TS2/2025 (Machining by Multi Point Tools & Unconventional Machining)

Q.1 A 22 mm diameter hole is made in 30 mm thick solid block using 20 mm diameter drill and boring tool. The twist drill related angles are: helix angle=22^0, point angle=118^0, and chisel angle=130^0. The selected cutting velocity and feed are 20 m/min and 0.1 mm/rev, respectively for both the operations. The measured cutting and thrust forces are 600 N and 200 N, respectively. Find (I) Maximum and minimum rake angle of the drill (II) Time required for making through hole taking approach and over travel length as 3 mm each (III) Time required for making blind hole up to 20 mm depth (V) Upward thrust and Torque on the drill

Q.2 A peripheral straight milling cutter of diameter 80 mm and thickness 20 mm having 15 teeth of 10^0 radial rake angle and zero helix angle is used for slab milling of MS block of dimension 15 mm width and 100 mm length in single pass. The cutter rotates at 200 RPM and table feed speed is 75 mm/min with depth of cut of 5 mm. The shear strength of workpiece is 400 MPa and coefficient of friction as 0.5. Find (I) Rake angle (II) Maximum Cutting and Thrust forces (II) MRR using minimum approach and over travel (III) Surface roughness

Q.3 A spur gear of 60 teeth is to be cut on a horizontal milling machine in up-milling mode. The gear blank thickness is 40 mm. The cutter has 100 mm diameter and 12 cutting teeth. The cutting speed, feed and depth of cut selected are 30 m/min, 0.2 mm per tooth per revolution, and 5 mm respectively. The time needed for indexing and rapid traversing the cutter over the blank is 15 second. Explain the procedure of setting of the dividing head. Also calculate the time of milling for cutting of the spur gear

Q.4 The top surface of a workpiece having 100 mm length and 50 mm width is ground using Al2O3 grinding wheel of 152 mm diameter, 20 mm bore diameter and 10 mm thickness. The grinding parameters used are; cross-feed=0.25 mm, Infeed= 0.1 mm, wheel RPM=2000 and frequency of worktable reciprocation is 60 per minute. The number of active grits per square cm of the wheel surface is 78. Calculate (I) Number of chips formed per minute (II) MRR (III) Cutting and Thrust force if specific grinding energy is 30 GJ/m^3 (IV) Average ground surface temperature considering thermal conductivity of grinding wheel and workpiece material as 17 W/m-K and 50 W/m-K, respectively and thermal diffusivity of grinding wheel and workpiece material as 8.2 X 10^{-6} and 1.6 X 10^{-5} m^2/s, respectively

Q.5 A cylindrical workpiece of length 12 m and diameter 100 mm is ground by external centreless grinding operation using depth of cut of 40 micron and grinding speed 2000 m/min. The grinding wheel dimension is 500 mm X 20 mm and regulating wheel dimension is 300 mm X 15 mm. The angle between the axis of grinding wheel and regulating wheel is kept 3^0. FIND (I) RPM of the workpiece (II) Grinding time of the workpiece (III) Percentage change in RPM of the workpiece and grinding time if RPM of regulating wheel is reduced by 50%. (IV) MRR (V) Percentage change in feed rate if the angle between the axis of grinding wheel and regulating wheel is doubled

Q.6 A 15 mm square cross-section hole of depth 5 mm is made in MS workpiece (melting temperature 1435 ^{o}C) using sinking EDM process with Copper tool and liquid dielectric of strength 10^6 V/m. The Process is performed with 15 A current at the IEG of 0.15 mm. The supply voltage of pulsating power supply is 250 V having pulse frequency of 10 kHz with pulse off time of 40 microsecond. FIND (I) Duty factor of power supply (II) MRR using Workpiece Melting Temperature Model (III) Time of machining for the hole if MRR (mm^3/min) =27.4 (Power input in kW)$^{1.54}$.

Q.7 A 40 mm diameter hole of depth 10 mm is made in HSS workpiece using Sinking EDM process with RC circuit based pulsating DC power supply of supply voltage 220 V. The tool used is brass and dielectric is kerosene. The resistance and capacitance used in RC circuit are 50 ohm and 15 microfarad, respectively. FIND (I) Frequency of sparking (II) Discharge Power if discharge voltage is 150 volt (V) Time of machining of hole for maximum discharge power

Q.8 A rectangular cross-section through hole of dimension 15 mm X 10 mm is made in an iron plate (Atomic weight=56, valency=2 and density=7.8 g/cc) of thickness 30 mm using Sinking ECM process at current of 1000 A with 90% current efficiency. Faradays constant is taken as 96500. FIND (I) MRR and Feed Rate if (II) the time of machining for the hole with 2000 A current (III) percentage change in current if machining time is reduced by 40% (IV) mass of material removed if 2000 A current is supplied for 30 s.

Q.9 Sinking-ECM is used to machine binary alloy (density 6000 kg/m^3) of metal M1 (atomic weight 56 and valency 2) and metal M2 (atomic weight 24 and valency 4). If MRR of the alloy is 3000 mm^3/min using current of 2000 A then find (I) the percentage of metal M2 in the alloy (II) MRR if percentage of M2 is made 35% and current 1500 A.

Q.10 An alloy containing 18% Co, 62% Ni and 20% Cr is machined using Sinking ECM process. Assume Faradays constant as 96500. FIND (I) MRR and Feed Rate with current of 1500 A. (II) Over all density of the alloy. (III) Charge required to remove all Cr element present in the alloy

The data given in following table can be used for calculations.

Element	Gram Atomic Weight	Valency of dissolution	Density (g/cm^3)
Cobalt (Co)	58.93	2	8.85
Nickel (Ni)	58.71	3	8.90
Chromium (Cr)	51.99	6	7.19