

2021

ELECTRICAL ENGINEERING

PAPER-I

Time Allowed — 3 Hours

Full Marks — 200

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be written either in **English** or in **Bengali** but all answers must be in one and the same language.

All symbols have their usual significance.

Group-A

Answer any three questions.

1. (a) State and prove the Maximum Power Transfer theorem. Assume impedance load and source impedance.
- (b) A bridge network ABCD is arranged as follows: resistances between terminals A-B, B-C, C-D, D-A and B-D are 10Ω , 30Ω , 15Ω , 20Ω and 40Ω respectively. A 4V battery of negligible resistance is connected between terminals A and C. Determine the value and direction of current in 40Ω resistor.
- (c) Find the Thevenin and Norton equivalents of the circuit (as shown in Fig. 1) at XY terminal.

10+15+15=40

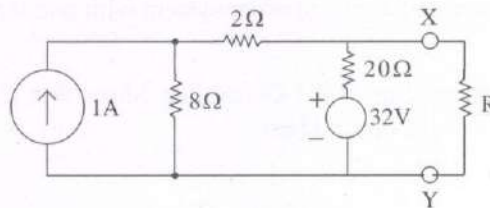


Fig. 1

2. (a) State and explain Biot-Savart's Law.
- (b) Explain Faraday's Laws of electromagnetic induction. Deduce the expression of induced *emf* in a Coil.
- (c) A Coil having an inductance of 60 mH is carrying current of 90A. Calculate the self induced *emf* in the Coil, when the current is (i) reduced to Zero in 0.03 second and (ii) reversed in 0.03 sec. 5+(10+10)+(9+6)=40
3. (a) Explain the theory of Schering Bridge for measurement of capacitance and loss angle. Draw the phasor diagram.
- (b) Two wattmeters are connected to measure the 3-phase power of a balanced system. Determine the power factor of the load when (i) $W_1 = W_2$, (ii) $W_2 = -W_1$, (iii) $W_1 = 2W_2$ and (iv) $W_2 = 0$.
- (c) A Sinusoidal alternating current of frequency 25 Hz has a maximum value of 100A. How long will it take for the current to attain values 20, 50 and 100A? (8+4)+12+16=40

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4. (a) Explain the theory of Instrument C.T. Deduce the ratio and phase angle error. Draw the phasor diagram. "C.T. secondary should never be opened"—Justify.
 (b) Calculate the Laplace transform of the periodic pulse train represent by $f(t)$ as shown in Fig.2.

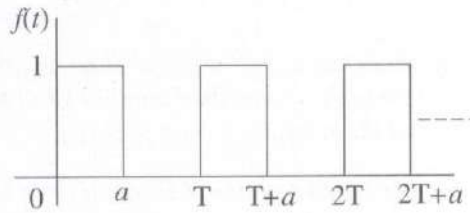


Fig. 2

- (c) Find the (i) average value, (ii) rms value, (iii) form factor and the (iv) peak factor of the square wave as shown in Fig. 3. 18+10+12=40

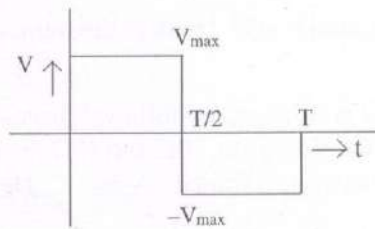


Fig. 3

5. (a) Obtain the time response of a second order system with unit step input with different damping ratio.
 (b) Deduce the transfer function of P-I Controller. Show that the P-I Controller improves the steady state characteristics of the Plant. 20+20=40

Group-B

Answer any two questions.

6. (a) Calculate the real and reactive power by the Conjugate method. Justify your calculation.
 (b) Given $V = 173.2+j100$ Volts and $I = 5.0+j8.66$ Amps. Find the real power and reactive voltampere by the method of Conjugate. Explain the result.
 (c) State the time domain and frequency domain specification used in Control System. 20+10+10=40
7. (a) Find the overall transfer function of the circuit shown in Fig. 4.

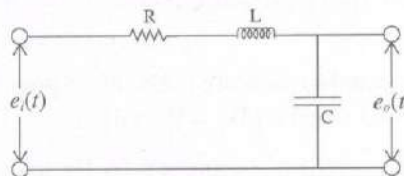


Fig. 4

- (b) Using Routh's Stability Criterion, find the range of K for stability of unity feedback system whose characteristic equation is given by

$$S^4 + 2S^3 + 2S^2 + (3+K)S + K = 0.$$

Also find the value of K for which the system will marginally stable and also the location of imaginary axis poles for this value of K.

- (c) The impedances Z_1, Z_2 are connected in parallel across a 100 volts, 50 Hz source.

$$Z_1 = 6 + j8 ; Z_2 = 4 - j3.$$

Find (i) g_1, b_1, g_2 and b_2 ,

(ii) Resultant admittance.

10+20+10=40

8. (a) State the drawbacks of standard form of PID Controller. How I-PD Controller overcomes these difficulties?

(b) Explain Ziegler-Nichols methods of tuning of PID regulator for step unit.

(c) Define minimum and non-minimum phase systems.

20+15+5=40

9. Write short notes on the following:

10×4=40

(a) ϕ -factor at resonance

(b) Bandwidth

(c) Z-transform

(d) Transport lag

For Classroom / Online guidance / coaching of WBCS Prelims , Main Exam by experts and officers and Interview by IAS / WBCS Gr A Officers/ Toppers, WBCS Prelims and Main Mock Test (Classroom & Online), Optional Subjects, Studymaterials, Correspondence Course etc. Call WBCSMadeEasy™ at Toll Free no 1800 572 9282 or 8274048710 Or 9674493673 or mail us at mailus@wbcsmadeeasy.in (Our centers as of now - College Street 8585843673, Garia/ HO 8274048710, Siliguri - 9051265991. Medinipur 8274972589)