CLASS TEST

SL. : 01_SK_ABCD_040822

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# ELECTRICAL ENGINEERING

# DC Machine

**Duration : 1:00 hr.** **Maximum Marks : 50**

Read the following instructions carefully

1. This question paper contains **30** objective questions. **Q.1-10** carry one mark each and **Q.11-30** carry two marks each.
2. Answer all the questions.
3. Questions must be answered on Objective Response Sheet (**ORS**) by darkening the appropriate bubble (marked **A**, **B**, **C**, **D**) using HB pencil against the question number. Each question has only one correct answer. In case you wish to change an answer, erase the old answer completely using a good soft eraser.
4. There will be **NEGATIVE** marking. For each wrong answer **1/3rd** of the full marks of the question will be deducted. More than one answer marked against a question will be deemed as an incorrect response and will be negatively marked.
5. Write your name & Roll No. at the specified locations on the right half of the **ORS**.
6. No charts or tables will be provided in the examination hall.
7. Choose the **Closest** numerical answer among the choices given.
8. If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that questions.
9. If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

**DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO**

**Q.No. 1 to Q.No. 10 carry 1 mark each**

**Q.1** A 280 V, separately excited lap wound dc motor has 100 armature conductor. Flux per pole is 0.15 Wb. Armature resistance is 0.2 Ω. If motor is running at 1000 rpm, then armature current is

(a) 175 A (b) 150 A
(c) 200 A (d) 125 A

**Q.2** A 300 V, 25 kW dc shunt motor is subjected to speed control. At half of load, armature voltage is found out to be 250 V. The induced emf taking flux and speed to be same is

(a) 200 V (b) 250 V
(c) 150 V (d) 220 V

**Q.3** For a dc shunt machine given stray loss is 150 W, full load Copper loss = 400 W, Brush loss = 50 W, field loss = 200 W. To get the maximum efficiency at full load the Iron loss is

(a) 40 W (b) 50 W
(c) 60 W (d) 70 W

**Q.4** Two coupled DC series motor with constant load torque are changed over from series to parallel connection across a fixed voltage supply. How does the set speed changes compared to the original speed?

(a) Double (b) Half
(c) Equal (d) None

**Q.5** A DC series motor has linear magnetization and negligible armature resistance. The motor speed is

(a) directly proportional to $\sqrt{T}$
(b) inversely proportional to $T$
(c) directly proportion to $T$
(d) inversely proportional to $\sqrt{T}$

**Q.6** A dc shunt motor drives an elevator load which requires a constant torque of 300 Nm. The motor is connected to a 600 V dc supply and the motor rotates at 1500 rpm. The armature resistance is 0.5 Ω and speed is 1500 rpm. If the shunt field flux is reduced by 10%, then the armature current is

(a) 93.89 A (b) 84.49 A
(c) 45.42 A (d) 105.87 A

**Q.7** A dc shunt motor develops a torque of 20 N-m when the armature current is 40 A. If it is changed as a cumulative compound motor by adding series field, which increases 20% of flux, and the armature current is 60 A, then the developed torque is

(a) 24 N-m (b) 18 N-m
(c) 36 N-m (d) None of the above

**Q.8** A commutator with a diameter of 50 cm rotates at 600 rpm. For a brush width of 2 cm, the time of commutation is,

(a) 0.718 msec (b) 1.273 msec
(c) 2.47 msec (d) 1.78 msec

**Q.9** A 4-pole, DC generator with wave wound armature has 50 slots containing 18 conductors in each slot. The induced emf is 357 volts and the speed is 9000 rpm. The flux per pole will be

(a) 5.2 mWb (b) 4.8 mWb
(c) 3.6 mWb (d) 1.32 mWb

**Q.10** A 60 kW, 250 V shunt motor takes 16 A when running light at 1440 rpm. The resistance of the armature and field are 0.2 Ω and 125 Ω respectively. The efficiency of the motor when taking 152 A is

(a) 87.17% (b) 77.73%
(c) 81.45% (d) 85.17%

**Q. No. 11 to Q. No. 30 carry 2 marks each**

**Q.11** To conduct load test on a dc shunt motor, it is coupled to a generator which is identical to the motor. The field of the generator is also connected to the same supply source as the motor. Armature of a generator is connected to a resistance load. The armature resistance of both machines is 0.02 p.u. Armature reaction and mechanical losses can be neglected. With rated voltage across the motor, the load resistance across the generator is adjusted to obtain rated armature current in both motor and generator. The p.u. value of the resistance load is,

(a) 0.91 p.u. (b) 0.96 p.u.
(c) 0.98 p.u. (d) 0.85 p.u.

