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[This question paper contains 04 printed pages]

Roll Number: \_\_\_\_\_

HPAS Etc. Combined Competitive (Main) Examination, 2019

Electrical Engineering-I

Time Allowed: 3 Hours

Maximum Marks: 100

Note:

1. This question paper contains total eight questions. *Attempt five questions taking at least one from each part, but Question No.1 is compulsory.*
  2. Each question carries equal marks. Marks are divided and indicated against each part of the question. Write answer in legible handwriting. Each part of the question must be answered in sequence and in the same continuation.
  3. Attempts of questions shall be counted in sequential order. Unless struck off, attempt of question shall be counted even if attempted partly. Any page or portion of the page left blank in answer book must be clearly struck off.
  4. *Re-evaluation / Re-checking of answer book is not allowed.*
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Part A

1. (a) Find the power delivered by the dependent source in the circuit of Fig.1.1. (10)

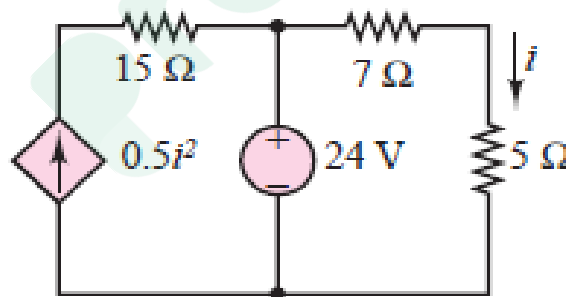


Fig. 1.1

- (b) A 3-phase supply of 400V, 50 Hz is feeding to a 3-phase star load. The phase current of the load is  $20\angle-37^\circ$  A. Find
  - (i) the value of voltage drop across the resistance in each leg of the load.
  - (ii) 3-phase reactive power absorbed by the load. (10)
2. (a) An ac voltage of  $v(t) = 400 \sin 100 \pi t$  is applied at  $t = 0$  sec. to a series R-L circuit having resistance  $R = 5 \Omega$  and inductance  $L = 0.2$  H,. Obtain an expression of current at any instant “t”. Calculate the transient current 0.01 sec, after switch is on. (10)

- (b) Determine the convolution between  $f_1(t)$  and  $f_2(t)$ . If

$$f_1(t) = 2 u(t) \quad \text{and} \quad f_2(t) = e^{-3t} u(t) \quad (10)$$

### Part B

3. (a) What is Zero-Order Hold? How it can be used as a reconstruction filter?  
The signal  $x(t) = 12 \cos(800\pi t) \cos^2(1800800\pi t)$  is ideally sampled at 4600 sps.  
What is the minimum allowable sampling frequency? (10)

- (b) Determine the Z- transform and the region of convergence of the two-sided signals  
(a)  $x(n) = (0.5)^{|n|}$  (b)  $x(n) = (2)^{|n|}$  (10)

4. (a) What is meant by polarization of waves? When the wave is linearly polarized and circularly polarized?

The electric field of a uniform plane wave is given by

$$E = 3 \cos(\omega t - \beta z - 45^\circ) a_y + 4 \sin(\omega t - \beta z + 45^\circ) a_z \text{ V/m.}$$

Determine the polarization of the wave. (10)

- (b) Define the phase velocity and group velocity of a parallel plate waveguide and obtain the expressions.

A parallel plate waveguide operating at a frequency of 12 GHz in  $TM_2$  mode with the separation of 8 cm. Find the wave impedance of the waveguide. (10)

### Part C

5. (a) For the Op-amp circuit shown in Fig 5.1. Find the  $V_o$ .

