12: Geological mapping

Learn to read a geological map and measure dip & strike, using the geological compass; perform engineering geological mapping; read engineering geologic maps; prepare cross sections; draw cross sections perpendicular and parallel to, strike; prepare a surface map using borehole data; work with a map, with a fault and folds; prepare a map and two cross sections with given data. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print) _____

Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Unit 106 Building Engineering

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to:

Field visits:

1: Visit the site of a utility provider (Water or Electricity or Gas) to understand the day to day running and maintenance operation of the utility provider. [ ]

2: Visit a building construction site to understand aspects of design and construction operations. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

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Tutor/Assessor name _____

Completion date _____

Unit 107 Quantity Surveying

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to:

Mini project

1: Prepare an estimate for a project given the relevant documentation. [ ]

(Do we need to expand this or give some criteria or parameters?)

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

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Unit 108 Highway Engineering

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to:

1: Aggregate testing
Understand the suitability of aggregates for highway construction by performing the standard tests for aggregates. [ ]

2: Tests for binder: penetration, viscosity, ductility, softening point and flash point
Understand the suitability of binders for highway construction by performing the standard tests for binding material. [ ]

3: Bituminous mix design
Design the bituminous mix suitable for highway construction applications. [ ]

4: Design of traffic surveys
Design traffic surveys. [ ]

5: Traffic simulation software
Use traffic simulation software required for traffic design. [ ]

6: Highway design software
Use highway design software required for design of highways. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

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Tutor/Assessor name _____

Completion date _____

Unit 109 Irrigation Engineering

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to:

1: Infiltrometer

Measure the infiltration rates of soils in order to understand the physical properties of soils required for the purpose of irrigation. [ ]

2: Notch / Weir (repetition of practical 4 for Unit 103)

Calibrate flow of measurement devices. [ ]

3: Design reservoir components

Design hydraulic aspects of reservoir components like capacity bunds, sluices and spills. [ ]

4: Reservoir operations

Perform reservoir operation computations. [ ]

5: Irrigation scheduling

Design schedules for irrigation applications under different scheduling modes. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

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Tutor/Assessor name _____

Completion date _____

Unit 110 Water and Wastewater Engineering

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to:

1: Water quality testing

Determine the suitability of a sample of water with regard to different aspects of quality by performing the following tests and comparing the observed results against the established standards.

a)	Colorimetry: Colour identification using Hazen disks and Nesslerizer	[ ]
b)	pH measurements: pH disks and comparator and pH meter	[ ]
c)	Chlorine test	[ ]
d)	Turbidity measurement	[ ]
e)	Flocculation test	[ ]
f)	Dissolved oxygen measurement	[ ]
g)	BOD measurement	[ ]
h)	Fungi and Algae observations	[ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

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Tutor/Assessor name _____

Completion date _____

Unit 111 Structural Analysis

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to:

1: Design a steel roof truss in accordance with BS449

a) considering dead, imposed and wind loads; [ ]

b) design tension members, compression members and compression members subjected to bending; [ ]

c) design joints-welded /bolted; design purlins; [ ]

d) carry out detail drawing including key diagram, configuration diagram, details of joints and detail of heel joint. [ ]

2: Design Reinforced Concrete structures to include:

a) Procedure for design of concrete beams & slabs: spanning & layout, sizing, loads etc. [ ]

b) Design of reinforced concrete solid slabs to BS 8110 [ ]

c) Design of reinforced concrete beams to BS 8110 [ ]

d) Design of reinforced concrete short, braced columns to BS 8110 [ ]

e) Design of reinforced concrete pad footings to BS 8110 [ ]

3: Use at least one software package for stress calculations in the structural members [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Unit 112 Circuits and Waves

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory experiments: There are four laboratory experiments to be carried out for the completion of this unit.

Experiment 1: Verification of superposition theory

Aim: The aim of this experiment is to verify the superposition theory

Practical competencies and outcomes

The candidate will be able to:

1. Assemble a circuit consisting of different types of liner elements on breadboard. [ ]
2. Use electric measuring instruments to measure voltage at nodes and current in branches of the circuit containing voltage/current source in each set-up. [ ]
3. Verify the results of the experiment with the calculated values. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. How to select components with appropriate values.
2. How to get the readings from measuring instruments.
3. How to assemble a circuit in a breadboard.
4. How to connect different measuring equipment.
5. The difference between calculated values and theoretical values.

Experiment 2: Use of circuit simulator to solve electric circuit operation

Aim: The aim of this experiment is to gain hands-on experience of using appropriate software package for solving electric circuit operation.

Practical competencies and outcomes

The candidate will able to:

1. Familiarize him/herself with a given simulator and learn how input data and get the output data. [ ]
2. Simulate the circuit containing different circuit components (LRC) with more than one source. [ ]
3. Use the simulator to find parameters of the circuit (voltage, current, power etc). [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to:

1. Simulate circuits using software for the calculation of circuit parameters

Experiment 3: Determination Z, Y, H parameters of unknown two-port network

Aim: The aim of this experiment is to become familiar with the different two –port network parameter and experimentally determine the parameters of unknown two-port networks

Practical competencies and outcomes

The candidate will be able to:

1. Measure the magnitude and phase angle of the required voltages and currents for the calculation of Z parameters by supplying voltage to the unknown two-port network input and output terminals. [ ]
2. Measure the magnitude and phase angle of the required voltages and currents for the calculation of Y parameters by supplying voltage to the unknown two-port network input and output terminals. [ ]
3. Measure the magnitude and phase angle of the required voltages and currents for the calculation of H parameters by supplying voltage to the unknown two-port network input and output terminals. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. How to calculate z, y and h parameters of the unknown two-port network based on experimental data.
2. The relationship between z and y parameters that are calculated using experimental data.
3. The impact of frequency of the supply for the parameters.

