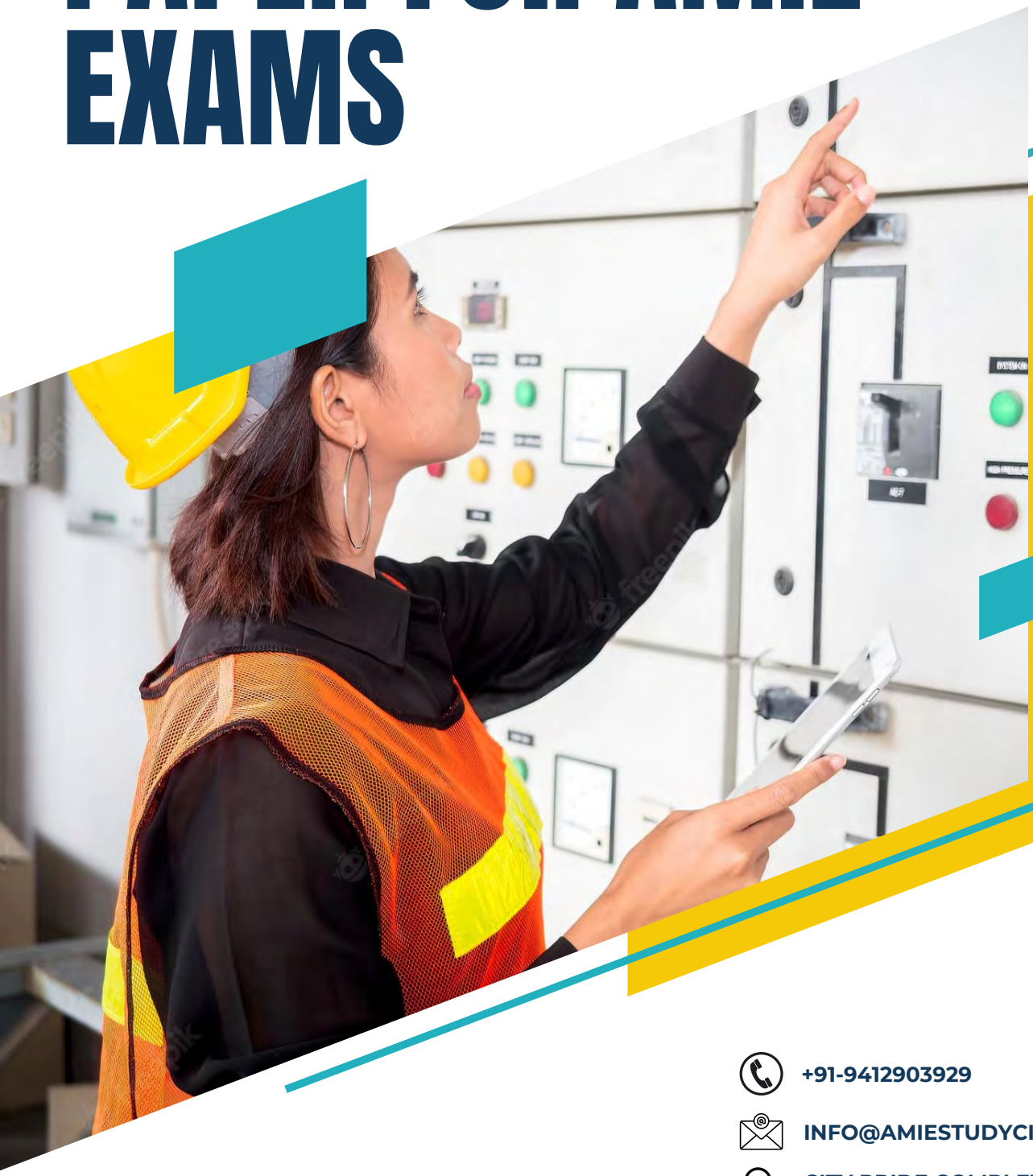
MODEL TEST PAPER FOR AMIE EXAMS



CIRCUIT THEORY & CONTROL

TEST PAPER 1

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CIRCUIT THEORY & CONTROL

***Time**: Three Hours*

***Maximum Marks**: 100*

Answer five questions, taking ANY TWO from Group A, any two from Group B and all from Group C.

All parts of a question (a, b, etc.) should be answered at one place.

Answer should be brief and to-the-point and be supplemented with neat sketches.

Unnecessary long answer may result in loss of marks.

Any missing or wrong data may be assumed suitably giving proper justification.

Figures on the right-hand side margin indicate full marks.

Group A

1. (a) Define the following terms related to a network: 6

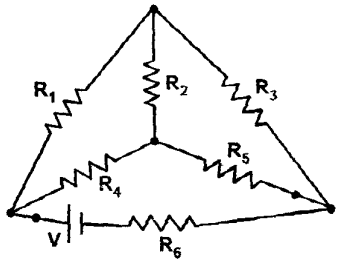
   (i) Branch;

   (ii) Node;

   (iii) Graph.

