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RM-7103

B. E. III (Sem. VI) (Ele.) Examination

May / June – 2010

Electrical Drives & Utilization of Electrical Power

Time : 3 Hours] [Total Marks : 100

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. 3 (Sem. 6) (Electrical)**

Name of the Subject :

☛ **Electrical Drives & Utilization of Electrical Power**

☛Subject Code No. : **7 1 0 3** ☛Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

(2) Answers to the **two** sections must be written in **separate** answer books.
(3) Make suitable assumptions, wherever **necessary**.
(4) Figures to the **right** indicate full marks.
(5) Answer all questions.

SECTION - I

1 (a) Answer in one or two sentences. **(10)**

1. Rheostatic braking implies reconnecting the power supply. State true or false and correct it if false otherwise justify it.**(2)**
2. For DC motor, flux control method is used for speed control below base speed. **(2)**
3. In armature voltage control method, as the resistance in the armature circuit increases, the magnitude of the slope of the speed-torque characteristics _____ . Fill in the blank with appropriate answer. **(1)**
4. State two differences between active and passive torques. **(2)**
5. Draw speed-torque characteristic for coiler. **(1)**
6. In which quadrant does the electric vehicle operate when it is moving down-hill ?**(1)**
7. What characteristic should a power supply of an electric arc welding process possess? **(1)**

(b) Explain the four quadrant operation of an electrical drive with an illustration of a hoist. **(5)**

(c) Explain the modified speed torque characteristics of d.c. series motor when it is operated in shunted armature configuration. **(5)**

2 (a) Discuss the Ward-leonard method for speed control of DC motor with relevant speed-torque characteristics. Clearly mention the advantages and dis-advantages of this method over other methods. **(7)**

(b) A series motor having resistance of 1 ohm between its terminals drives a fan, the speed of which is proportional to the square of the speed. At 230V its speed is 300 rpm and takes 15A. The speed of the fan is to be raised to 375 rpm by supply voltage control. Estimate the supply voltage required. **(8)**

OR

2 **(a)** Explain the dynamic braking of DC shunt motor. Clearly explain the performance at lower speed with suitable speed torque characteristic. Also indicate how the minimum time of reversal can be achieved in this braking. **(6)**

(b) A weight of 500 kg is being lifted up at a uniform speed of 1.5 m/s by a winch driven by a motor running at a speed of 1000 rpm. The moments of inertia of the motor and winch are 0.5 and 0.3 kg/m^2 respectively. Calculate the motor torque and the equivalent moment of inertia referred to the motor shaft. In the absence of weight, motor develops a torque of 100 N-m when running at 1000 rpm. **(5)**

(c) A 220 V DC shunt motor has an armature resistance of 0.062 ohm and with full field has an EMF of 215V at speed of 960 rpm. The motor is driving on overhauling load with a torque of 172 Nm. Calculate the minimum speed at which the motor can hold the load by means of regeneration bracking. **(4)**

3 **Attempt any three from the following** **(15)**

(a) Discuss the two zone operation of a DC drive clearly indicating the constant torque and constant power operating region.

(b) Derive the following equation determining the radius of gyration of the flywheel used for the load equalization purpose.

$$J = \frac{T_r}{\omega_o - \omega_r} \times \frac{t_h}{\log_e\left(\frac{T_{Lh} - T_{\min}}{T_{Lh} - T_{\max}}\right)}$$

(c) Write brief note on Arc welding.

(d) Write brief note on Gas discharge lamps.

(e) Classify the power modulators. Also explain in brief the functions of power modulators.

SECTION - II

4 **(A)** **Answer the followings** **(10)**

1 If a 3 - ∅ induction motor runs at 4% slip having its rotor input of 2000 W then its rotor copper loss = _____ watt. **(1)**

2 The slip at which maximum torque occurs becomes larger as the operating frequency decreases. State true or false. **(1)**

3 For braking of synchronous motors _____ type of braking is almost exclusively used. **(1)**

4 If R_2 is the effective rotor resistance then a fictitious resistance which represents, the mechanical power developed in the rotor is _____. **(1)**

5 If a 3-∅ induction motor having a rating of 434/250 volt, 10KW,1440 rpm, 0.8 p.f.(lag), is connected with 250 V supply, the stator winding must be connected in star. State true or false. **(1)**

6 Why stator voltage control is suitable for speed control of induction motor in fan and pump drives? **(2)**

7 _____ type of braking takes place when the rotor rotates in the same direction as that of the stator magnetic field, but with a speed greater than the synchronous speed. **(1)**

8 Define 'Luminous flux' **(1)**

9 The traction system of Bombay- Igatpuri has the transmission voltage of _____ V DC. **(1)**

(B) Define the following terms in relation to traction system, **(04)**
(i) Co-efficient of adhesion
(ii) Train resistance

(C) For 3-∅ Induction motor prove that ratio of its starting current to stator current (I_{st}) at any slip (s) can be expressed as, **(06**

$$\frac{I_{st}}{I} = \sqrt{\frac{s^2 + s_{\max T}^2}{s^2\left(1 + s_{\max T}^2\right)}}$$

where I = stator input current at any slip s and s_{maxT} = slip at which maximum torque occurs. Neglect stator resistance and no-load current.

5 **(A)** Explain reverse current braking of induction motor drives. **(06)**

(B) A 440V, 10-pole, 50 Hz, 3-∅ star connected induction motor has following parameters: $R_1 = 0.15\ \Omega$, $R_2 = 0.45\ \Omega$, $X_1 = 0.6\ \Omega$, $X_2 = 1.8\ \Omega$, full load slip $S_f = 0.05$ and the ratio of effective stator to rotor turns $1/\sqrt{3}$. The motor is to be braked at rated speed and external resistance of 1.75 Ω per phase (referred to stator) has been inserted in to the rotor circuit. Determine the initial braking current and initial braking torque for the plugging operation. **(06)**

OR

5 **(A)** Show the different methods of feeding dc to stator winding of an induction motor for the purpose of rheostatic braking. Critically evaluate them. **(07)**

(B) A 6-pole, 50 Hz synchronous motor coupled to a load has a moment of inertia of 540 kg-m^2. If load torque is independent of speed and the frictional torque is 300 N-m, calculate the time taken by the motor to come to stop and the number of revolutions made during plugging which produces a constant braking torque of 3300 N-m. **(05)**

6 **Attempt any three** **(18)**

(a) Write a brief note on the braking methods used for synchronous motors.

(b) Make a critical comparison between mainline and suburban trains.

(c) A local train uses motor and trailer coaches in the ratio of 1:2. The weight of a motor coach is 40 tonnes and that of trailer 35 tonnes. All the wheels in a motor coach are driving wheels. The train resistance is 30 N/tonne. Effective rotating mass is 10% of the dead weight. If the coefficient of adhesion is 0.2,calculate
(i) The maximum train acceleration on a level track.
(ii) What will be the maximum acceleration if the motor and trailer coaches are used in the ratio of 1:1.

(d) Define and explain in brief the following terms with respect to illumination:
(i) Waste light factor
(ii) Co-efficient of utilization
(iii) Depreciation factor

(e) Write a short note on "Induction Heating".