Roll No. ..... **Total No. of Pages : 7**

1(CCE.M)2

Electrical Engineering–II

(09)

Time : Three Hours] [Maximum Marks : 300

Note :— (i) Answers must be written in English.

(ii) The number of marks carried by each question is indicated at the end of the question.

(iii) The answer to each question or part thereof should begin on a fresh page.

(iv) Your answer should be precise and coherent.

(v) The part/parts of the same question must be answered together and should not be interposed between answers to other questions.

(vi) Candidates should attempt Section A and B or A and C. Question No.**1** is compulsory. Attempt **one** more question from Section A and any **three** more from Section B or C.

(vii) If you encounter any typographical error, please read it as it appears in the text-book.

(viii) Candidates are in their own interest advised to go through the General Instructions on the back side of the title page of the Answer Script for strict adherence.

(ix) No continuation sheets shall be provided to any candidate under any circumstances.

(b) Explain the operating principle of electromagnetic relay. Derive an expression for torque produced in this type of relay. 20

(c) In a short circuit test on 132 kv 3 phase system, the breaker gave following results : pf of fault =0.4, recovery voltage 0.95 of full line voltage; the breaking current is symmetrical and restriking transient had a natural frequency of 16 kHz. Determine RRRV. Assume that fault is grounded. 20

SECTION–C

8. (a) Discuss frequency modulation techniques in communication. Obtain the relation between phase and frequency modulation. 20

(b) Explain the use of amplitude modulators and demodulator in communication systems, with the help of block diagram. 20

(c) Determine η and the percentage of the total power carried by the side bands of the AM wave for tone modulation when (i) μ =0.5 (ii) μ = 0.3. 20

9. (a) A signal m(t) of bandwidth B = 4 kHz is transmitted using a binary companded PCM with μ = 100. Compare the case L = 64 with L = 256 from point of view of transmission Bandwidth and O/P SNR. 20

(b) Verify Parsexal's theorem for the signal $g(t) = e^{-at}\,u(t)$ $(a>0)$. 20

(c) An angle modulated signal with carrier frequency $\omega_c = 2\pi \times 10^5$ is described by

$\theta_{e\mu}(t) = 10 \cos (\omega_c t + 5 \sin 300t + 10 \sin 2000\,\pi t)$

Find :

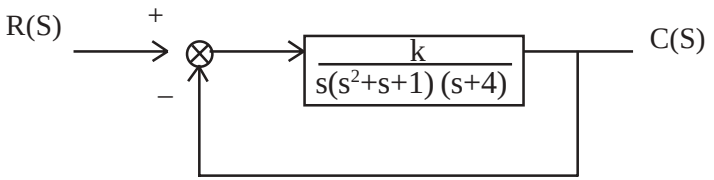
(i) Power of modulated signal

(ii) Frequency deviation Δf

(iii) The deviation ratio β. 20

(d) Explain the principle of operation of a single phase fully controlled rectifier. Derive an expression for output voltage. 20

2. (a) Given the following system, determine the range of k for which the system is stable. 20



(b) A unity feed back system has an open loop transfer function of

$$G(s) = \frac{k(3s+4)}{s^2(s+12)}$$

Plot root locus. Find the value of k for which all roots are equal. What is the value of these roots. 20

(c) Explain Nya/ceist stability criterion with an appropriate example. 20

3. (a) Sketch static V-I characteristics of SCR. Explain its operation in different regions of V-I characteristics. 20

(b) Draw the circuit of a single phase inverter. Explain its principle of operation. Derive expression for its output voltage. 20

(c) An electrically driven automobile is powered by a dc series motor rated at 72 V, 200 A. The motor resistance and inductance are 0.04 Ω, 6 mH respectively. Power is supplied via dc-dc converter operating at 100 H_Z. When the machine is running at 2500 rpm the emf per field ampere (k_{fs}) is 0.32 V. (This may be taken as constant). Detemine maximum and minimum values of current. Duty ratio is 3/5. 20

SECTION–B

4. (a) Derive torque equation of 3-phase induction motor from first principles. Also obtain ratio $\frac{T_f}{T_{max}}, \frac{T_s}{T_{max}}$ 20

(b) Explain why a starter is required for 3-phase induction motors.

Derive relation $\frac{T_{st}}{T_{ft}}$ for :

(i) Auto transformer starter

(ii) Y/A starter. 20

(c) The results of no load and blocked rotor tests on 400 V, 50 hp, 50 Hz, 3-phase, 4-Pole induction motor are as under :

NLT :	400V,	30A,	1800w.
BRT :	110V,	80A,	4000w.