**Q.12** A compensated DC machine has 19000 armature ampere turns per pole. The ratio of pole arc to pole pitch is 0.7. Interpolar air gap length and flux density are respectively 1 cm and 0.3 T. For rated armature current of 1000 A. The number of turns on each interpole and compensating winding conductors per pole would be respectively

(a) 7 and 28 (b) 8 and 32
(c) 8 and 28 (d) 7 and 32

**Q.13** A belt driven 60 kW shunt wound dc generator running at 500 rpm is supplying full load to a busbar at 200 V. At what speed will it run if the belt breaks and machine continues to run taking 5 kW from the bus bar? (armature and field resistance are 0.1 Ω and 100 Ω and take brush drop of 2 V).

(a) 325.2 rpm (b) 421.4 rpm
(c) 430 rpm (d) 502.5 rpm

**Q.14** A compensated dc machine has 20000 AT/Pole. The ratio of pole arc to pole pitch is 0.8. The interpolar airgap length and flux density are 1.2 cm and 0.3 T. For rated armature current $I_a$ = 1000 A, the number of turns on each interpole are,

(a) 7 (b) 8
(c) 5 (d) 9

**Q.15** A 200 V shunt motor takes 10 A when running on no load. At higher loads the brush drop is 2 V and at light loads it is negligible. The stray load loss at a line current of 100 A is 50% of no load loss. If armature and field resistance is 0.2 Ω and 100 Ω respectively, then the power loss in the motor when line current is 100 A is

(a) 1.8 kW (b) 3.2 kW
(c) 9.4 kW (d) 5.1 kW

**Q.16** A 12-pole, 165 A, dc shunt generator has 662 lap connected armature conductors. Field winding takes current of 5 A. At full load, brushes are shifted from GNA by 4° mechanical. Then the cross magnetizing ampere turns per pole are

(a) 122.14 AT/pole (b) 286.56 AT/pole
(c) 91.29 AT/pole (d) 312.42 AT/pole

**Q.17** A 20 kW, 300 V dc shunt motor is driving a constant torque load with line current of 100 A at a speed of 1600 rpm. Motor has armature and field winding resistance as 0.02 Ω and 100 Ω respectively. If 50 Ω external resistance is added in field circuit, then motor is running at
(Assume linear magnetization curve)

(a) 1594.8 rpm (b) 1812.9 rpm
(c) 2392.18 rpm (d) 2100 rpm

**Q.18** A 230 V, dc series motor has 500 lap connected armature conductor. It is supplying a shaft load of 1.5 kW. Armature and field winding resistances are 0.02 Ω/phase and 0.04 Ω/phase respectively. Friction and windage losses are 100 W. At this load flux per pole is 0.035 Wb. The speed of motor at this load is

(a) 790.1 rpm (b) 787.13 rpm
(c) 813.22 rpm (d) 900.32 rpm

**Q.19** A dc series moter is driving a fan load where the load torque is proportional to square of speed. The resistance of armature and field are 0.03 Ω and 0.05 Ω respectively. If the motor takes 15 A and runs at 1500 rpm with supply voltage of 200 V. The value of resistance to be added in series with the armature to reduce the speed to 750 rpm, is _____

(a) 20.04 Ω (b) 19.96 Ω
(c) 20.12 Ω (d) 19.88 Ω

**Q.20** A 230 V, 250 rpm, 100 A separately-exited dc motor has an armature resistance of 0.5 Ω. The motor is connected to 230 V dc supply and rated dc voltage applied to the field winding. It is driving a load whose torque-speed characteristic is given by $T_L = 500 - 10\,\omega$. The steady state speed at which the motor will drive the load is