Experiment 4: Antenna Radiation Patterns

Aim: The aim of the experiment is to draw radiation patterns of antennas and obtain the beam width using Matlab software.

Practical competencies and outcomes

The candidate will be able to do following:

1. Draw the radiation pattern of a short dipole and determine the half power beam width. [ ]
2. Draw the radiation pattern of a half wave dipole and determine the half power beam width. [ ]
3. Draw the radiation pattern of a linear array of N identical isotropic radiators separated by a constant distance of $\lambda/2$ and determine the beam width of the main beam, when the feeding currents are equal in magnitude and in phase: for N = 2, 6, 10, and determine the beam of the main beam in each case. [ ]
4. Repeat 3 when the feeding currents are equal in magnitude but having a constant phase difference of 180 between any two adjacent radiators and determine the beam width of the main beam. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to:

1. Write a simple program in Matlab.
2. Write the far field electric field due to a short dipole, half wave dipole.
3. Write the far field electric field due to an isotropic array of identical radiators and identify a broad side array and an end fire array.

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Unit 113 Electrical Machines and Electrical Energy System Fundamentals

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory experiments: There are four laboratory experiments to be carried out for the completion of this unit.

Experiment 1: No-load and Load characteristics of Synchronous machine

Outcome: Understand the behaviour of synchronous machine and determination of equivalent parameters and performance characteristic

Practical competencies

The candidate will be able to:

1. Achieve synchronization of synchronous machine under the laboratory conditions. [ ]
2. Measure the armature voltage for different values of filed current under no-load conditions. [ ]
3. Measure the phase current for different field current under short circuit condition. [ ]
4. Plot the open circuit and short circuit characteristic. [ ]
5. Measure the armature current for different field current for different loads and plot the load characteristic. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. The procedure adopted for synchronization.
2. How to use open circuit and short circuit characteristics for the calculation of equivalent circuit parameters of a synchronous machine.
3. Load characteristic of synchronous machine.
4. Impact of field excitation current on torque production.

Experiment 2: Blocked Rotor and No-load of Induction motor tests

Outcome: Determination of equivalent circuit parameters of three-phase induction motor and computation of efficiency and sources of losses

Practical competencies

The candidate will be able to:

1. Measure the voltage, current and power of an induction motor when it is running without load. [ ]
2. Measure voltage, current and power of the motor when the rotor of the motor is blocked with the help of external force. [ ]
3. Use the record data for finding no-load losses and equivalent circuit parameters of the machine. [ ]
4. Measure torque and speed of the machine by changing the load to plot the torque vs speed characteristic [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. How to calculate losses of the machine using experimental data.
2. How to determine equivalent circuit parameters using experimental data (no-load test, blocked rotor test).
3. The Torque vs. Speed characteristic of the machine

Experiment 3: Load characteristics of DC shunt and compound motor

Outcome: Determine the load characteristics of DC shunt and compound motors

Practical competencies

The candidate must be able to:

1. Be familiar with the model provided for the electrical machine experiment. [ ]
2. Measure the terminal voltage, armature current, torque and speed of the DC motor and compound motor for the constant filed current. [ ]
3. Use the experimental data to plot following characteristics of the DC motor and DC compound motor.

- Angular velocity (ω) vs. armature current (Ia) [ ]
- Torque (T) vs. armature current (Ia) [ ]
- Angular velocity (ω) against Torque (T) [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. Equations relating ω-Ia, T-Ia, ω-T for both DC shunt and compound motors.
2. The shapes of the characteristics obtained in experiment.

Experiment 4: Speed control using Variable Frequency Drive (VFD)

Outcome: Investigate the induction motor speed control using variable frequency drive

Practical competencies

The candidate will be able to:

1. Change the electrical frequency of the inverter and observe the operation of three-phase induction motor. [ ]
2. Observe the wave forms of voltage and current (filtered and unfiltered). [ ]
3. Change the frequency of the inverter and observe the variation of the speed of the motor and take measurements. [ ]
4. Compute efficiency of the motor and inverter for different frequencies using measured values. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. The operation of induction motor with variable frequency drive.
2. The shapes of voltage and current wave forms.
3. How to find efficiency of the inverter and motor for different frequencies.
4. State advantages and disadvantages of controlling induction motor using variable frequency drive.

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor Signature _____

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Completion date _____

Unit 114 Electrical Energy Systems

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Assignments: There are four assignments to be carried out for the completion of this unit

Assignment 1: Medium and Short length Transmission line

Outcome: Verification of the theories of power transmission lines (short and medium length) using a suitable transmission line simulator

Practical competencies

The candidate will be able to:

1. Simulate a short/medium length transmission line in a transmission line simulator using Pi or T-model. [ ]
2. Connect inductive /capacitive load to the end of the line. [ ]
3. Investigate voltage profile along the line. [ ]
4. Monitor voltage, current and power at any point along the line. [ ]
5. Investigate the effect of power and reactive power flow on voltage drop and transmission angle. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. The difference between short length and medium length transmission lines parameters.
2. Why parameters of the lines (R,X,Y) are included/excluded for short and medium length lines.
3. Why the transmission line parameters are considered as distributed parameters.
4. Why the current, voltage and power readings are different along the line.
5. Voltage variation along the line for different types of loads: inductive and capacitive.

Assignment 2: Load flow calculation of electrical power system

Outcome: Get hands on experience in load flow determination of an electrical power system using a suitable load flow simulator

Practical competencies

The candidate will be able to:

1. Prepare the bus data and branch data of a sample power system provided according to the given software. [ ]
2. Simulate the system using load flow simulator. [ ]
3. Use the load flow simulator for load flow analysis: peak load, off-peak load, post fault situation. [ ]
4. Find steady-state stability limit of the system by increasing the load at bus. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. The difference between different types of buses in the system and their function: slack bus, voltage control buses, load busses.
2. What measures can be taken for voltage regulation and power loss minimization in the system.
3. Why different voltages at busses are recommended for peak load and off-peak load.
4. Steady state stability limit of the system.

