This question paper contains 7 printed pages]

HPAS (Main)—2013

ELECTRICAL ENGINEERING

Paper I

Time : 3 Hours　　　　　　　　Maximum Marks : 150

Note :— Attempt *Five* questions in all, taking at least *one*
question from each Part.

Part A

1. (a) Find the Thevenin equivalent circuit for the
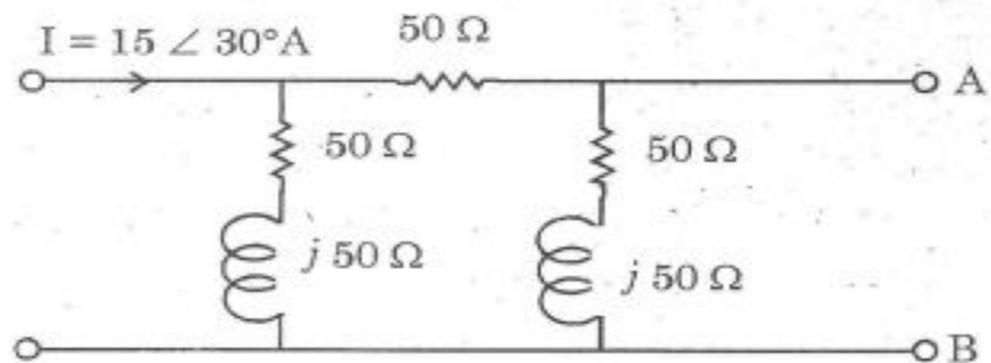network shown in Fig. 1 at terminal A–B : 15

Fig. 1

P.T.O.

(b) Write the restriction on the location of poles and zeros in the s-plane if a network function is : 15

$$F(s) = \frac{N(s)}{D(s)}$$

2. (a) Write the properties of RC impedance and R–L admittance functions, also explain its properties. 15

(b) Synthesize the following function using Cauer form–I and Cauer form–II : 15

$$F(s) = \frac{3(s + 2)(s + 4)}{s(s + 3)}$$

Part B

3. (a) Explain, what is meant by the transmission (ABCD) parameters of a two-port network. Derive the condition necessary to be satisfied for the

network to be :   16

(i)   reciprocal

(ii)   symmetrical

(b)   Find the trigonometric Fourier series for the
       half wave rectified sine wave shown in Fig. 2
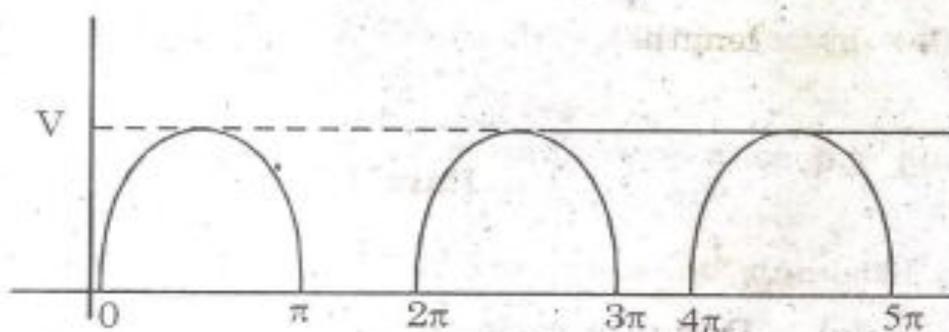   and sketch the spectrum :   14

Fig. 2

4.   (a)   Given that $J = 10^3(x^2 + y^2)a$, A/m^2, determine :

            (i)   The current density at (–3, 4, 6)

            (ii)   The rate of increase in the volume charge
                   density at (1, –2, 3)

(*iii*) The current crossing a disk of radius 5 mm placed on the *xy*–plane and centred at the origin. 20

(*b*) Show that in a good conductor, the skin depth δ is always much shorter than the wave length. 10

Part C

5. (*a*) Design a cycle counter that will output states 0 through 5. 10

(*b*) Reduce the following Boolean expression : 10

(*i*) $(AB + C)(AB + D)$

(*ii*) $\left(A + \overline{BC}\right)\left(A\overline{B} + \overline{ABC}\right)$

(c) Which type of FF can receive slow rise times and fall times on the clock input ? 10

6. (a) Explain the principle of operation of : 14

    (i)   Shaded pole motor

    (ii)   Stepper motor.

(b) A three-phase, four-pole, star-connected 440 V induction motor has rotor resistance per phase = 0.1 Ω and rotor reactance at standstill per phase = 0.8 Ω. The ratio of stator turns per phase to rotor turns per phase = 1.3. Calculate :

    (i)   The speed at which the mechanical power from the rotor will be maximum and

    (ii)   The maximum power from the motor. 16

Part D

7. (a)   What are the advantages and disadvantages of one quadrant converters over two quadrant converters ?

14

  (b)   Define the terms :

16

    (i)   Frequency deviation of FM signal.

    (ii)   Deviation sensitivity

    (iii)   Deviation ratio

    (iv)   Carrier swing.

8. (a)   What is meant by Gaussian noise ? What is the maximum power available from a noisy resistor R at a temperature T ?

10

  (b)   Draw protective circuit for a thyristor against :

    (i)   High voltage

    (ii)   High current

with brief description of each one.

10

(c) Discuss the following :

    (i) What happens if sampling rate exceeds Nyquist rate ?

    (ii) What happens if sampling rate is less than Nyquist rate ?   10