PAPER III: SUBJECT SPECIALIZATION PAPER for ELECTRICAL ENGG./ ELECTRICAL & ELECTRONICS ENGG. (Technical)

ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2012
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALIZATION PAPER for ELECTRICAL ENGG./ ELECTRICAL & ELECTRONICS ENGG.

Date	: 14 October 2012
Total Marks	: 100
Examination Time	: 150 minutes (2.5 hours)
Reading Time	: 15 Minutes (prior to examination time)

READ THE FOLLOWING INSTRUCTIONS CAREFULLY:

1. Write your Roll Number clearly on the Answer Booklet in the space provided.

2. The first 15 minutes is being provided to check the number of pages, printing errors, clarify doubts and to read the instructions. You are NOT PERMITTED TO WRITE during this time.

3. Use either Blue or Black ink pen or ball point pen for the written part and Pencils for the sketches and drawings.

4. All answers should be written on the Answer Booklet provided. Candidates are not allowed to write anything on the question paper or any other materials.

5. All answers must be labeled with appropriate question numbers (Section, Question and sub-Question Numbers wherever applicable). Unlabelled answers will not be assessed.

6. This paper is divided into two sections-namely SECTION A and SECTION B.

7. SECTION A consists of two parts: Part I and Part II.
   Part I consists of 30 Multiple-Choice Questions carrying one (1) mark each and is compulsory. The answer of your choice should be clearly written in whole along with the question and option number on your answer booklet. Eg. 31(c).

   Part II consists of four (4) short answer questions of five (5) marks each and all questions are compulsory.

8. SECTION B consists of two Case Studies. Choose only ONE case study and answer the questions under your choice. Each case study carries fifty (50) marks in total.

9. This Paper consists of THIRTEEN (13) pages including this Instruction page.

6. The preferable choice of turbine for high head (say beyond 350 meter) in hydroelectric power plant is:

   a) Francis Turbine
   b) Cross Flow Turbine
   c) Pelton Turbine
   d) Turgo Impulse Turbine

7. While carrying out the Load Flow Analysis, the slack or infinite bus is usually assigned to:

   a) Biggest generation bus
   b) Smallest generation bus
   c) Highest Load bus
   d) Lowest Load bus

8. If the winding of transformer is such that: HV side is connected in Delta, LV side is connected in Star with Neutral brought out and the LV leads HV by 30 degree, the winding configuration is:

   a) YNd11
   b) Dyn5
   c) Dyn11
   d) Dyn10

9. Which one of the following is NOT a condition of parallel operation of transformer?

   a) Voltage ratio of transformers must be same
   b) Percentage impedance of transformers must be same
   c) MVA rating of transformers must be same
   d) Polarity of transformers must be same

10. If the supply frequency of the transformer doubles, the eddy current loss in the transformer will:

   a) Doubles
   b) Become half
   c) Increase by eight times
   d) Increase by four times

17. A delta connected network with Y-equivalent is shown below. The resistance R_1, R_2, R_3 (in ohms) are respectively,
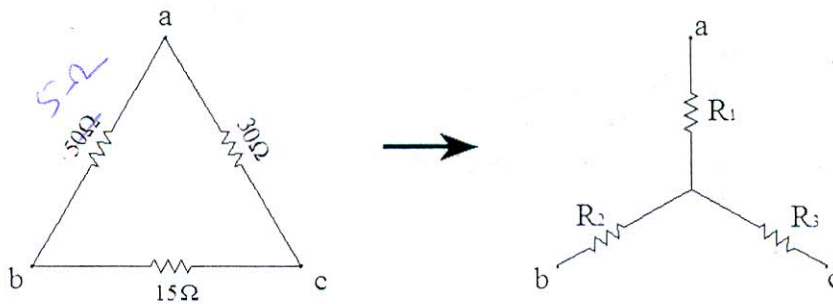
a) 1.5, 3, and 9
b) 3, 9 and 1.5
c) 9, 3 and 1.5
d) 3, 1.5 and 9

18. A generating station has maximum demand of 25 MW, a load factor of 60%, a plant capacity factor of 50% and a plant use factor of 72%, then the reserve capacity of the plant is

a) 30 MW
b) 15 MW
c) 10 MW
d) 5 MW

19. A 100 kVA transformer has copper loss of 1000 watts at full load and iron loss of 1000 watts. At half the full load and 0.8 power factor (lagging), the efficiency of the transformer will be nearly

a) 98.91%
b) 96.97%
c) 95%
d) 91.91%

20. The time taken for a surge to travel a 600 km long overhead transmission line is

a) 6 s
b) 1 s
c) 0.02 s
d) 0.002 s

c) Numeric
d) QWERTY

25. The digitizing technology which uses an electric field radiated from the tablet and picked by cursor is

a) Rastor
b) Electrostatic
c) Electromagnetic
d) Sonic

26. Which of the following transmission systems provides the highest data rate to an individual device?

a) Digital PBX
b) Computer Bus
c) LAN
d) Voice band modem

27. The simplified form of Boolean function F(x, y, z) =
$(x + \bar{y} + \bar{z})(x + \bar{y} + z)(x + y + z)$ is

a) xyz
b) x
c) $x + \bar{y}z$
d) $xy + \bar{z}$

28. The turn off time of a thyristor is 30μ sec at 50°C. Its run off time at 100°C is

a) Same
b) 15 μ sec
c) 60 μ sec
d) 100 μ sec

29. In a 3-phase, half wave diode rectifier, the ratio of average output voltage to per phase maximum ac voltage is

a) 0.955
b) 0.827
c) 1.654
d) 1.169

PART – II : Short Answer Questions (20 marks)

Answer ALL the questions. Each question carries 5 marks.