Assignment 3: Short circuit calculation of electrical power system

Outcome: Determination of symmetrical and unsymmetrical short circuit current using suitable software simulator

Practical competencies

The candidate will be able to:

1. Simulate a given power system using appropriate software for short circuit calculation. [ ]
2. Use the simulator for symmetrical short circuit calculation at different locations of the system. [ ]
3. Observe and note the variation of the short circuit current according to the location of the fault in the system. [ ]
4. Use a simulator for unsymmetrical (single-line to ground, double line to ground, line to line) short circuit current calculation. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. The difference between symmetrical and unsymmetrical faults.
2. Transient, sub-transient and steady state current of short circuit current.
3. Importance of symmetrical component for the unsymmetrical short circuit calculation.

Assignment 4: Over current protection

Outcome: Understand the operation of over current protective device

Practical competencies

The candidate will be able to:

1. Simulate a given radial distribution system using over current simulator. [ ]
2. Select the suitable current transformer ratio. [ ]
3. Set the plug setting multipliers and time liver settings for the over current relays. [ ]
4. Observe the disconnection time according to the location of the fault in the radial system. [ ]
5. Observe operation of back-up protection. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. How suitable current transformer ratio is selected for the relays.
2. How pick-up value for the relay is selected based on load current and fault current.
3. How time lever setting is set for the back-up protection.
4. Time –current characteristics of the relay.

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Unit 115 Electrical Machines and Devices

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory experiments: There are four experiments to be carried out for the completion of this unit

Experiment 1: No-load and Load characteristics of Synchronous machine

Outcome: Understand the behaviour of synchronous machine and determination of equivalent parameters and performance characteristic

Practical competencies

The candidate will be able to:

1. Achieve synchronization of a synchronous machine under the laboratory conditions. [ ]
2. Measure the armature voltage for different values of filed current under no-load condition. [ ]
3. Measure the phase current for different field currents under short circuit condition. [ ]
4. Plot the open circuit and short circuit characteristic. [ ]
5. Measure the armature current for different field currents for different loads and plot the load characteristic. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. The procedure adopted for synchronization.
2. How to use open circuit and short circuit characteristics for the calculation of equivalent circuit parameters of a synchronous machine.
3. Load characteristic of a synchronous machine.
4. The impact of field excitation current on torque production.

Experiment 2: Blocked Rotor test and No-load test of an Induction motor

Outcome: Determination of equivalent circuit parameters of three-phase induction motor and computation of efficiency and sources of losses

Practical competencies

The candidate will be able to:

1. Measure the voltage, current and power of an induction motor when it is running without load. [ ]
2. Measure voltage, current and power of the motor when the rotor of the motor is blocked with the help of external force. [ ]
3. Use the record data for finding no-load losses and equivalent circuit parameters of the machine. [ ]
4. Measure torque and speed of the machine by changing the load to plot the torque versus speed characteristic. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. How to calculate losses of the machine using experimental data.
2. How to determine equivalent circuit parameters using experimental data (no-load test, blocked rotor test).
3. Torque versus Speed characteristic of the machine.

Experiment 3: Load characteristics of DC shunt and compound motors

Outcome: Determine the load characteristics of DC shunt motor and compound motor

Practical competencies

The candidate will be able to:

1. Become familiar with the model provided for the electrical machine experiment. [ ]
2. Measure the terminal voltage, armature current, torque and speed of the DC motor and Compound motor for the constant filed current. [ ]
3. Use the experimental data to plot following characteristics of the DC motor and DC compound motor

- Angular velocity (ω) vs. armature current (Ia). [ ]
- Torque (T) vs. armature current (Ia). [ ]
- Angular velocity (ω) against Torque (T) [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. Equations relating ω-Ia, T-Ia, ω-T for both DC shunt and compound motors.
2. The shapes of the characteristics obtained in experiment.

Experiment 4: Speed control using Variable Frequency Drive (VFD)

Outcome: Observe the induction motor speed control using variable frequency drive

Practical competencies

The candidate will be able to:

1. Change the electrical frequency of the inverter and observe the operation of three-phase induction motor. [ ]
2. Observe the wave forms of voltage and current (filtered and unfiltered). [ ]
3. Change the frequency of the inverter and observe the variation of the speed of the motor and take measurements. [ ]
4. Compute efficiency of the motor and inverter for different frequencies using measured values. [ ]

Assessment Guide

The supervisor must ensure that the candidate is able to explain:

1. The operation of induction motor with variable frequency drive.
2. The shapes of voltage and current wave forms.
3. How to find efficiency of the inverter and motor for different frequencies.
4. State the advantages and disadvantages of controlling induction motor using variable frequency drive.

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Unit 116 Electronics and Telecommunications

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory experiments: There are four laboratory exercises to be carried out for the completion of this unit in order for the candidate to understand the performance of electronic circuits and the limitations.

Section A – Electronics

Assignment 1: Single Stage Common Emitter (CE) Transistor Amplifier

The student will be able to:

1. Estimate the operating point bias conditions of a CE single stage transistor amplifier. [ ]
2. Observe and record the input and output voltage waveforms for a small signal at 1kHz. [ ]
3. Estimate the voltage gain of the amplifier. [ ]
4. Observe and record the output voltage by varying the frequency from 10 Hz to 20 kHz and estimate the bandwidth of the amplifier. [ ]
5. Observe the distortion of the output voltage with signal strength and with change of bias point. [ ]

Assignment 2: Binary Adder

The student will be able:

1. Design and build a 2-bit Half Adder. [ ]
2. Design and build a 2-bit Full Adder. [ ]

Section B – Telecommunications

Outcome: Carry out laboratory exercises and computer simulations in order to understand the basics of communication channel characteristics and analogue modulation techniques.

