Himachal Pradesh Administrative Service Combined Competitive (Main / Written) Examination, 2020

ELECTRICAL ENGINEERING (PAPER-I)

Time allowed: Three Hours Maximum Marks: 100

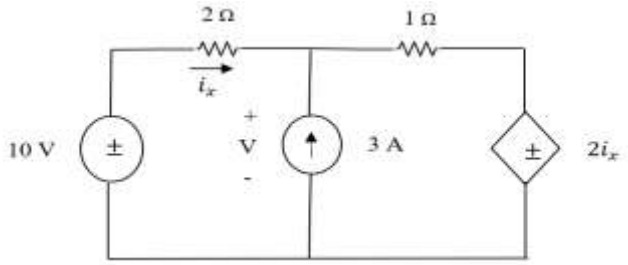
QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.

1. There are EIGHT questions printed in English.
2. Candidate has to attempt FIVE questions in all.
3. Question No.1 is compulsory. Out of the remaining SEVEN questions, FOUR are to be attempted choosing *at least one from each part.*
4. All questions carry equal marks. The number of marks carried by a question / part is indicated against it.
5. Write answers in legible handwriting.
6. Wherever any assumptions are made for answering a question, they must be clearly indicated.
7. Diagrams / Figures, wherever required, shall be drawn neatly. Unless otherwise mentioned, symbols and notations carry their usual standard meanings.
8. Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a 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.
9. Re-evaluation / Re-checking of answer book of the candidate is not allowed.

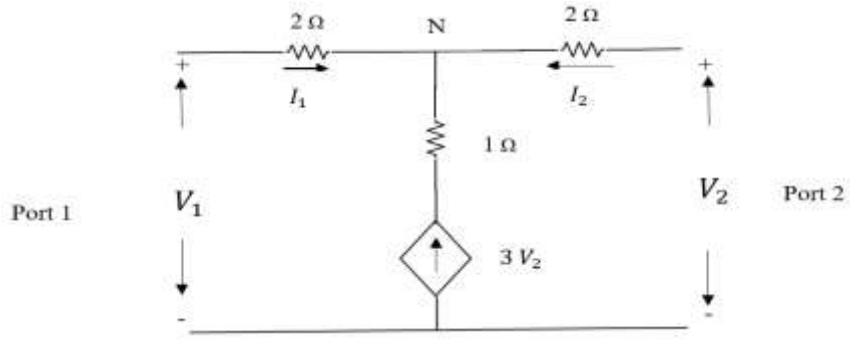
Part A

1. (a) In the circuit shown in figure, use the superposition theorem to determine the value of i_x.



(10)

(b) Find the short-circuit admittance parameter of the two-port network as shown in the figure below:

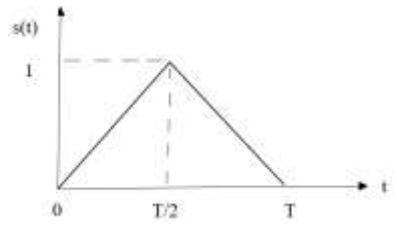


(10)

2. (a) Find the current i(t) in a series R-L-C circuit comprising R = 3 Ω, L = 1 H and C = 0.5F, when each of the following driving force voltage is applied:
(i) ramp voltage 12 r(t - 2)
(ii) step voltage 2 u(t - 3)

(10)

(b) Find the Laplace transform of the triangular pulse as shown in figure below:



(10)

Part B

3. (a) The input and output of a casual LTI system is related by the differential equation

$$d^2y(t)/dt^2 + 6dy(t)/dt + 8y(t) = 3x(t)$$

(i) Find the impulse response of the system.
(ii) What is the response of the system if $x(t) = te^{-2t}\,u(t)$?

(10)

(b) Define the Z- transform of a discrete time signal x[n] and also list its two advantages. Find the Z- transform of signal x[n], where, $x[n] = a^{-n}\,u[-n-1]$.

(10)

4. (a) The electric field intensity of a uniform wave in free space is given by

$$\vec{E} = 94.25\,cos(wt + 6z)\vec{a}_z \text{ V/m.}$$

Determine (i) the velocity of propagation (ii) the wave frequency (iii) the wavelength (iv) the magnetic field intensity and (v) the average power.

(10)

(b) Define "Attenuation constant" and "phase constant" in reference of a transmission line. An ideal lossless transmission line $Z_0 = 60\ \Omega$ is connected to a resistive load. If the standing wave ratio on the line is 4. Find

(i) the value of load impedance (Z_L).

(ii) the reflection coefficient at the load,

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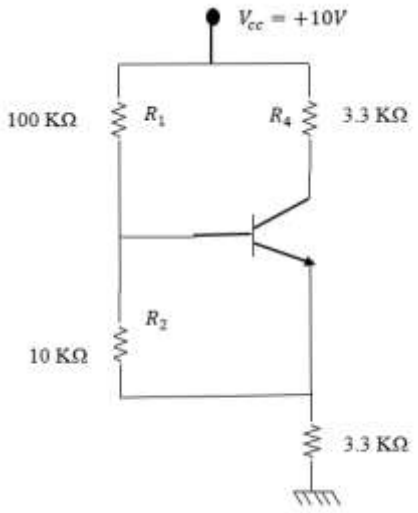
(10)

Part C

5. (a) Using Op-AMP design and draw a circuit diagram of a bandpass filter. Its parameters are f_L = 300 Hz, f_H = 2 kHz and passband gain is 4.

(10)

(b) For the circuit shown, find the voltages at the base, collector and emitter for $\beta = \infty$ and 100.



(10)

6. (a) Given that f(A, B, C, D) = ∑m(2, 3, 8, 10, 11, 12, 14, 15) using *K*-map technique, minimize the function in the SOP form. Also, give the realization using only two Input NAND gates and find the total number of NAND gates required for this.

(10)

(b) What are the main applications of multiplexers? Design a binary Half Adder using only basic gates.

(10)

Part D

7. (a) In a 1- phase, 25 kVA, 2000/200 V transformer the iron and copper losses are 350 and 400 W respectively. Calculate the efficiency on unity power factor at (i) full load (ii) half load (iii) determine the load for maximum efficiency and the iron and copper losses in this case.

(10)

(b) A 3- phase, 16 pole alternator has a star-connected winding with 144 slots and 10 conductors per slot. The flux per pole is 0.03 Wb, sine distributed and the speed is 375rpm. Find the frequency and phase and line emfs.

(10)

8. (a) A 200V, 875 rpm, 150 A seperately excited dc motor has an armature resistance of 0.06 Ω .It is fed from a single phase fully-controleed rectifier with an ac source voltage of 220V 50 Hz. Assuming continous conduction, calculate

(i) Firing angle for rated motor torque and 750 rpm.

(ii) Firing angle for rated motor torque and (-500) rpm.

(iii) Motor speed for $\alpha = 160^0$ and rated torque.

(10)

(b) Consider a FM wave as given below:

$$s(t) = 12\sin\left(6 \times 10^8 \pi t + sin1250\pi t\right)$$

Find out the following parameter:

(i) Modulating frequency

(ii) Modulating index β

(iii) Maximum frequency deviation

(iv) Bandwidth

(v) and also find the power dissipated across 10 Ω resistor.

(10)

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