This question paper contains 8 printed pages]

HPAS (M)—2014

ELECTRICAL ENGINEERING

Paper I

Time : 3 *Hours* *Maximum Marks :* 150

Note :— Attempt *Five* questions in all, taking at least *one* from each Part. Question No. **1** is compulsory.

Part A

1. (*a*) In transmission line analysis why do we use the concept of distributed elements ? 30

(*b*) What are the demerits of a linear power supply ?

(*c*) What is the drawback of an emitter feedback bias ?

P.T.O.

(*d*) What is third approximation of a diode ?

(*e*) State the two rule-of-thumb relations between size of a dynamo and the speed at which it is operated.

(*a*) Explain why a circularly polarized wave can still be plane wave. 14

(*b*) Show that :

$$E(x, t) = f_1(x - ct) + f_2(x + ct)$$

is solution of the wave equation

$$(\nabla^2 + \omega^2 \mu\varepsilon)E = 0$$

with $k = \omega\sqrt{\mu\varepsilon}$ and $c = \omega/k$. 16

Part B

3. (*a*) Place on a truth table and map the function : 12

$$R = A\bar{B}\bar{C}D + A\bar{B}C\bar{D} + ABCD.$$

(*b*) Convert the following : 18

(*i*) Binary numbers to octal

11001, 10011101, 111010111

(*ii*) Decimal numbers to 10-bit binary

37.31, 6.215, 33.333.

P.T.O.

4. (*a*) Draw a diagram showing the dark-lamp method of synchronization of two single-phase alternators and explain the conditions under which : 16

(*i*) The lamps will always remain dark.

(*ii*) The lamps will always remain bright.

(*iii*) The lamps will flicker in unison.

(*b*) Explain why all field coils placed on field poles have the same number of turns/pole and are always connected in series. 14

Part C

5. (*a*) Write the Tellegen's theorem statement. Also, verify Tellegen's theorem for the network shown in Fig. 1 : 16

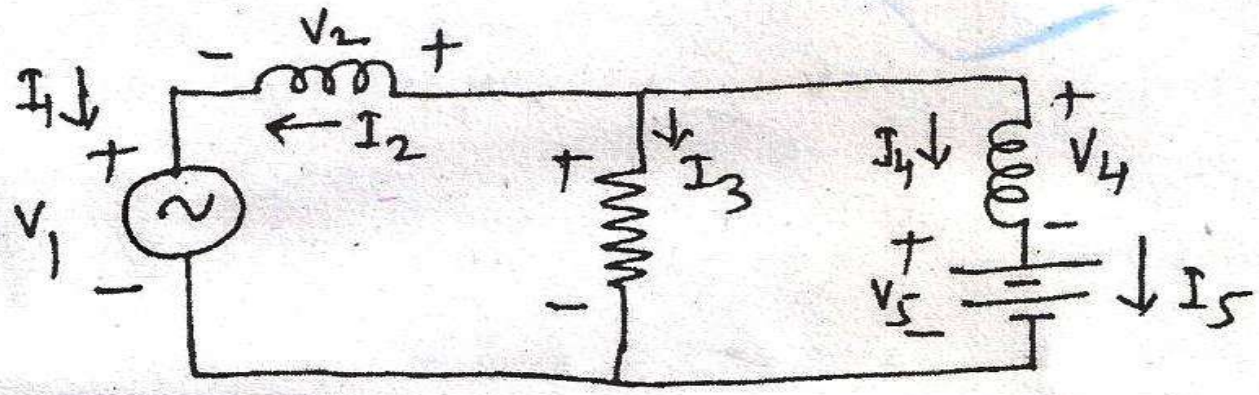

Fig. 1

Given $V_1 = 4$ V, $V_2 = -2$ V, $V_3 = 2$ V, $V_4 = 8$ V, $V_5 = -6$ V and $I_1 = 2$ A, $I_2 = 2$ A, $I_3 = -6$ A, $I_4 = 4$ A, $I_5 = 4$ A.

(*b*) Write necessary conditions for transfer functions. 14

P.T.O.

6. (*a*) A 10 kVA, 60 Hz, 4800/240 V transformer is tested by the open circuit and short circuit test. The test data are as follows : 16

Test	V	A	W	Side used
Open Circuit	240	1.5	160	LV
Short Circuit	180	2.08	180	HV

Calculate, from these test data :

(*i*) Equivalent resistance and reactance referred to HV side.

(*ii*) Equivalent resistance and reactance referred to LV side.

(*b*) Is it possible for a 60 Hz transformer to operate on 400 Hz ? Under what conditions ? 14

Part D

7. (*a*) Derive the relationship between total transmitted power and carrier power of AM signal. Calculate its transmission power efficiency. 15

(*b*) A white noise of magnitude $\eta = 0.001$ μW/Hz is applied to an RC low-pass filter of R = 1 kΩ and C = 0.1 μF. Determine its cut-off frequency and the output noise power. 15

8. (*a*) A three-phase bridge inverter is fed from a 480 V dc source. The inverter operates in 180° conduction mode and it supplies a purely resistive, star connected load with R = 10Ω/phase.

Determine : 15

(*i*) The rms value of load current

(*ii*) The rms value of switch current

(*iii*) The power delivered to the load, and

(*iv*) The average source current.

(*b*) Briefly explain the following : 15

(*i*) In what respect an IGBT is better than a MOSFET ?

(*ii*) Working of Single-phase gate-commutation device current source inverter.