

MCL431: CAM and Automation

Minor Exam

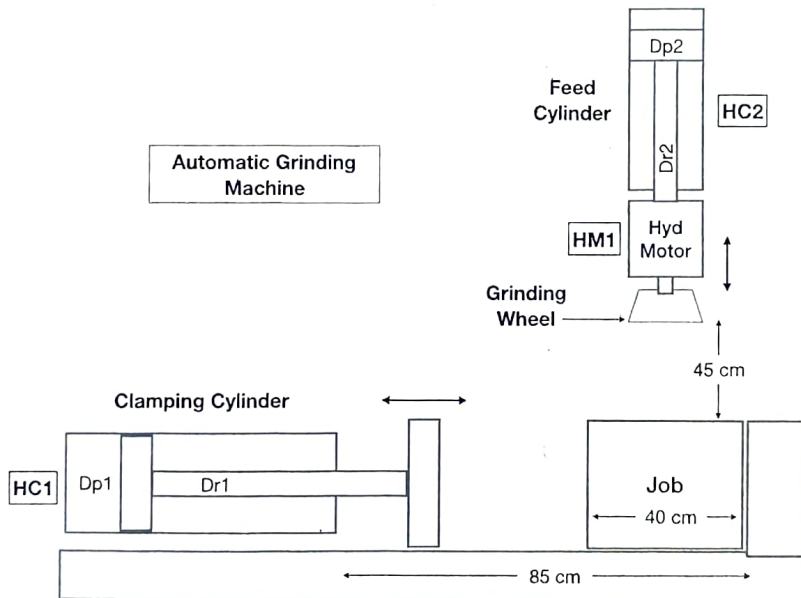
MAX MARKS: 80

MAX TIME: 50 min

Instructions:

- Only Hand written notes are allowed in the exam.
- No printed or Xeroxed material allowed except Lecture Slides
- Make suitable assumptions wherever necessary and state them clearly.

Q1. In an **Automated surface grinding machine**, a top surface of the cube of edge **40 cm** is to be grind by the grinding wheel. The torque required to grind surface is **1.6 kN-cm**. The grinding wheel should approach job from a distance of **45 cm**. The job is clamped on the machine with the help of hydraulic cylinder **HC1** having **50 mm** bore dia and **25 mm** rod dia. After job is clamped to **2.50 kN** force, the feed cylinder **HC2** having **40 mm** bore dia and **25 mm** rod dia will advance to make grinding wheel touching the workpiece top surface. Grinding wheel is made to rotate at **600 RPM** by Hydraulic Motor **HM1**. Frictional resistance in hydraulic cylinders **HC1** and **HC2** are **1.50 kN**. Hydraulic motor **HM1** requires minimum **0.40 kN-cm** torque to overcome internal frictional resistance during CW and CCW rotations. Volumetric displacement and Volumetric efficiency of Hydraulic Motor **HM1** are **5 cm³/rev** and **80%** respectively. During grinding operation, only pump **PB** will be operating relieving pump **PA** to drain fluid to the reservoir. Ignore all frictional losses in the tubings, valves and fittings.



- i) What will be the sequence of operation of HC1, HC2, and HM1 when DCV1 is actuated to left envelop and right envelop respectively? [6 Marks]
- ii) Name different pressure relief valves RV1-RV5 based on their functions. [5 Marks]
- iii) Job is to be ground for 35 seconds, what will be flow rates of pumps PA and PB in cm³/sec to produce 60 components per hour? DCV1 will be controlled manually as desired to complete operations. Assuming No time lost in valve position changeovers. [25 Marks]
- iv) Find the pressure ratings of pumps PA and PB in MPa. [15 Marks]
- v) Find pressure settings of pressure relief valves RV1, RV2, RV3, RV4, RV5. Consider safety PRV will open at 10% higher pressure than the system pressure requirement. [10 Marks]
- vi) Find HP of Electric Motor M required to run the system assuming 90% mechanical efficiency of the electric motor. [15 Marks]
- vii) What will be the Reservoir size for the hydraulic power pack in Litres? [4 Marks]

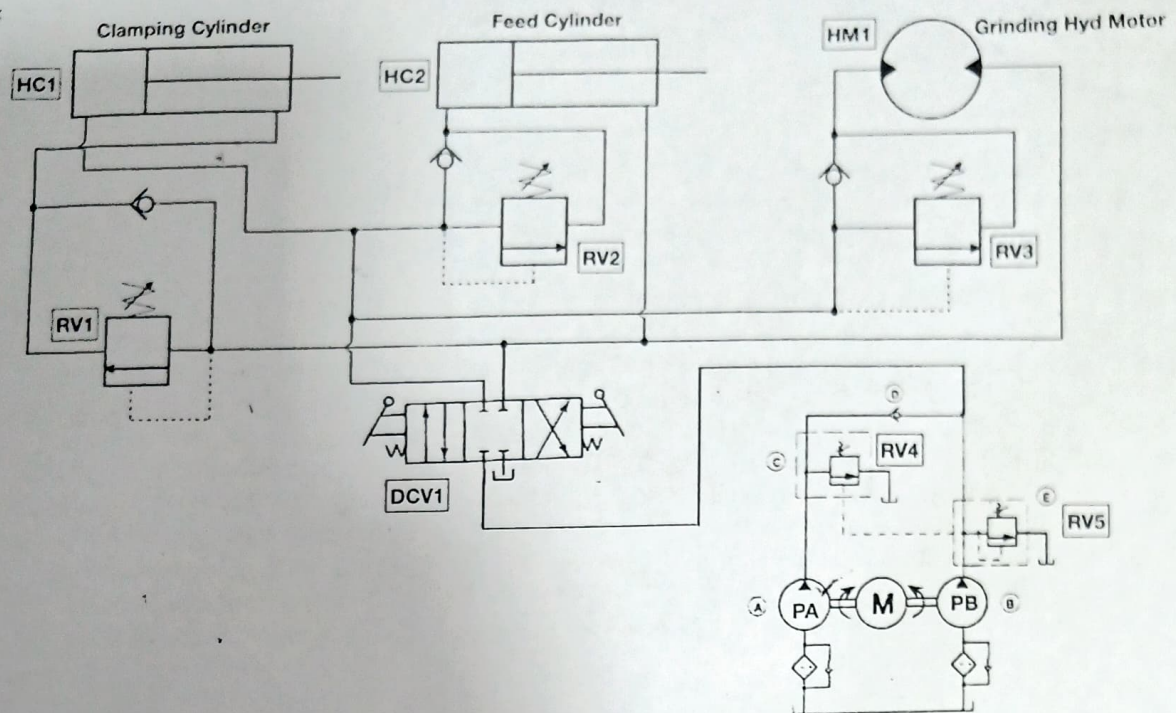


Fig. 2: Hydraulic Circuit of Automated Surface Grinding Machine

HINT:

Volumetric Efficiency of Hydraulic Motor is the ratio of theoretical flow-rate motor should consume to actual flow rate consumed by Motor.