Assignment 3: Communication Channel Characteristics

The student will be able:

1. Determine the bandwidth of a low pass channel and distortion in signal transmission. [ ]
2. Observe and record signal transmission through a band-pass channel. [ ]
3. Observe and record the effect of noise on signal transmission. [ ]

Assignment 4: AM and FM Modulation

Using Matlab software the student will be able to:

1. Generate a low frequency modulating signal, a high frequency carrier and modulate the amplitude of the carrier with the modulating signal. [ ]
2. Plot the modulating signal, the carrier signal and the AM signal in the time domain. [ ]
3. Identify the modulation index of the AM signal and obtain AM signal plots for different modulation index values. [ ]
4. Obtain a plot of the AM signal in the frequency domain for a particular modulation index. [ ]
5. Estimate the power in the carrier component and the signal component. [ ]
6. Record the effect of modulation index on signal shape and power distribution. [ ]
7. Generate an FM signal and obtain a plot of the FM signal in time domain and frequency domain. [ ]
8. Identify the bandwidth of AM and FM signals. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor signature _____

Tutor/Assessor name _____

Completion date _____

Unit 117 Electronic Systems

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory experiments: There are four laboratory experiments to be carried out for the completion of this unit in order to design, build and observe the performance of electronic circuits and the limitations.

Assignment 1: Single Stage Common Emitter (CE) Transistor Amplifier

The candidate will be able to:

1. Estimate the operating point bias conditions of a CE single stage transistor amplifier. [ ]
2. Observe and record the input and output voltage waveforms for a small signal at 1kHz. [ ]
3. Estimate the voltage gain of the amplifier. [ ]
4. Observe and record the output voltage by varying the frequency from 10 Hz to 20 kHz and estimate the bandwidth of the amplifier. [ ]
5. Observe the distortion of the output voltage with signal strength and with change of bias point. [ ]

Assignment 2: Regulated dc Power Supply

The candidate will be able to:

1. Build a full wave rectifier using diodes & observe on a dual trace oscilloscope, the dc voltage output from an ac supply and record the input and output voltage waveforms. [ ]
2. Use a simple capacitor & observe the smooth dc output and record the unregulated dc output. [ ]
3. Use a zener regulator & record the dc output and record the output for different load resistors. [ ]
4. Estimate the voltage regulation of the zener regulated dc power supply built. [ ]
5. Use a bridge rectifier chip & the regulator chip LM 723 and the associated other components to build a regulated dc power supply; and measure the voltage regulation as in step 4. [ ]

Assignment 3: Binary Adder

The candidate will be able:

1. Design and build a 2-bit Half Adder. [ ]
2. Design and build a 2-bit Full Adder. [ ]

Assignment 4: Sequential Logic Circuits

The candiate will be able to:

1. Design and build a SR flip flop, JK flip flop and D flip flop using logic gates. [ ]
2. Design a 3-bit an up-counter, down-counter and an up-down counter using JK flip flops. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor signature _____

Tutor/Assessor name _____

Completion date _____

Unit 118 Communication Systems

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Assignments: There are four laboratory assignments to be carried out for the completion of this unit.
Aims: to understand the performance of electronic circuits and the limitations, and to carry out laboratory exercises and computer simulations to understand the basics of communication channel characteristics and analogue modulation techniques.

Assignment 1: Communication Channel Characteristics

The candidate will be able to:

1. Determine the bandwidth of a low pass channel and distortion in signal transmission. [ ]
2. Observe and record signal transmission through a band-pass channel. [ ]
3. Observe and record the effect of noise on signal transmission. [ ]

Assignment 2: AM and FM Modulation

Using Matlab software the candidate will be able to:

1. Generate a low frequency modulating signal, a high frequency carrier and modulate the amplitude of the carrier with the modulating signal. [ ]
2. Plot the modulating signal, the carrier signal and the AM signal in the time domain. [ ]
3. Identify the modulation index of the AM signal and obtain AM signal plots for different modulation index values. [ ]
4. Obtain a plot of the AM signal in the frequency domain for a particular modulation index. [ ]
5. Estimate the power in the carrier component and the signal component. [ ]
6. Record the effect of modulation index on signal shape and power distribution. [ ]
7. Generate an FM signal and obtain a plot of the FM signal in time domain and frequency domain. [ ]
8. Identify the bandwidth of AM and FM signals. [ ]

Assignment 3: Digital Modulation Schemes

Using Matlab software the candidate will be able to:

1. Generate a binary ASK modulation for a given bit pattern; example: - [1 0 0 1 1 0 1 1 1 0 1 1 0 0 0 1 1 1 1 0 0 0 1 1]; observe and save the figure. [ ]
2. Extend the software to generate a 4-level ASK modulation for a common signal constellation. [ ]
3. Generate the FSK modulation for the same bit pattern as before and save the figure. [ ]
4. Generate the BPSK modulation for the same bit pattern as before and save the figure. [ ]
5. Generate the QPSK modulation for a common signal constellation and save the figure. [ ]

Assignment 4: Matched Filtering

Using Matlab software the candidate will be able to:

1. Use the concept of matched filtering to optimize the signal to noise ratio at detection when the transmitted signal shape is known. [ ]
2. Use matched filtering to decode an actual received signal. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor name _____

Tutor/Assessor Signature _____

Completion date _____

Unit 128 Applied Thermodynamics

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory Experiments: There are six practical laboratory exercises to be carried out for the completion of this unit.