(a) 600 rpm (b) 300.75 rpm
(c) 157 rpm (d) 428 rpm

**Q.21** A short shunt, cumulative compound generator is rated at 100 A. Voltage across load is 240 V. The shunt field current is 3 A. It has an armature resistance of 50 mΩ, a series field resistance of 10 mΩ, a field diverter resistance of 40 mΩ, and a rotational loss of 2 kW. The generator is connected to the load via a feeder, $R_{fe}$ of 30 mΩ resistance. The efficiency when the generator is supplying the full load at rated voltage, is

(a) 86.82%
(b) 78.12%
(c) 81.87%
(d) 89.86%

**Q.22** Interpoles in a DC motor must be:

(a) Series excited and should have polarity opposite to that of the next main pole in the direction of rotation of armature.
(b) Series excited and should have same polarity as that of the next main pole in the direction of rotation of the armature.
(c) Shunt excited and should have polarity opposite to that of the next main pole in the direction of rotation of the armature.
(d) Shunt excited and should have the same polarity as the next main pole in the direction of rotation of armature.

**Q.23** A 50 kW, 120 V, long shunt compound generator is supplying a load at its maximum efficiency and the rated voltage. Armature resistance is 50 mΩ, series field resistance is 20 mΩ, shunt field resistance is 40 Ω, and rational loss is 2 kW. The maximum efficiency of the generator is

(a) 82.35% (b) 96.5%
(c) 88.4% (d) 94.32%

**Q.24** A 25 kW, 250 V dc machine is separately excited. The field current is held constant at a speed of 3000 rpm. The open circuit voltage is 250 V. The terminal voltage is 255 V. Armature resistance is 0.05 Ω. The electromagnetic torque developed will be

(a) 79.58 N-m (b) 25 N-m
(c) 141.46 N-m (d) 38.74 N-m

**Q.25** The number of conductors on each pole piece required in a compensating winding for a 6-pole lap wound dc armature containing 286 conductors, will be (The compensating winding carries full armature current. Assume ratio of pole Arc/pole pitch = 0.7)

(a) 5 (b) 6
(c) 8 (d) 10

**Q.26** A 230 V, 1500 rpm, 20 A separately excited dc motor is fed from 3-phase full converter. The motor has armature resistance of 0.6 Ω. Full converter is connected to 400 V, 50 Hz source, through a delta-star transformer. Motor terminal voltage is rated when the firing angle is zero. What is the firing angle delay of the converter when it is running at -900 rpm and at half rated torque?

(a) 53.51°
(b) 126.5°
(c) 122.86°
(d) 127.24°

**Q.27** A permanent Magnet dc motor drives a mechanical load requiring a constant torque of 25 Nm. The motor produces 10 Nm with an armature current of 10 A. The resistance of the armature circiut is 0.2 Ω. A 200 V dc supply is applied to the armature terminals speed of the motor is

(a) 1427 rpm
(b) 1862 rpm
(c) 1238 rpm
(d) 1672 rpm

**Q.28** A 220 V, dc shunt motor takes no load armature current of 3 A and runs at 1500 rpm. If the full load armature current is 45 A then what is the speed? Assuming that flux remains constant and armature resistance is 0.5 Ω.

(a) 1356 rpm (b) 1326 rpm
(c) 1367 rpm (d) 1345 rpm

Q.29 To conduct load test on a dc shunt motor, it is coupled to a generator which is identical to the motor. The field of the generator is also connected to the same supply source as the motor. The armature of generator is connected to a resistive load. The armature resistance of both machines is 0.015 p.u. Armature reaction and mechanical losses can be neglected. With rated voltage across the motor, the load resistance across the generator is adjusted to obtain rated armature current in both motor and generator. The p.u. value of the resistive load is;

(a) 0.97 p.u.
(b) 0.985 p.u.
(c) 0.96 p.u.
(d) 0.975 p.u.

Q.30 Two shunt generators are in parallel with no load voltage 60 V and 50 V and full load power delivered 400 W and 500 W respectively at 20 V terminal voltage. The common voltage while delivering 700 W to load is

(a) 30.5 V (b) 22.6 V
(c) 20 V (d) 27.5 V

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