MIZORAM PUBLIC SERVICE COMMISSION

GENERAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF JUNIOR GRADE OF MIZORAM FOREST SERVICE i.e. ASSISTANT CONSERVATION OF FOREST (ACF) UNDER ENVIRONMENT, FOREST & CLIMATE CHANGE DEPARTMENT, GOVERNMENT OF MIZORAM, 2018

ELECTRICAL ENGINEERING

Time Allowed : 3 hours | Full Marks : 100

The figures in the margin indicate full marks for the questions.

Answer any 10 (ten) questions taking 5 (five) questions from each section.

SECTION - A

1. State and Explain Gauss's law. A spherical volume charge density ρ is given by

$$\rho = \rho_0\left(1-\frac{r^2}{100}\right) \quad \text{for } r \le 10\,\text{mm}$$
$$= 0 \quad \text{for } r > 10\,\text{mm}$$

Show that the maximum value of electric field intensity E occurs at r=7.45 mm. Obtain the value of E at r=7.45mm. **(10)**

2. Explain the behaviour of ferromagnetic materials above and below Curie temperature. Also discuss the phenomenon of hysteresis associated with ferromagnetic materials. **(10)**

3. Using Kirchoff's Law, find the current in 2Ω resistor in the circuit of Figure 1. **(10)**

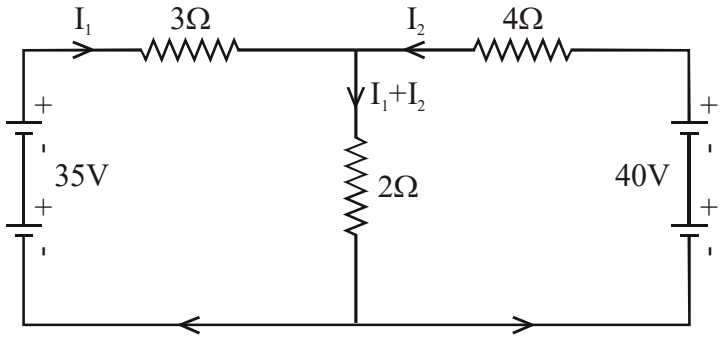

Figure 1

4. Derive the general torque equation for a moving iron instrument. The inductance of a moving iron ammeter is given by the following expression:

$$L=(20+10\ \theta-2\ \theta^2)\ \mu H$$

where θ is deflection in radian. The spring constant is 24×10^{-6} Nm/rad. Calculate the value of deflection for a current of 5 A. **(10)**

5. Mentioned various types of analog to digital converter in increasing order of speed of operation. Why is dual slope ADC preferred in digital voltmeter?

An 8 bit successive approximation type ADC uses a clock frequency of 1 MHz. Calculate the time of conversion. **(10)**

6. Determine a non-negative value of R such that the power consumed by the 2 Ω resistor in the figure-2 is maximum. **(10)**

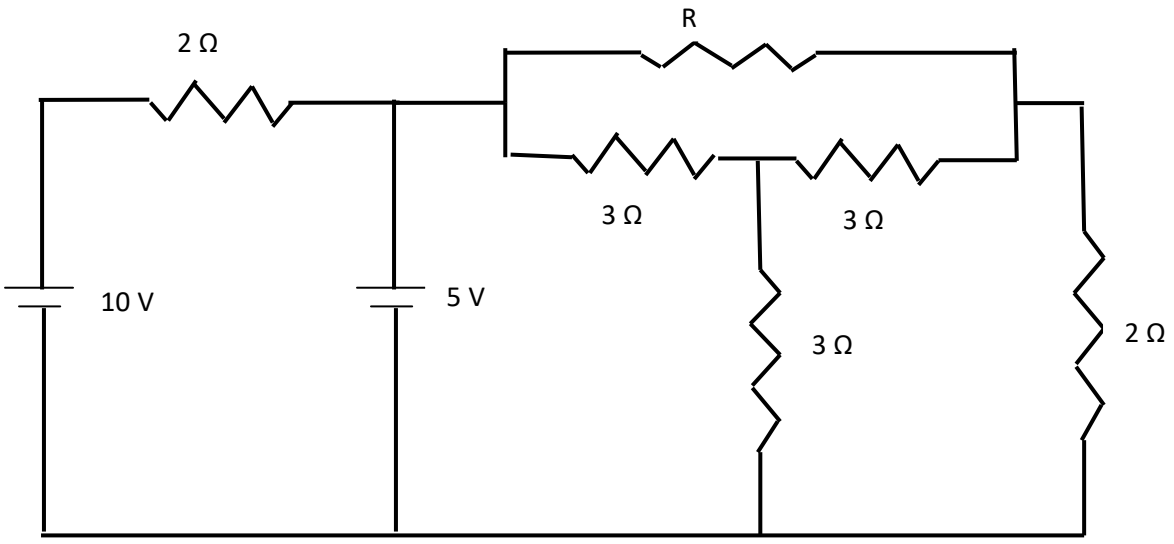

Figure-2

7. A circuit has the following transfer function

$$\frac{C(s)}{R(s)} = \frac{s^2+3s+4}{s^2+4s+4}$$

Find c(t) when r(t) is a unit step. State if the circuit is undamped, underdamped, critically damped or over-damped. **(10)**

SECTION - B

8. Derive expressions for sending end voltage and current for a long transmission line. A 50Hz transmission line 300km long has a total series impedance of 40+j20 ohms and a total shunt admittance of 10^{-3} mho. The receiving end load is 50MW at 220KV with 0.8 lagging power factor. Find the sending end voltage, current, power and power factor using (i) short line approximation (ii) Nominal pi method and (iii) long transmission line approximation. **(10)**

9. Explain the term "synchronous impedance" of an alternator with necessary diagrams. Find the synchronous impedance and reactance of a single phase alternator in which a given field current produces an armature current of 250 A, on short circuit and a generated e.m.f. of 1500 V on open circuit. The armature resistance is 2.0 ohms. Calculate the terminal potential difference when a load of 250 A at 6.6 kV at a lagging p.f. of 0.8 is switched off. **(10)**

10. A 100 kVA transformer has its maximum efficiency of 98% at full load and unity p.f. During the day it is loaded as follows:- **(10)**

12 hrs. – 20 kW at a p.f. of 0.5 lag

6 hrs. – 50 kW at a p.f. of 0.9 lag

6 hrs. – 75 kW at a p.f. of 0.8 lag

11. (a) A p-n-p transistor has V_{EB}=0.8 V at a collector current of 1 A. What do you expect V_{EB} to become at i_C=10 mA and at i_C=5A? **(5)**

(b) Design a combinational circuit that accepts a 3-bit number as input and generates an output binary number equal to square of the input number. **(5)**

12. What are the criterions of good "addressing mode" used in an Intel 8085 microprocessor? Briefly explain the different types of addressing mode of 8085 microprocessor with an example. **(10)**

13. (a) In an FM system, when the audio frequency (AF) is 500 Hz and the AF voltage is 2.4 volt, the deviation is 4.8 KHz. If AF voltage is now increased to 7.2 V, what is the new deviation? Now, if the AF voltage is raised to 10 V and AF is dropped to 200 Hz, what is the deviation? Find the modulation index in each case. **(7)**

(b) Mention two disadvantages of FM over AM. **(3)**

14. Describe the turn-off process in a GTO with relevant voltage and current waveforms. Enumerate the advantages and disadvantages of a GTO as compared to a conventional thyristor. **(10)**

* * * * * * *