

Question

In *Avengers: Infinity War*, Tony Stark is seen designing a high-powered suit to combat Thanon's army. The suit is powered by an advanced induction motor energized by a power source based on the arc reactor. Tony have used an **induction motor** for high-power tasks, such as driving mechanical systems, controlling joint movements, or operating actuators with precision. The arc reactor's energy, allowing Stark to control the motor's speed and torque based on the suit's needs during flight or combat. To make this feasible, Tony have engineered the induction motor using **nanotechnology** or **advanced composite materials**, making it more compact, lightweight, and efficient than typical industrial motors.



Fig. 1. Tony Stark's new nano-tech Iron Man suit powered by an induction motor.

Assume, the induction motor powering the suit has the following specifications:

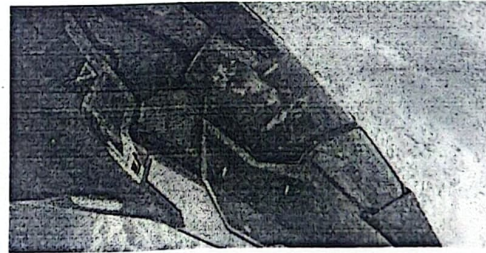
- I. Power input to the rotor: 80 kW
- II. Voltage: 440 V, 50 Hz
- III. Number of poles: 6
- IV. The rotor electromotive force is observed to make 100 complete alterations per minute.

Calculate the following to ensure the suit operates at peak performance:

- (i) Slip of the induction motor.
- (ii) Rotor speed in RPM.
- (iii) Rotor copper losses per phase (assuming balanced 3-phase conditions).

2. During a critical mission in *Avengers: Endgame*,

Tony Stark is tasked with upgrading the Quinjet to ensure it can handle the extreme energy demands required for deep-space travel and combat. To achieve this, he has incorporated a **long-shunt compound generator** into the Quinjet's power system, which works alongside the arc reactor to manage the jet's electrical load efficiently. This generator can supply steady power to key systems like propulsion, shields, weaponry, and onboard life-support systems, ensuring that the Quinjet operates smoothly even in the most challenging environments.



Given the following generator specifications for the Quinjet: Terminal voltage: 230 V, Output current: 150 A, Shunt field resistance: 92  $\Omega$ , Series field resistance: 0.015  $\Omega$ , Divertor resistance: 0.03  $\Omega$ , Armature resistance: 0.032  $\Omega$

Calculate the following to ensure the Quinjet operates at peak performance during high-energy space combat:

- I. The induced EMF in the generator.
- II. The total power generated.
- III. The distribution of power across the armature, shunt field, series field, and divertor.