The motor has star connected stator winding having resistance 0.1 r/ph. Draw circle diagram and determine :

(i) Full Load Current

(ii) Pf at full load

(iii) Efficiency. 20

5. (a) Explain potier method of determining voltage regulation of an atternator from the results of OC, SC, ZPF full load test. 20

(b) A 2 MVA, 3-phase, 4-connected, 8 pole, 750 rpm alternator is operating on 6000 V busbars. Its reactance is 6 Ω/ph. Determine synchronizing power per unit mechanical degree displacement, for full load, 0.8 pf lagging. 20

(c) A 10 MVA, 3-phase, star connected 11 kv, 16-pre, 50 Hz, salient pole synchronous motor has X_d = 6 Ω/ph, X_q = 4 Ω/ph. The motor is working at full load upf. Determine current, back emf, power angle. 20

6. (a) A 3-phase 50 Hz line has conductors of 90 mm^2 section and effective dia of 1 cm and are placed at vertices of an equilateral triangle of side 1 m. The line is 20 km long and delivers a load of 10 MW at 33 kV and 0.8 pf lagging. Neglect capacitance. Assuming temperature of 20°C, determine efficiency and regulation of the line. 20

(b) A 500 kV, 2 μ sec rectangular surge on a line having a surge impedance of 350 Ω, approaches a station at which the concentrated earth capacitance is 3000 pF. Determine the maximum value of transmitted wave, both voltage and current. 20

(c) What are various methods of neutral grounding ? Compare their performance with respect to :

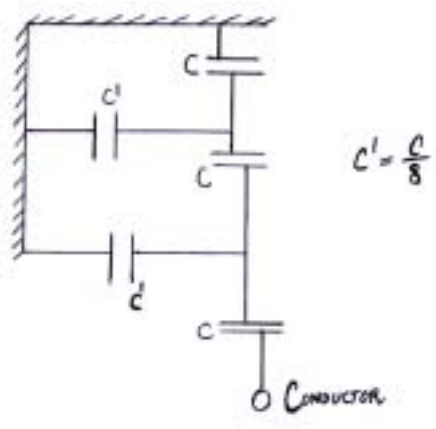
(i) Protective relaying

(ii) Fault levels

(iii) Stability

(iv) Voltage levels. 20

7. (a) Determine the maximum voltage than the string of the supension insulators, shown below, can with stand if maximum voltage per unit is 17.5 kV. 20



(x) Candidates shall put a cross (×) on blank pages of Answer Script.

(xi) No blank page be left in between answer to various questions.

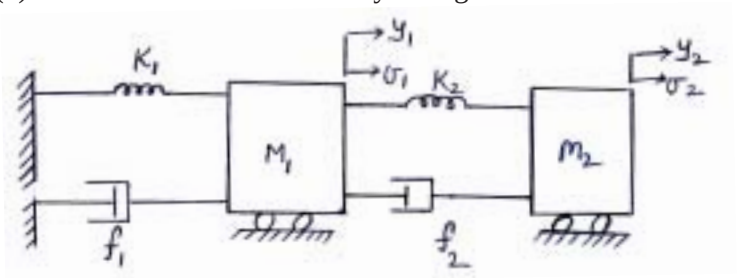
(xii) No programmable Calculator is allowed.

(xiii) No stencil (with different markings) is allowed.

SECTION–A

1. Answer any **three** :

(a) Consider the mechanical system given below :–



Write the differential equation relating the fundamental variables. 20

(b) Draw the following circuits used for turning off an SCR :

(i) Load commutation

(ii) Complementary commutation.

How SCR is getting commutated in above circuits ? Explain. 20

(c) Given

$$G(S) = \frac{k\nu}{s(sT+1)}$$ (closed loop I.)

$$k\nu = \frac{10^3 k_A}{10100} \quad T = 0.0198 \text{ sec}$$

Determine steady state error for unit step input. 20

10. (a) What is scattering matix ? Derive scattering matrix formulation for n-port network. 20

(b) Enumerate the appropriate equations the power frequency limitations of (BJTS) at high frequencies. 20

(c) Describe with neat diagram, the measurement of dielectric constant of a solid using a rectangular wave guide. 20

11. (a) In connection with optical-fibre, derive equation for numerical aperture. 20

(b) A distortionless line has $z_0 = 60\ \Omega$, $\alpha = 20\ mN_p/m$, $\mu = 0.6c$ where C is the speed of light in vacuum. Find R, L, G, C and λ at 100 MHz. 20

(c) A 30 m long lossless transmission line with $z_0 = 50$ ohms operating at 2 MHz is terminated with load $z_L = 60 + j40$ ohms. If $\mu = 0.6c$ on the line , find ;

(i) The reflection co-efficient Γ,

(ii) The standing wave ratio and

(iii) The input impedance. (c is the speed of light) 20