ROLL NO. _____

Code: DE52/DC52 Sub: FUNDAMENTALS OF ELECTRICAL & ELECT. ENGG.

DipIETE – ET/CS (NEW SCHEME)

JUNE 2012

Time: 3 Hours **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions, selecting at least TWO questions from each part. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. The mean length of the circular path of a ring of iron uniformly wound with 1000 turns of copper wire, is 25 cm. If the wire carries a current of 0.1 A, the field strength along the mean path of the ring is

(A) 400 AT/m **(B)** 300 AT/m
(C) 250 AT/m **(D)** 100 AT/m

b. A sinusoidal voltage v = 10 sin 314 t volts is applied to pure inductor of 2 H. The power dissipated in the inductor is

(A) 20 W **(B)** zero W
(C) 314 W **(D)** 200 W

c. A 4-pole d.c. generator has 600 wave-wound conductors on its armature. The flux per pole is 0.025 Wb. If the rotor speed is 600 rpm, the open circuit emf generated is

(A) 240 V **(B)** 200 V
(C) 300 V **(D)** 155.5 V

d. In a 3ϕ induction motor, the ratio of the synchronously rotating stator mmf to the mmf in one phase winding is

(A) 0.5 **(B)** 2.5
(C) 2.7 **(D)** 1.5

e. The unbiased depletion region around a p-n junction

(A) does not contain any free charge carriers
(B) is electrically neutral region
(C) contains free electrons only
(D) contains free holes only

f. The a.c. equivalent circuit of a reverse-biased p-n diode is represented as shown in Fig.1. The capacitance C_{pn} represents

(A) Diffusion capacitance
(B) Depletion layer capacitance
(C) Electrode capacitance
(D) Stray capacitance

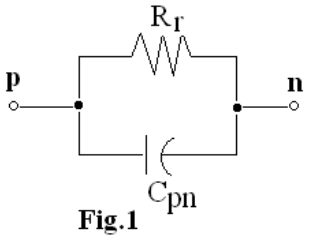

Fig.1

g. The sinusoidal input voltage to a half-wave rectifier with capacitor filter is $v = 25 \sin \omega t$. The peak-inverse voltage on the diode used for rectification is roughly

(A) 50 V **(B)** 25 V
(C) $\frac{25}{\sqrt{2}}$ V **(D)** $25\sqrt{2}$ V

h. The graph of output characteristics of a transistor in CE configuration showed a change of I_C by 5 mA required a change of I_B from 150 μA to 250 μA at $V_{CE} = 8V$. The d.c. current gain β_{dc} of the transistor is

(A) 100 **(B)** 40
(C) 50 **(D)** 90

i. For maximum undistorted signal output in a CE amplifier, the Q point should be

(A) at the intersection of the loadline and I_C axis.
(B) at the intersection of the loadline and the V_{CE} axis.
(C) at the intersection of the loadline and the vertical line corresponding to $V_{CE} = \frac{3}{4} V_{CC}$.
(D) at the middle of the load line.

j. The half-power points on the gain-frequency plot of an amplifier, which define bandwidth are often called

(A) 0.5 dB points **(B)** $\frac{1}{\sqrt{2}}$ dB points
(C) 3 dB points **(D)** 10 dB points

PART A
Answer at least TWO questions. Each question carries 16 marks.

Q.2 a. Derive an expression for the voltage across the capacitor C w.r.t. time when it is being charged through the resistor R in the circuit shown in Fig.2 by a d.c. voltage source V_s. Hence show that at t = RC, the value of $V_c = 0.632 V_s$. **(8)**

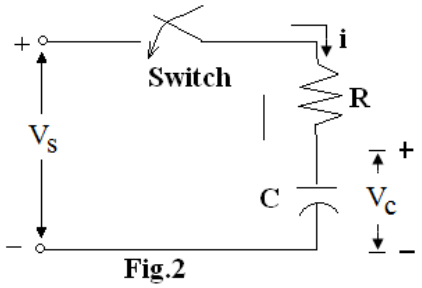

Fig.2

b. The distance between two point charges Q_A and Q_B is 14.142 cm. $Q_A = 2\,\mu C$ and $Q_B = 4\,\mu C$. Find the force between them and state whether the force is attractive or repulsive. Take $\in_0 = 8.854 \times 10^{-12}$ F/m. **(3)**

c. A ring-shaped electromagnet which is uniformly wound with a coil of 500 turns, has an air gap of 4 mm long. The mean length of the ring core is 48 cm. A current of 5A in the coil produces a flux density of $0.4\,Wb/m^2$ in the air gap. Calculate the relative permeability of the material of the ring electromagnet. The free space permeability: $\mu_o = 4\pi \times 10^{-7}$ H/m. **(5)**

Q.3 a. Find the direction and the value of current flowing through the arm BD in the bridge circuit shown in Fig.3. **(8)**

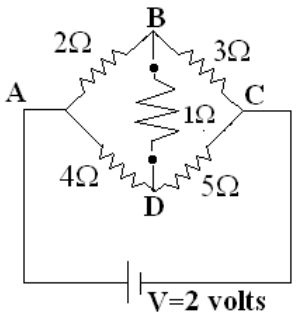

Fig.3

b. Define Thevenin's theorem and Norton's theorem. **(4)**

c. A coil having a resistance of 8Ω and an inductance of 0.18H is connected to a 60V, 50 Hz supply. Compute
(i) the impedance of the coil;
(ii) the current in the coil and
(iii) the phase angle between the current and the voltage applied. **(4)**

Q.4 a. Draw the schematic diagram of shunt motor and show the relationship among current, voltage and resistance of armature in the machine. **(4)**

b. Find the torque developed by a 4-pole motor whose armature has 1500 conductors which are wave-wound. The armature current is 10 A and the flux per pole = 20 mWb. **(4)**

c. Explain the necessity of a starter for d.c. motors. **(4)**

d. A shunt motor has an armature resistance of 0.2Ω. It is connected to 440 V supply and takes 140 A when running at 660 rpm. If the total torque developed is unchanged, find the speed and armature current when the magnetic field is decreased to 70% of its initial value. **(4)**

Q.5 a. Derive the emf equations of a transformer for its primary and secondary windings. **(4)**

b. Define slip of an induction motor. Explain the necessity of slip for the operation of the motor. **(4)**

c. Explain how rotating magnetic field is produced in a three-phase induction motor. **(8)**

PART B
Answer at least TWO questions. Each question carries 16 marks.

Q.6 a. Explain the classification of materials into conductor, insulator and semiconductor on the basis of energy band pattern. **(8)**

b. What are p and n-type semiconductors? Explain how they are obtained from pure basic semiconductor materials. **(8)**

Q.7 a. Define 'regulation' of a d.c. power supply. What is the cause of difference in regulation between any two power supplies? **(3)**

b. Draw the circuit diagram of a clamper. Explain its operation. **(5)**

c. Why is it that a basic half-wave or full-wave rectifier is unsuitable for use as a power supply? Explain qualitatively (giving simple circuit diagrams) how and what additional components may be connected with it to develop a practically useful power supply. **(8)**

Q.8 a. Describe an experimental set-up with the help of a neat circuit diagram and explain the procedure to determine the common emitter input and output characteristics of a transistor. **(8)**

b. Discuss qualitatively, the problems of instability in transistor operation due to temperature variations. **(8)**

Q.9 a. Draw the circuit of Colpitt's oscillator and explain its operation. **(8)**

b. Show the general scheme of series voltage negative feedback applied to an amplifier. Describe qualitatively the effect of the feedback on the voltage gain, input impedance and output impedance of the amplifier. **(8)**