UNIVERSITY OF KWAZULU-NATAL
HOWARD COLLEGE CAMPUS
SCHOOL OF ENGINEERING

SELECTED TOPICS IN ELECTRICAL ENGINEERING 1 (ENEL 4SA H1)

MAIN EXAMINATION

DATE: 3 JUNE 2014 **TIME: 2 HOURS** **FULL MARKS: 80**

EXAMINERS: AK SAHA **MRS. K AWODELE (EXTERNAL)**

STUDENTS ARE ADVISED TO FOLLOW THE INSTRUCTIONS BELOW:

- **USE BLUE OR BLACK BALL PEN ONLY**
- ***ANSWER THE QUESTION ON YOUR TOPIC AND ANY THREE FROM THE REMAINING QUESTIONS***
- **ALLOCATED MARKS ARE INDICATED IN 'SQUARE BRACKETS' NEXT TO EACH QUESTION**
- **NO FORMULA SHEET WILL BE SUPPLIED**
- **STUDENTS CAN USE SCIENTIFIC CALCULATOR WITH A CLEARED MEMORY**

Q1. Topic: Battery **[20]**

(a) Discuss the operation of a battery in brief. **[4]**
(b) Give four examples of where primary cells can be used. **[2]**
(c) Mention two advantages of secondary cells. **[2]**
(d) What are the challenges faced in a battery monitoring systems? **[3]**
(e) What is float-charging current related to a battery? **[2]**
(f) Discuss about the lifetime of a battery. **[4]**
(g) Mention three important qualities of intelligent batteries. **[3]**

Q2. Topic: Conducting Materials used in Electrical Engineering **[20]**

(a) Discuss conductive materials in the light of energy-band theory. **[3]**
(b) Briefly explain how hard-drawn copper is made and where it is used. **[1+2]**
(c) Briefly mention application areas of copper in electrical engineering. **[3]**
(d) Briefly mention application areas of aluminium in electrical engineering. **[3]**
(e) Mention two applications of copper-silver alloys in electrical engineering. **[2]**
(f) Mention the criterions considered while selecting material for transformer winding. **[3]**
(g) Briefly discuss about application areas of superconductors. **[3]**

Q3. Topic: Flow Measurement and Transducers **[20]**

(a) Discuss about nuclear mass flow sensor used to weigh flowing material. **[4]**
(b) Discuss about the applications of Coriolis flow meters. **[3]**
(c) Mention advantages of thermal flow meters. **[4]**
(d) Discuss about turbine meters used for flow measurement. **[4]**
(e) Briefly discuss about choice between flow meters for particular applications. **[5]**

Q4. Topic: Gas Turbine Power Station **[20]**

(a) What are the advantages of a gas turbine power plant? **[4]**
(b) Briefly discuss the gas turbine cycle showing the basic components of it. **[4]**
(c) Discuss the Brayton cycle with regeneration used in a gas turbine power plant. **[4]**
(d) Briefly discuss electric power generation using gas turbine combined cycle system. **[4]**
(e) Briefly discuss about the factors that affect the performance of a gas turbine. **[4]**

Q5. Topic: Hydroelectric Power Station **[20]**

(a) Briefly discuss the basic hydraulic system operation of a micro-hydroelectric plant showing its components. **[4]**
(b) What are the purposes of settling basin and spillway in a micro-hydroelectric plant? **[2+2]**
(c) Define runaway speed and its significance related to hydroelectric power plant. **[1+2]**
(d) Briefly discuss installation criteria of hydroelectric power plant from the point of view of hydro-climatology and geology of the site. **[2]**
(e) Briefly discuss electric power generation using a tidal power plant. **[3]**
(f) Briefly discuss how density, flow and height of water play important roles in power generation in a hydroelectric power plant. **[4]**

Q6. Topic: Insulating Materials used in Electrical Engineering **[20]**

(a) Discuss the use of PVC as insulating material. **[3]**
(b) Discuss the properties of glass as insulating material. **[3]**
(c) Discuss applications of insulating materials in electrical engineering. **[3]**
(d) What are the factors that affect dielectric loss associated with an insulating material? **[3]**
(e) Discuss about suspension insulators that are used in electrical power systems. **[4]**
(f) Discuss about pin-type insulators that are used in electrical power systems. **[4]**

Q7. Topic: Magnetic Materials used in Electrical Engineering **[20]**

(a) Briefly discuss the hysteresis phenomenon in ferromagnetic materials. **[4]**
(b) Briefly discuss about paramagnetic materials with examples. **[4]**
(c) Briefly discuss about soft magnetic materials with examples. **[4]**
(d) Give some examples of industrial applications of hard magnetic materials. **[3]**
(e) Give two examples of ferromagnetic materials. **[2]**
(f) Briefly discuss magnetostriction in a magnetic material. **[3]**

Q8. Topic: Resistive Materials used in Electrical Engineering **[20]**

(a) Briefly discuss about wire-wound resistors. **[4]**
(b) Briefly explain the use of resistance heating alloys. **[4]**
(c) Briefly discuss about variable resistors. **[4]**
(d) Briefly discuss application of resistors in light bulbs. **[2]**
(e) Briefly discuss about ribbon resistors. **[3]**
(f) Mention the features of punched grid resistors. **[3]**

Q9. Topic: Solar Power **[20]**

(a) Briefly explain solar water heating. **[4]**
(b) Briefly explain how a solar photovoltaic system generates electricity from sun. **[4]**
(c) Briefly discuss the working of a solar dish. **[4]**
(d) Briefly discuss about water purification using solar energy. **[4]**
(e) Briefly discuss about solar pool heating. **[4]**

Q10. Topic: Substations **[20]**

(a) What are the different types of substations based on operating voltage? **[3]**
(b) Briefly explain the working of a distribution electrical power substation. **[3]**
(c) Briefly discuss the working of a gas insulated electrical power substation. **[3]**
(d) Explain step- and touch-potential that a person may experience in a substation. **[4]**
(e) Discuss the use of surge arrestors in a substation. **[3]**
(f) Discuss about gas monitoring system in a gas insulated substation. **[4]**

Q11. Topic: Temperature Measurement and Transduces **[20]**

(a) Explain the working of a thermocouple for temperature measurement. **[4]**
(b) What are the common resistance materials used for RTD for temperature measurement? **[2]**
(c) What are the advantages of RTD used for temperature measurement? **[2]**
(d) Explain how distance to spot ratio can affect the accuracy of temperature measurement by IR thermometer? **[2]**
(e) Briefly discuss about bead type thermistors used for temperature measurement. **[4]**
(f) What are the advantages of using bead-type thermistors for temperature measurement? **[3]**
(g) Explain the working principle of integrated circuit temperature sensors. **[3]**

Q12. Topic: Thermal Power Station **[20]**

(a) Briefly explain the working of a thermal power station. **[4]**
(b) What are the sources of pollution caused by nitrogen in a thermal power plant? Explain briefly how nitrogen causes pollution in a thermal power plant. **[2+1]**
(c) Explain working of a boiler in relation to a thermal power plant. **[3]**
(d) How does raising the average boiler temperature help in a thermal power plant? **[3]**
(e) Explain briefly the water supply system for a boiler in a thermal power plant. **[3]**
(f) Briefly discuss about water pollution related to the operation of a thermal power plant. **[4]**

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