Research Proposal

1. **Title of the research:** Machining of superalloys and effect of cutting tool materials.
2. **Research area:** Manufacturing engineering & Material science
3. **Objectives:** High speed machining of superalloys using ceramic and PCBN cutting tool and tool wear characteristics are to be studied.
4. **Abstract:** Superalloys are one of the tested high-performance materials used in various industries due to their superior properties like high strength to weight ratio, high tensile and compressive strength, lower density, higher fatigue resistance high corrosion resistance. Super alloys are classified as difficult-to-machine materials because of their non-favourable properties such as poor thermal conductivity, low modulus of elasticity, strong chemical reaction to tool materials at higher temperatures. Due to increase in the usage of super alloys in to aerospace and other applications, their fabrication with higher efficiency, safety and reliability shows a lot of importance. It is reported that, the temperature generated during machining of super alloys is a single source of all the problems occurring during machining. These factors were associated with cutting performances, e.g., tool wear, surface integrity, and tool failure. Therefore, it should be minimized.
5. **Literature Review:** Material machinability is one of the most important topics in the field of machining, especially for difficult-to-cut materials. In general, there are too many factors related to machinability, yet no widely accepted ways to quantify machinability; therefore, it has been performed case by case. Ezugwu et al. [1] was focused on the machinability of a set of Ni-based superalloys in terms of wrought/cast superalloys, alloying elements/microstructure, and strengthening/heat treatment. These factors were associated with cutting performances, e.g., tool wear, surface integrity, and tool failure. They pointed out that the machined surface abuse and tool life were the most important factors. Moreover, they presented an up-to-date review with updating the results of the research on tool materials and coolants [2]. Cubic boron nitride (CBN) and PCBN tool materials could be capable to produce high quality at a high cutting speed and the conventional coolant might not reach the cutting zone. Arunachalam and Mannan [3] also reviewed the machinability of superalloys in highspeed machining (HSM) of Inconel 718, a Ni-based superalloy. They discussed

cutting tool materials, coolants, and surface integrity in HSM. Their conclusions showed that the chemical composition should be taken into account of the machinability of Ni-based superalloys.

6. References:

1. Ezugwu EO, Wang ZM, Machado AR (1999) The machinability of nickel-based alloys: a review. J Mater Process Technol 86:1– 16. https://doi.org/10.1016/S0924-0136(98)00314-8
2. Ezugwu EO, Bonney J, Yamane Y (2003) An overview of the machinability of aeroengine alloys. J Mater Process Technol 134: 233–253. https://doi.org/10.1016/S0924-0136(02)01042-7
3. Arunachalam R, Mannan MA (2000) Machinability of nickelbased high temperature alloys. Mach Sci Technol 4:127–168. https://doi.org/10.1080/10940340008945703

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