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KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

COLLEGE OF ENGINEERING

BSc. (Mechanical Engineering) Mid sem Examination

EE 252 : ELECTRICAL ENGINEERING MACHINES

MARCH, 2019

Time allowed**: ONE HOUR**

INSTRUCTIONS FOR CANDIDATES:

1. Answer **ALL** questions.

2. Circle your answer on the question paper and on the Scannable sheet.

CAUTION: DO NOT TAKE AWAY ANY EXAMINATION MATERIAL PROVIDED TO YOU , UNLESS YOU ARE TOLD TO DO SO.

Two parallel plates are arranged to maintain a potential difference e of $2x10^{4}$ V. Each plate has an area of $0.02m^2$

1.Calculate the capacitance between the plates if the spacing between the plates is 1cm,
Given that $\varepsilon_0=8.85x10^{-12}$, $\varepsilon_r=1$

a) $15.8x10^{-12}$ F b)$17.7x10^{-12}$ F c) $18.9x10^{-12}$ F d)None of the above

2.Find the energy converted to mechanical form as the plate spacing is reduced from 1 cm to 0.5 cm

a)) $23.9x10^{-20}$ N b)) $38.7x10^{-20}$ N c) $35.4x10^{-20}$ N d)None of the above

A solenoid relay is operated from a 220-V, dc supply and the 1000-turn coil resistance is 5.5 kΩ. The core diameter of the relay is 20 mm and the gap length is 1.5 mm, the armature being stationary. The gap faces may be taken as parallel and the permeability of the ferromagnetic parts as very high. Take $\mu_o=4\pi\times10^{-7}$.

3.Determine the current that will flow through the relay coil .

a) 0.04A b)0.004A c)0.05A d)None of the above

4.Determine the mmf of the magnetic system

a)40.0 At b) 80.0 At c) 120.0 At d)None of the above

5.Determine the air gap flux density

a)$0.0107Wb/m^2$ b) $0.00107Wb/m^2$ c) $0.107Wb/m^2$ d)None of the above

6.Determine the coil inductance

a)0.804 H b) 0.084H c) 0.656H d)None of the above

7. Determine the pull on the armature.

a)0.95N b) 0.88N c) 0.69N d)None of the abov

8.A long shunt compound D.C. motor runs at full-load speed of 1000 rpm. If the current through its series field windings is caused to be zero, then its full-load speed

a)becomes more than 1000 rpm b)remains 1000 rpm

c)becomes less than 1000 rpm d)becomes 1100 rpm

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9. In a d.c. series generator, the terminal voltage with increase in load

a)decreases b) remains unchanged

c) Increases d) varies with drooping characteristics

10.Armature winding is one in which working

a) flux is produced by field current b)e.m.f. is produced by the working flux

c) flux is produced by the working e.m.f. d) e.m.f. is produced by the leakage flux

The armature of a d.c machine has a resistance of 0.1 Ω *and is connected to a 230 V supply.*

Use the above information to answer questions 11 and 12.

11.Calculate the generated E.M.F when it is running as a generator giving 80A.

a)218V b)265V c) 238V d)None of the above

12.Calculate the generated E.M.F when it is running as a motor taking 60A.

a)190V b)245V c)224V d)None of the above

13.A four pole d.c motor is fed at 440V and takes an armature current of 50A .The resistance of the armature circuit is 0.28 Ω .The armature winding is wave –connected with 888 conductors and the useful flux per pole is 0.023Wb. Calculate the speed.

a)567rev/min b)626rev/min c)545 rev/min d)None of the above

14.A d.c. motor runs at 900rev/min off a 460 V supply. Calculate the approximate speed when the machine is connected across a 200V supply. Assume the new flux is to be 0.7 of the original flux

a)367rev/min b)648 rev/min c)559 rev/min d) None of the above

15.A D.C. shunt motor is running with a certain load. The effect of adding an external resistance in the field circuit is to

a)reduce the motor speed b) reduce the armature current of the motor

c) increase the motor speed d) stop the motor

16.Which of the following explains why the armature current of a shunt motor decreases as the motor accelerates?

b) The high speed of the motor will cause the flux in the motor to decrease.

c) The supply voltage decreases because the back emf has increased.

d) The current decreases because the motor cannot take up any load.

e) The current decreases because the back emf has increased

17.DC series motor should never be switched on at no load, because

a) the field current is initially zero b) the motor does not pick up

c) the speed becomes dangerously highd) it will take long to accelerate

An eight –pole armature is wound with 480 conductors. The magnetic flux and speed are such that average emf generated in each conductor is 2.2V and each conductor is capable of carrying a full load current of 100A.

