**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(END SEMESTER EXAMINATION)**

**CLASS: BE** **SEMESTER : VI**
**BRANCH: EEE** **SESSION : SP/19**

**SUBJECT EE6205 INDUSTRIAL DRIVES AND CONTROL**

**TIME: 3 Hours** **FULL MARKS: 60**

**INSTRUCTIONS:**
**1. The question paper contains 7 questions each of 12 marks and total 84 marks.**
**2. Candidates may attempt any 5 questions maximum of 60 marks.**
**3. The missing data, if any, may be assumed suitably.**
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
**5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

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Q.1(a) Define an electrical drive with an example. [2]

Q.1(b) Derive the criteria for steady state stability. [4]

Q.1(c) Explain four quadrant operation of a drive with the example of a hoist. [6]

Q.2(a) What do you understand by constant torque drive and constant power drive? [2]

Q.2(b) A constant speed drive has the following duty cycle; [4]

i. Load rising from 0 to 400kW : 5 min
ii. Uniform load of 500kW : 5 min
iii. Regenerative power of 400kW returned to the supply : 4 min
iv. Remains idle for : 2 min

Estimate the power rating of the motor. Assume the losses to be proportional to $(\text{power})^2$

Q.2(c) Explain the working of close-loop speed control of multi-motor drive with a suitable diagram. [6]

Q.3(a) What is regenerative braking in dc motor drives? [2]

Q.3(b) A 200 V, 10.5 A, 2000 rpm shunt motor has the armature and field resistance of 0.5 and 400 Ω respectively. It drives a load whose torque is constant at rated motor torque. Calculate motor speed if source voltage drops to 175 V. [4]

Q.3(c) A 200 V, 875 rpm, 150 A separately excited dc motor has an armature resistance of 0.06 Ω. It is fed from a single phase fully controlled rectifier with an ac source voltage of 220 V, 50 Hz. Assuming continuous conduction, calculate [6]

i. Firing angle for rated motor torque and 750 rpm
ii. Firing angle for rated motor torque and (-500) rpm
iii Motor speed for α= 160° and rated torque

Q.4(a) Draw the per-phase stator referred equivalent circuit of an induction motor and give an expression for rotor current. [2]

Q.4(b) Draw and briefly describe about the close loop speed control of induction motor with static rotor resistance control. [4]

Q.4(c) A 2200V,2600kw,735rpm,50Hz,8pole, 3-phase squirrel-cage induction motor has following parameters referred to the stator: Rs=0.75Ω,$R'_r$=0.1Ω,Xs=0.45Ω, $X'_r$=0.55Ω. Stator winding is delta and consists of two sections connected in parallel. [6]

(i) Calculating starting torque and maximum torque as a ratio of rated torque, if the motor is started by star-delta switching. what is the maximum value of line current during starting?

Calculate transformation ratio of an auto transformer so as to limit the maximum starting current to twice the rated value. What is the value of starting torque?

Q.5(a) What are the advantages of current source inverter (CSI) Control over voltage source inverter (VSI) control drives of Induction Motor? [2]

Q.5(b) Draw and explain voltage source invertor (VSI) controlled induction motor drive with ac supply and dc supply. [4]

Q.5(c) Describe the closed-loop speed control of induction motor using voltage source inverter (VSI) drives. [6]

Q.6(a) What are the modes of variable frequency control in synchronous motor? [2]

Q.6(b) Explain the starting, and braking phenomena with fixed frequency supply of a synchronous motor. [4]

Q.6(c) A 500 kW, 3-phase, 3.3 kV, 50 Hz, 0.8 (lagging) power factor, 4 pole, star-connected synchronous motor has following parameters: $X_s = 15\Omega, R_s = 0$. Rated field current is 10 A. Calculate [6]

(i) Armature current and power factor at half the rated torque and rated field current

(ii) Field current to get unity power factor at the rated torque.

Q.7(a) Define Co-efficient of Adhesion in traction system? [2]

Q.7(b) Draw speed-time curve for main line train and explain different sections of the curve. [4]

Q.7(c) Write a short note on 'Pulse width modulated (PWM) voltage source inverter (VSI) squirrel-cage Induction motor drive' for electric traction. [6]

**:::::24/04/2019 E:::::**