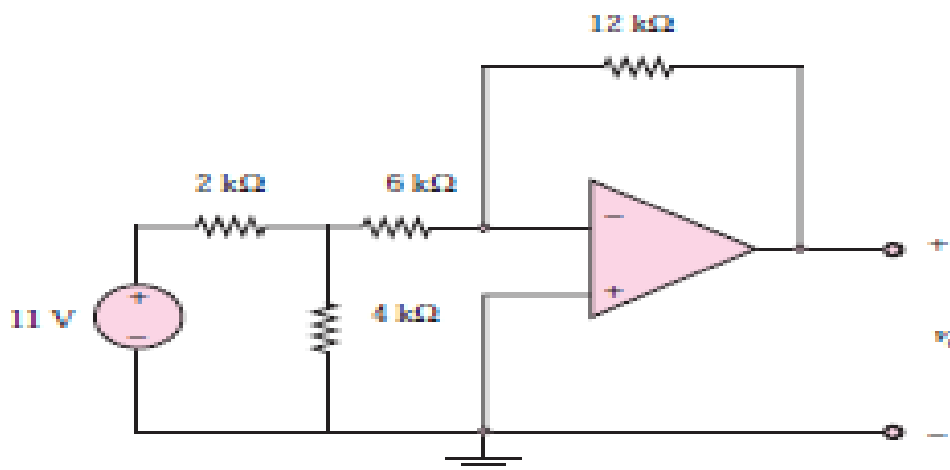


Fig 5.1

- (b) Find the expression for the gain of the circuit given in Fig 5.2.

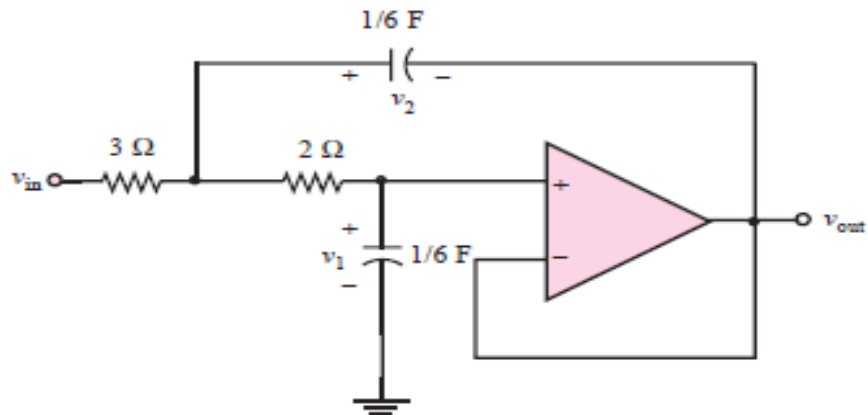


Fig 5.2

6. (a) What is a PLA? How does a PLA differ from PAL?  
Use Boolean algebra to simplify the equation. Then draw the corresponding logic circuit. (10)
- $$Y = (\bar{A} + B + C)(A + B + \bar{C})$$
- (b) What is a decade counter? Explain the difference between the 5 x 2 decade counter and the 2 x 5 decade counter? Construct a 5 x 2 decade counter. (10)

Part D

7. (a) Derive the condition for maximum efficiency of a Transformer.  
A transformer has its maximum efficiency of 97 % at 20 kVA at unity power factor. Compare its all-day efficiency for the load cycle -  
Full load of 24 kVA for 12 hours / day and no-load rest of the day. (10)
- (b) Explain in brief about the significance of damper winding in synchronous machine.  
A synchronous generator having a synchronous reactance of 1.0 pu is connected to infinite busbar of 1.0 pu voltage through two parallel lines each of 0.5 pu reactance. It is delivering rated 1.0 pu current at upf . Calculate the active and reactive power delivered to the infinite busbars. (10)
8. (a) A three – phase fully controlled bridge converter is fed from a supply voltage of 230 V per phase and frequency of 50 Hz. The source side inductance is 3 mH. The load current on dc side is constant at 20 A. If the load consists of a dc source voltage of 400 V having an internal resistance of 1.5  $\Omega$ . Find the (i) firing angle (ii) overlap angle. (10)

(b) Explain in brief BASEBAND and CARRIER COMMUNICATION.

For the baseband signal  $m(t) = 2 \cos 1000t + \cos 2000t$ , identify the frequencies in the DSB-SC, USB, and LSB spectra. (10)

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