1) Determine the value of load resistance $R_{L\ in}$ Figure (a) given below for maximum power transfer. What is the maximum power delivered to R_L?
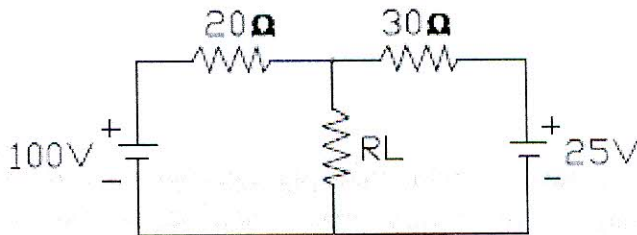

Figure (a)

2) An ideal transformer has 150- turn primary and 750 -turn secondary. The primary is connected to a 240 V, 50 Hz source. The secondary winding supplies a load of 4 A at a lagging power factor of 0.8. Determine:

   a) the transformation ratio "a"
   b) the primary current
   c) the voltage on the secondary side
   d) the power supplied to the load
   e) the maximum flux in the core

3) Two units of generation maintain 66 kV and 60 kV (line) at the ends of an interconnector of inductive reactance per phase of 40Ω and with negligible resistance and shunt capacitance. A load of 10MW is to be transferred from the 66 kV unit to the other end. Calculate the necessary conditions between the two ends, including the power factor of the current transmitted.

4) The full costs of a two unit plant are given by
   $$C_1=100+2P_1+0.005P_1^{\ 2}$$
   $$C_2=200+2P_2+0.01P_2^{\ 2}$$
   Where P_1 and P_2 are in MW. The plant supplies a load of 400MW. Calculate the economic load scheduling of the two units.

b) List down at-least 10(ten) nos. of Electrical and Mechanical equipments found in hydropower generating stations. Discuss the advantages and disadvantages of using Gas Insulated Switchgear over Air Insulated Switchgear?   **[10 marks]**

c) The operation of generator in hydropower plant is guided by Generator Capability Diagram. Draw and explain in detail the Generator Capability Diagram.

[12 marks]

d) It is very important to maintain the synchronism in Power System. As an engineer of the project, recommend an appropriate mechanism to control the speed of the turbine and explain briefly with the help of simple block diagrams. **[3 marks]**

B. Generators A and B are identical and rated 13.8 kV, 21,000 kVA and have a transient reactance of 30% at own kVA base. The transformers are also identical and are rated 13.8/66 kV, 7,000 kVA and have reactance of 8.4% to their own kVA base. The tie line is 50 miles long; each conductor has a reactance of 0.848 ohm per mile. The three phase fault is assumed at F, 20 miles from station A.   **[10 marks]**

a) Draw Single Line Impedance diagram of the circuit

b) Find the short circuit kVA and current in the short circuit.

CASE 2

A. You are given to design, prepare electrical drawings and cost estimate of a building by your office. In relation to the electrical design answer the following,

  i.   List all the electrical components required in a building   **[3 marks]**
  ii. Describe how the power is distributed in the building in the context of tree distribution or ring distribution system with the help of a diagram.

[3 marks]

  iii. What kinds of electrical protection devices are required? List all.

[3 marks]

  iv. If the building load is 1000kW, calculate the current rating of the four pole main protection device.   **[2 marks]**

  v.   Why is earthing necessary for the buildings? Describe how earthing is provided with a simple diagram.   **[3 marks]**

  vi. Describe with a diagram how to provide lightning arrestor in a building.

[2 marks]

  vii. Explain and prepare a simple cost estimate using five electrical items only

[4 marks]

Calculate the following design parameters

i.	Volt ampere rating of transformer	[1 mark]
ii.	Flux	[2 marks]
iii.	Net Iron area of the Core	[1 mark]
iv.	Gross Core area	[1 mark]
v.	Width of the Central Limb	[1 mark]
vi.	Primary Winding Current	[2 marks]
vii.	Area of Primary winding conductor	[2 marks]
viii.	Space factor for primary winding	[2 marks]
ix.	Area of primary winding conductor used	[1 mark]
x.	Number of primary winding turns	[2 marks]
xi.	Window space required by primary winding	[2 marks]
xii.	Area of secondary winding conductor	[1 mark]
xiii.	Space factor for secondary winding	[2 marks]
xiv.	Area of secondary winding conductor	[2 marks]
xv.	Number of secondary winding turns	[2 marks]
xvi.	Window space required by secondary winding	[2 marks]
xvii.	Total window space required	[1 mark]
xviii.	From the given diagram calculate the width and height of the window.	[2 marks]
xix.	State whether the window space provided in the diagram is enough or not. If yes or no why?	[1 mark]