   (iv) Tree

   (b) Draw a graph of the network shown in figure. Select a tree and write the Tieset matrix and cut set matrix. 6

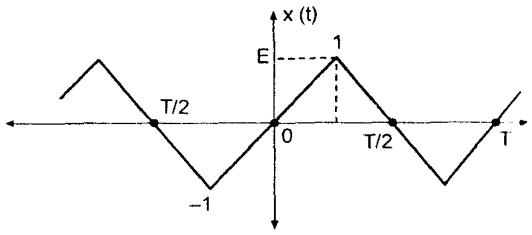


   (c) State and explain (prove) the following: (i) Initial value theorem (ii) final value theorem (ii) Convolution integral. 8

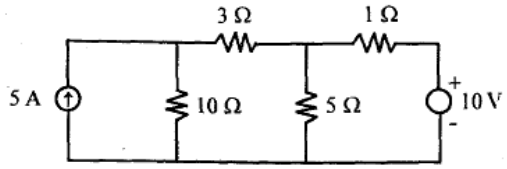
2. (a) Obtain the inverse Laplace transform of the following: 8

   (i) $\frac{12(s+2)}{s(s^2+4s+8)}$ (ii) $F(s)=\frac{s^2+6s+8}{s^3+4s^2+3s}$

(b) Obtain the complex exponential Fourier series of the waveform shown below. 6



(c) Write the node equations and determine the currents in each branch for the network shown in figure below. 6



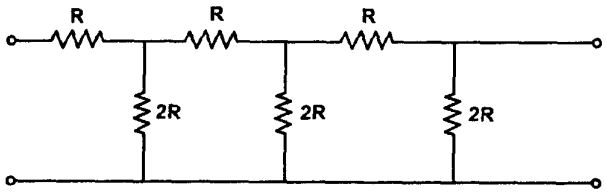
3. (a) Explain the dot rule for a magnetic coupled circuit with an example of transformer network. 6

(b) Define Pole and Zero of a network functions. Write the significance of poles and zeros of any network. 6

(c) For the given network function, draw the pole zero diagram and hence obtain the time domain response i(t). 8

$$I(s) = \frac{5s}{(s+1)(s^2+4s+8)}$$

4. (a) Find the ABCD parameters of the network shown in following figure. 8



(b) Draw a series resonant circuit and derive the expression for its resonant frequency. Draw its phasor diagrams and explain the resonance. 6

(c) A coil of inductance L and resistance R is in parallel with a capacitor C. 6

Show that the resonant frequency is

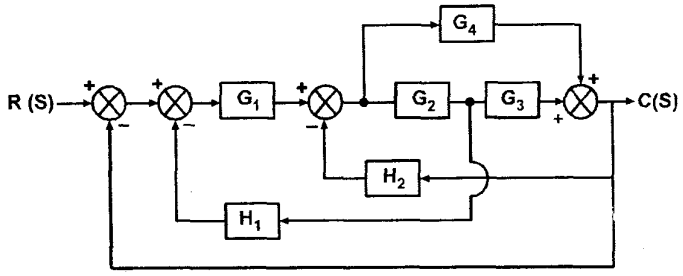
$$f_0 = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$$

Group B

5. (a) Define (i) Open loop system (ii) Closed loop system with examples.

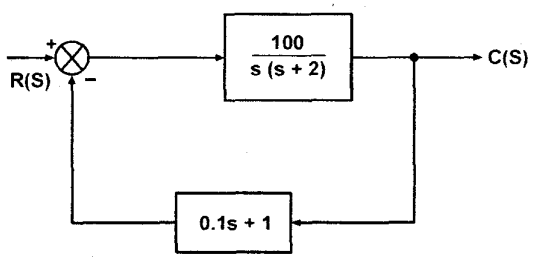
   (b) What is the signal flow graph? Write down the basic properties of signal flow graph.

   (c) Obtain signal flow graph representation for a system whose block diagram is shown in following figure and determine transfer function using Mason's gain formula.



6. (a) Derive the transfer function for the armature and field controlled d.c. motor. 8

   (b) A position control system with velocity feedback is shown in figure. Determine the response of the system for unit step input. 6



   (c) A system has open loop transfer function as 6

$$G(s) = 10 / s(s+5)$$

   Find the undamped natural frequency, damping ratio, damped natural frequency, rise time, peak time, peak overshoot and the settling time with 2% criterion.

7. (a) Explain briefly the action of the following controllers: (i) proportional (ii) proportional + integral (iii) derivative control 6

(b) Describe the basic features of Routh Hurwitz stability criterion. What are the necessary and sufficient conditions under which a system is said to be absolutely stable with a view to Routh-Hurwitz criterion? Justify in brief. 8

(c) Illustrate the stability condition for the system with characteristic equation 6

$$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$$

8. (a) Write short notes on the following: (i) Potentiometer (ii) Synchros (iii) Gyros 6

(b) Write short note on (i) Nyquist Polar Plots (ii) Bode plots 6

(c) The open loop transfer of a unity feedback system is given by 8

$$G(s) = \frac{2}{s(1+0.5s)(1+0.05s)}$$

Determine gain margin and phase margin.

Group C

9. Answer the following in brief: 20

(i) Define Tellegen's theorem.

(ii) How is reference node chosen in nodal analysis?

(iii) Draw a neat sketch of general two-port network.

(iv) What is the limitation of superposition theorem?

(v) What is coefficient of coupling in a coupled circuit and when is its value zero ?

(vi) How will you find stability of the system by using polar plots?

(vii) What is direct root locus, inverse root locus and root contours?

(viii) What is the effect on system performance when a proportional controller is introduced in a system?

(ix) Explain all the time domain specifications with a neat sketch.

(x) Which is greater between gain and phase cross-over frequency?

(Refer our course material for answers)