Use the above information to answer questions 18 to 21

18.Find the terminal voltage on no load in volts if the armature is lap-connected.

a)162 b) 153 c)132 d)None of the above

19.Find the output current on full load in amperes if the armature winding is lap-connected.

a)800 b)750 c) 700 d)None of the above

20.Find the terminal voltage on no load in volts if the armature winding is wave-connected.

a)556 b)544 c)528 d)None of the above

21.Find the output current on full load in amperes if the armature is wave-connected.

a)200 b)180 c)140 d)None of the above

22. A D.C shunt generator when driven without any excitation showed an open circuit voltage of 12 volts .When the field winding was excited, the voltage dropped to zero . It happened because

a) The field resistance was higher than the critical resistance

b) There was break in the armature circuit

c) Field winding was wrongly connected

d) There was no residual magnetism in the field circuit

23. A D.C shunt motor runs at a rated speed if its field circuit gets open –circuited, then soon after this the motor speed would tend to

a) decrease b) remain ungagged c) increase d) fluctuate around its previous speed

A four-pole armature is wound with 564 conductors and driven at 800rev/min, the flux per pole being 20mWb.The current in each conductor is 60A .

Use the above information to answer questions 24 to 26.

24.Calculate the armature if the conductors are connected wave.

a)240A b)60A c)120A d)None of the above

25.Calculate the emf generated in the armature if the conductors are connected wave.

a)300.8V b) 358.0V c)420V d)None of the above

26.Calculate the power generated in the armature if the conductors are connected wave.

a)36,096W b) 21,480W c)100,800W d)None of the above

27.Which of the following is **NOT TRUE** about an electrical machine?

a)It converts electrical energy into mechanical energy.
b)It consists of stationary and rotationary parts.
c)Both rotor and stator can be excited.

d)It is only the stator that is always excited.

28.Which of the following describes a critical field resistance of self excited d.c. machines?

a) It is the maximum total resistance of the field circuit above which self-excitation will not be achieved.

b) It is the total resistance in the armature and field circuits.

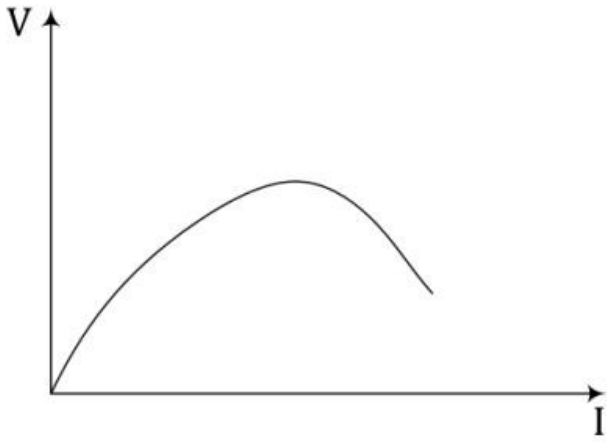
c) Its value decreases with increasing speed of the machine.

d)It is the total resistance of the field circuit when the machine is operating at full load.

29.Which of the following is **NOT** among the requirements for a d.c. machine to be self excited?

a)The critical field resistance must not be exceeded.
b)The speed of the machine must be below a critical value.
c)There should be a residual magnetic field in the machine.
d)The residual magnetic field and the generated field must add up.

30.The graph below is an external characteristic of a …….d.c. generator.



a) Separately excited b) Series wound c) Shunt wound d) Compound wound

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FORMULA SHEET

$$S = \frac{l}{\mu_0 \mu_r A} \quad ; \quad \Phi = \frac{mmf}{reluctance} = \frac{NI}{S} \quad ; \quad L = \frac{N\Phi}{I} = \frac{N^2}{S} \quad ; \quad W_{fld} = \frac{1}{2} LI^2$$

$$mmf = Hl = IN \quad ; \quad B = \mu H = \mu_r \mu_0 H \quad ; \quad H = \frac{B}{\mu_r \mu_0} \quad ; \quad I = \frac{Hl}{N}$$