Practical 1: Natural Convection & Radiation and Free & Forced Convection

On completion of this practical the candidate will be able to understand the principals of heat transmission through natural convection and radiation and free and forced convection. [ ]

Practical 2: Gas turbine Plant

On completion of this practical the candidate will be able to understand the operating characteristics of a gas turbine engine and related instrumentation. [ ]

Practical 3: Steam Turbine Plant

On completion of this practical the candidate will be able to:

- Understand the operating characteristics of a steam turbine and related instrumentation. [ ]
- Gain hands-on experience of the operation of a functional steam turbine power plant. [ ]
- Make a comparison of actual operating characteristics to that of the ideal Rankine power cycle. [ ]

Practical 4: Heat Pump

On completion of this practical the candidate will be able to understand the principles of heat pump and the thermodynamic cycle on which the heat pump works. [ ]

Practical 5: Vapour Compression Refrigeration Cycle (demonstration model)

On completion of this practical the candidate will be able to understand the principle of the vapour compression refrigeration cycle and calculate the coefficient of performances. [ ]

Practical 6: Boys Gas Calorimeter and Auto Bomb Calorimeter

On completion of this practical the candidate will be able to determine the calorific value of a variety of fuels. [ ]

Practical 7: Flash point Apparatus

On completion of this practical the candidate will be able to quantitatively determine the flash point of a pure flammable substance. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

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Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Unit 129 Fluid Mechanics

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory Experiments: There are six practical laboratory exercises to be carried out for the completion of this unit.

Practical 1: Bernoulli apparatus

On completion of this practical the candidate will be able understand the Bernoulli principle and observe the variation of energy in steady pipe flow (Bernoulli apparatus). [ ]

Practical 2: Pipe friction

One completion of this practical the candidate will be able to:

- Describe the relationship between 'head loss' and 'average velocity' in pipe flow [ ]
- Determine the friction factor and Reynolds's number. [ ]

Practical 3: Circular orifice

On completion of this practical the candidate will be able to determine the:

- coefficient of contraction [ ]
- coefficient of area, and [ ]
- coefficient of discharge of a circular orifice [ ]

Practical 4: Flow measurement devices

On completion of this practical the candidate will be able to:

- Determine the coefficient of discharge [ ]
- Calibrate flow measurement devices [ ]

Practical 5: Open channel

On completion of this practical the candidate will be able to estimate the Manning's coefficient of an open channel. [ ]

Practical 6: Pumps

On completion of this practical the candidate will be able to establish the relationship between pump discharges, pump head and pump efficiency in a centrifugal pump. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or No]

Candidate Signature _____

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Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Unit 130 Mechanics of Machines and Strength of Materials

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory Experiments: There are ten practical laboratory exercises to be carried out for the completion of this unit.

Practical 1: Rigid Beam experiment

On completion of this practical the candidate will be able to determine the spring stiffness of two similar springs. [ ]

Practical 2: Simple Roof Truss

On completion of this practical the candidate will be able to determine the forces developed in a triangular roof truss. [ ]

Practical 3: Buckling of struts

On completion of this practical the candidate will be able to investigate the stability of axially loaded struts. [ ]

Practical 4: Torsion of circular bars

On completion of this practical the candidate will be able to examine the torsional behaviour of circular bars. [ ]

Practical 5: Tensile strength of Metals

On completion of this practical the candidate will be able to observe the nature of the stress-strain behaviour of metals. [ ]

Practical 6: Variation of deflection of a simply supported beam

On completion of this practical the student will be able to:

- Study the variation of deflection of a simply supported beam considering load, thickness and material. [ ]
- Verify the theory of simple bending applied to a beam which is subjected to bending only in the plane of the applied moment. [ ]

Practical 7: Verification of the theory of pure bending

On completion of this practical the student will be able to:

- Obtain an expression for the deflection of a beam in terms of beam constants using the geometry of the beam after deflection. [ ]
- Verify the theory of pure bending [ ]

Practical 8: Simple and Compound Pendulum

On completion of this practical the candidate will be able to:

- Understand the principles of simple and compound pendulums. [ ]
- Determine the frequency of oscillation. [ ]

Practical 8: Use of Vibration Equipment – Vibration Simulation

On completion of this practical the candidate will be able to:

- Understand the simulation of vibratory mechanical systems into a spring-mass-dash pot model. [ ]
- Determine the natural frequency, damped frequency and coefficient of damping. [ ]
- Determine the response of the system under excitation forces. [ ]

Practical 9: Static and Dynamic Balance

On completion of this practical the candidate will be able to:

- Understand static balancing of the system and using a moment polygon construction. [ ]
- Understand dynamic balancing of the system by calculating the positions of the blocks along the shaft, by resolving and taking moments about one end of the shaft. [ ]
- Demonstrate balanced and unbalanced systems. [ ]

Practical 10: Whirling of shafts

On completion of this practical the candidate will be able to:

- Understand the whirling phenomenon. [ ]
- Measure the natural frequency of steel shaft. [ ]
- Compare the measured natural frequency to that obtained theoretically. [ ]
- Discuss the sources of error. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

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Tutor/Assessor name _____

Completion date _____

Unit 131 Materials

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory Experiments: There are nine practical laboratory exercises to be carried out for the completion of this unit.

Practical1: Tensile Testing of Ductile Materials

On completion of this practical the candidate will be able to perform the common techniques of measuring the Ultimate Tensile strength and Ductility. [ ]

Practical 2: Tensile Strength – Brittle Materials

On completion of this practical the candidate will be able to:

- Understand the tensile testing of Brittle materials [ ]
- Determine the mechanical properties [ ]
- Compare these results to the tensile testing of ductile materials. [ ]

Practical 3: Compression Strength of Ductile Materials

On completion of this practical the candidate will be able to understand the effects of compressive testing of ductile materials. [ ]

Practical 4: Compression Testing of Materials

On completion of this practical the candidate will be able to perform the techniques of compression testing of various common materials (example concrete, wood, gray iron, etc). [ ]

Practical 5: Modulus of Elasticity

On completion of this practical the candidate will be able to understand practical applications of the property, modulus of elasticity. [ ]

Practical 6: Shear Strength

On completion of this practical the candidate will understand the shear behaviour of various materials. [ ]

Practical 7: Impact Strength

On completion of this practical the candidate will understand the impact strength of various materials. [ ]

Practical 8: Hardness number

On completion of this practical the candidate will be able to determine the hardness numbers of various ferrous and non-ferrous materials using the Brinell hardness test and Rockwell hardness test. [ ]

Practical 9: Metallography

On completion of this practical the candidate will have experienced and interpreted the microscopic effects of the heat treatment of steel. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

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Completion date _____

Unit 132 Manufacturing Technology

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory Experiments: There are eight practical laboratory exercises to be carried out for the completion of this unit

Practical 1: Static Acceptance Test for a Centre Lathe and Drilling Machine

On completion of this practical the candidate will be able to take Static measurements — such as the measurement of position deviations in the linear axes using a comparator system — permit conclusions exclusively on the geometric accuracy of the machine. [ ]

Practical 2: Measurement of cutting forces using a Lathe Tool Dynamometer

On completion of this practical the candidate will be able to:

- Examine the influence of the cutting geometry, material and lubricant coolant. [ ]
- Investigate the optimum parameters for a turning and drilling process. [ ]

Practical 3: Dependence of Chip Compression Factor on cutting conditions

On completion of this practical the candidate will be able to learn the impendence of chip compression factor on cutting conditions. [ ]

Practical 4: Measurement using Optical Comparator

On completion of this practical the candidate will gain hands on experience using the optical comparator to measure profile dimensions, for example gear profile, thread profiles, etc. [ ]

Practical 5: Surface Roughness Measurement

On completion of this practical the candidate will gain hands on experience of using instruments to measure the surface roughness of a given metal surface. [ ]

Practical 6: Screw Thread Measurement

On completion of this practical the candidate will be able to measure geometrical parameters of screw threads. [ ]

Practical 7: Measurements using Sine bar

On completion of this practical the candidate will be able to use the sine bar for measuring angles. [ ]

Practical 8: Demonstration on CNC Milling and CNC Turning

On completion of this practical the candidate will be able to appreciate the use of CNC machines over their conventional counterparts and understand the use of computer technology with production machines. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: {Yes } or {No }

Candidate Signature _____

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Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Unit 134 Hydraulics and Hydraulic Machines

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory Experiments: There are seven practical laboratory exercises to be carried out for the completion of this unit

Practical 1: Impact of Jet on Vanes

On completion of this experiment the candidate will be able to calculate the co-efficient of force by taking the values of flow rate and actual force for several types of plates. For example, flat plate, inclined plate, Hemi-Spherical plate. [ ]

Practical 2: Performance Test on Pelton Turbine

On completion o f this experiment the candidate will:

- Understand the constant speed characteristic and constant head characteristic of the Pelton turbine. [ ]
- Understand how the turbine works and in which conditions etc. [ ]

Practical 3: Performance Test on Kaplan Turbine

On completion of this experiment the candidate will:

- Understand constant speed characteristic and constant head characteristic of the Kaplan turbine. [ ]
- Understand how the turbine works and in which conditions etc. [ ]

Practical 3: Performance Test on Francis Turbine

On completion of this experiment the candidate will:

- Understand constant speed characteristic and constant head characteristic of Francis turbine. [ ]
- Understand how the turbine works and in which conditions etc. [ ]

Practical 5: Performance Test on a Single Stage Centrifugal Pump

On completion of this experiment the candidate will be able to calculate the efficiency of the pump by taking the values of time and heads at suction pipe and delivery pipe positions. [ ]

Practical 6: Performance Test on a Multi Stage Centrifugal Pump

On completion of this experiment the candidate will be able to:

- Calculate the efficiency of the pump. [ ]
- Draw curves in graphs to show the performance of the pump by taking values of delivery head, suction head and time taken for rise of water in collecting tank. [ ]

Practical 7: Performance Test on Reciprocating Pump

On completion of this experiment the candidate will be able to calculate the efficiency of the pump by taking the values of time and heads at suction pipe and delivery pipe positions. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Unit 135 Mechanics of Solids

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory Experiments: There are five laboratory practical exercises to be carried out for the completion of this unit.

Practical 1: Photo elasticity

On completion of this practical the candidate will be able to:

- Understand the photo-elastic experimentation of stress fields. [ ]
- Measure the difference of principal stresses and principal stresses. [ ]
- Observe stress trajectories. [ ]

Practical 2: Use of Strain Gauges

On completion of this practical the candidate will be able to:

- Experimentally determine the system sensitivity and compare it to the ideal sensitivity of a strain gauge measurement system. [ ]
- Use the actual system sensitivity to determine the modulus of elasticity of a cantilever beam. [ ]
- Gains experience on
  - how strain gauge devices are used for measurements, [ ]
  - the type of circuitry used in connecting strain gauge transducers, [ ]
  - how a strain gauge should be physically attached to objects. [ ]

Practical 3: Stress and Strain analysis of Thick Walled cylinder

On completion of this practical the candidate will be able to:

- Measure elongations by strain gauges. [ ]
- Application of Mohr's Circle for the triaxial stress state. [ ]
- Determination of the distribution of direct stress in radial, tangential and axial direction. [ ]
- Investigation of correlations between elongation, pressure and stress in the triaxial stress state. [ ]

Practical 4: Impact Measurement test – Charpy Impact Test

On completion of this practical the candidate will be able to learn and understand how impact energy is affected by a number of factors, such as:

- Yield Strength and Ductility. [ ]
- Notches (depth of notch and root curvature). [ ]
- Temperature and Strain Rate. [ ]

Practical 5: Impact Measurement test – Charpy Impact Test

On completion of this practical the candidate will understand the relationship between the impact energy with specimen temperature for different materials tested. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

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Tutor/Assessor name _____

Completion date _____

Unit 136 Control Systems

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory Experiments: There are four practical laboratory exercises to be carried out for the completion of this unit.

Practical 1: Carry out experiment satisfactorily on Servo Fundamentals Trainer [ ]

On completion of this practical the candidate will understand:

- Operational amplifier characteristics
- Motor, tacho generator and brake characteristics
- Simple control & speed systems
- Error channel and feedback polarity
- Influence of gain
- Velocity feedback
- System following error
- Speed control systems
- Introduction to 3-term control
- Applications of 3-term control
- Single amplifier control circuits
- Transient velocity feedback and derivative feed forward
- Transfer functions & frequency response principles
- Application of frequency response methods to the system

Practical 2: Carry out experiment satisfactorily on a Digital Inverted Pendulum [ ]

On completion of this practical the candidate will understand the following.

- Pendulum Description
- Pendulum model
- Equations of motion
- Nonlinear model
- Linear models
- Model identification
- Static friction compensation
- Running a real-time model
- Dynamic model
- Cart model identification
- First model identification
- Using the MATLAB system
- Model identification toolbox
- Crane linear model identification

- Inverted pendulum linear model
- Pendulum set-up control
- Plant control
- PID controller
- PID control of cart model position
- Real-time PID control of cart position
- Real-time swing-up control
- Inverted pendulum control of swing-up
- Inverted pendulum stabilization
- Crane control
- Combined control techniques
- Swing-up and hold
- Up and down model

Practical 3: Carry out experiment satisfactorily on a Twin Rotor MIMO System [ ]

On completion of this practical the candidate will understand the following:

- 1-Degree of Freedom (DOF) PID stabilizing and tracking horizontal controller
- 1-DOF PID stabilizing and tracking vertical controller with gravity compensation
- 2-DOF PID stabilizing and tracking controller
- Parameter tuning
- Coupled dynamics analysis
- Dynamics decoupling
- Phenomenology analysis
- Model identification

Practical 4: Carry out experiment satisfactorily on a Magnetic Levitation System [ ]

On completion of this practical the candidate will understand the following:

- Closed loop control
- Real time digital control
- Linearization of non-linear system
- Analogue-Digital control, conversion methods
- Closed loop PID control
- Sample time and sampling effects
- Animation

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Unit 137 Electro techniques

Assessments will be carried out by the tutor during the course of study and the results recorded on this form by placing a tick in the box provided. The candidate must achieve a tick in every box in order to achieve a pass.

This form must be copied and included into the respective candidate record of results file (held by the tutor) at the start of the course of study.

Learning outcomes (assessment criteria)

The candidate is required to carry out relevant guided practical activities and on completion will be able to do the activities listed below:

Laboratory Experiments: There are nine practical laboratory exercises to be carried out for the completion of this unit.

Practical 1: Series and Parallel Circuits

On completion of this practical the student will be able to:

- Measure the total resistance of a series/parallel circuit. [ ]
- Measure voltages of a series/parallel circuit. [ ]
- Measure currents of a series/parallel circuit. [ ]

Practical 2: Voltage Dividers

On completion of this practical the student will be able to learn to:

- Design a series voltage divider circuit to meet a specific voltage and current. [ ]
- Design a voltage divider circuit to meet a specific voltage and current. [ ]
- Design a voltage divider circuit to meet specific voltages and currents for multiple loads. [ ]

Practical 3: Kerchief's Laws and Series/Parallel Circuits

On completion of this practical the student will be able to:

- Apply KCL in a series/parallel circuit. [ ]
- Apply KVL in a series/parallel circuit. [ ]
- Design a series/parallel circuit to meet specific voltage and current requirements. [ ]

Practical 4: Phase Relationship and Resonance Condition for RCL Circuits

On completion of this practical the student will be able to:

- Compare measured and calculated voltages and current for a series - parallel RLC circuit at discrete frequencies. [ ]
- Measure voltage amplitude and phase. [ ]
- Measure current amplitude and phase (indirect). [ ]
- Simulate and analyze a series - parallel RLC circuit at discrete frequencies and over a wide range of frequencies. [ ]

Practical 5: Phase Relationship and Resonance Condition for RCL Circuits

On completion of this practical the student will be able to:

- Perform equivalent circuit reduction techniques. [ ]
- Design series to parallel and parallel to series RLC equivalent circuits. [ ]
- Verify equivalence by using voltage, current, and phase measurements. [ ]

Practical 6: Circuit Response to Time Varying Signals

On completion of this practical the student will be able to:

Part A: Measure, in terms of average value and RMS value, meter response to various combinations of DC and time varying waveforms. [ ]

Part B: Become familiar with the response of capacitors and inductors to time rates of change of forcing functions. [ ]

Verify the analogous behaviour of capacitors and inductors in terms of ic = C dvc/dt and VL = L diL/dt. [ ]

Practical 7: Electrical Energy Measurement

On completion of this practical the student will be able to:

- Measure electrical energy consumption supplied through single phase and 3-phase loads. [ ]
- Appreciate different methods available for electrical energy measurements. [ ]
- Measure power factor [ ]

Practical 8: Diode Characteristics Uses and Types of Diodes

On completion of this practical the student will be able to:

- Gain an insight into different uses and types of diodes. [ ]
- Identify current-voltage characteristics of diodes. [ ]
- Build rectifier circuits and measure small signal dynamic resistance of a diode. [ ]

Practical 9: Transistor characteristic and amplifiers

On completion of this practical the student will:

- Understand transistor characteristics. [ ]
- Understand how a transistor works as an amplifier. [ ]

This is to confirm that the candidate has demonstrated the ability to perform all the practical tasks listed above: [Yes] or [No]

Candidate Signature _____

Candidate name (please print _____

Tutor/Assessor Signature _____

Tutor/Assessor name _____

Completion date _____

Project guidance

1 Preparation

1.1 Location of work

The Project element of the qualification should be assessed at the training centre or other venue where supervision and appropriate working conditions will be provided.

1.2 Requirements

Paper, pens, pencils and ruler or a computer system running appropriate software (eg word processing, computer aided drafting software) and a printer connected to the system, with paper loaded and set up ready to print.

Manuals for software may also need to be made available.

1.3 Supervisor notes

Candidates are required to select and solve, individually, an engineering problem. The time period allowed may be based on practicalities such as scheduling marking during the required period, but the time allowed must always be sufficient for candidates to tackle the task fairly and candidates will be able to negotiate extra time in appropriate circumstances. The project must be agreed between the candidate and the project supervisor and must take into account the amount and level of work required and the resources available. The nature of the work must demonstrate the candidate's ability at the relevant level of either Graduate Diploma or Post Graduate Diploma.

The project is generally considered to be a candidate centred activity. The supervisor's main responsibility is to create an effective learning environment. In particular the supervisor should check the project objectives, monitor the candidate's progress, advise on project progression, exercise leadership if needed, assist in development of the candidate's skills and knowledge and counsel as appropriate. Guidance on the particular requirements for project supervisors can be found in the qualification handbook.

Candidates may carry out research and produce materials during the allocated time but the report must be produced at the centre under supervision.

It is recommended that candidates should be allowed adequate time to produce the final report. Candidates may use word processors to produce their report provided they have sufficient word processing skills to do so efficiently.

On completion of the report, candidates are required to carry out an oral presentation of their work to a panel of at least three subject experts including the project supervisor. It is envisaged that such a presentation will take between 15-30 minutes.

Project guidance

2 Candidates' instructions

2.1 You are requested to select and solve a realistic engineering problem as approved by your supervisor. At each stage of this project you must refer to your supervisor for continuous guidance and direction. You must keep a log book summarising the work undertaken. This log book will be useful in producing the final report.

2.2 Select an appropriate project and agree it with your supervisor.

2.3 Maintain on a regular basis a log book or diary detailing work undertaken.

2.4 Identify the main elements of the problem to define the objectives of the project.

2.5 Prepare a detailed specification of the problem and organise the tasks to be undertaken chronologically (network diagram or similar).

2.6 Plan the initial programme for solving the problem and determine the resource requirements in terms of time, equipment and materials.

2.7 Prepare a schedule of the work to be carried out (Gantt chart or similar).

2.8 Undertake research in order to obtain the information necessary to solve the problem.

2.9 Select equipment or methods of operation to progress the project.

2.10 Carry out the work necessary for the completion of the project.

2.11 Evaluate the success of the work undertaken and make recommendations for further work.

2.12 Prepare a project report using an appropriate format and layout, which should contain all the work produced.

2.13 Prepare an oral presentation and present it to the panel.

2.14 Ensure your name is on the report and hand it in to your supervisor

Project guidance

3 Project completion checklist

The following checklist should be used by the Project Supervisor when approving individual candidate's project proposals and before submitting the final report for marking.

3.1	Realistic engineering project selected and agreed with supervisor.	[ ]
3.2	Log book or diary maintained throughout the project.	[ ]
3.3	The main elements of the problem identified and the objectives defined.	[ ]
3.4	Detailed specification prepared	[ ]
3.5	Tasks to be undertaken are organised chronologically	[ ]
3.6	Network diagram or similar has been produced	[ ]
3.7	An Initial programme has been planned	[ ]
3.8	Resource requirements determined in terms of time, equipment and materials.	[ ]
3.9	Schedule of work has been prepared (Gantt chart or similar).	[ ]
3.10	Appropriate research has been undertaken and relevant information obtained.	[ ]
3.11	Appropriate equipment and methods to progress the work has been selected	[ ]
3.12	Necessary work carried out to complete project.	[ ]
3.13	Success of the project evaluated and the work has been assessed.	[ ]
3.14	Recommendations for further work have been made.	( )
3.15	Project report has been completed.	[ ]
3.16	Oral presentation prepared and presented to the panel.	[ ]
3.17	Report has been handed in.	[ ]

The candidate will have satisfactorily completed the project if they are successful in all the items marked with a [A]. [A = Achieved]. Items marked with a ( ) are desirable elements.

Candidates who have not achieved all of the essential items, should be encouraged to carry out further work in order to complete the project satisfactorily.

Project guidance

4 Project documentation

4.1 Choosing a project

The theme of the project is to investigate a specific engineering problem for improvement including cost, efficiency and innovation.

Possible areas for project work could include:

- improvement of the efficiency or effectiveness of an existing process
- introduction and commissioning of a new plant
- modification of existing equipment to perform new or additional operations
- improvement of maintenance procedures on selected plant or equipment
- introduction of new procedures for measuring, testing and calibrating products or equipment
- standardisation of component parts for product assembly.

4.2 Project report writing

Project reports should be no longer than 25 pages (excluding appendices).

The general layout of the project report should be as follows:

- title page
- summary
- contents page
- list of figures, list of tables, list of symbols, as required
- introduction
- work carried out
- evaluation of the results
- conclusions as related to the aims of the project
- practical recommendations
- references and appendices.

The project report should include:

- relevant background information
- clear and precise documentation of the aims of the project
- relevant theory
- previous work undertaken by other people within the area of activity
- the actual work undertaken.

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