Engineering Program

Dept. of Mechanical Engineering

Course specification

Theory of Metal Cutting and Applications MR 223

1. **Course Aim**	
Main Aim	A study of this course will enable the student to: • Gain the basic knowledge of the theory of metal cutting and its applications. • Explain the different machining phenomena e.g, BUE, tool failure,…etc • Select the proper tool material & tool geometry for different machining operations. • Calculate the cutting forces, torque and motor power for different machining processes. • Assess the cutting conditions required to attain the specified product quality. • Solve different machining problems, such as tool failure, gear cutting, broaching design, … etc • Participate effectively with communities activities related to metal cutting. • Incorporate their concurrent knowledge in metal cutting with their future jobs.
Sub-Aims	To prepare future engineers who are able to: • Understand the basic metal cutting action. • Understand cutting forces and torque analysis.

2. Course Content

Machine tools and machining operations, engine lathe – shapers - planners – machines using multi-point tool – Drilling – Milling – broaching . Machines using abrasives: Grinding machines – Mechanics of metal cutting : chip formation process – forces acting on cutting tools – shear angle relationships – friction in metal cutting- temperatures in cutting zones – tool life and tool wear: Crater wear – flank

wear – tool life criteria--cutting tool materials – machineability evaluation – Mechanics of milling processes-- horizontal milling – vertical milling - cutting forces in milling. – Nomenclatures of cutting tools – tool in hand angles – tool in use angles – Non-conventional machining processes: abrasive jet machining – electric discharge machining – laser cutting – electrochemical machining – Economics of metal machining: terms of machining costs – optimum cutting speeds for-minimum costs – maximum profit – maximum production rate. – Dynamometer design: lathe dynamometer, milling – drilling dynamometers, Grinding dynamometer – laboratory experiments. Machine tools and machining operations, engine lathe – shapers - planners – machines using multi-point tool – Drilling – Milling – broaching . Machines using abrasives: Grinding machines – Mechanics of metal cutting : chip formation process – forces acting on cutting tools – shear angle relationships – friction in metal cutting- temperatures in cutting zones – tool life and tool wear: Crater wear – flank wear – tool life criteria--cutting tool materials – machineability evaluation – Mechanics of milling processes-- horizontal milling – vertical milling - cutting forces in milling. – Nomenclatures of cutting tools – tool in hand angles – tool in use angles – Non-conventional machining processes: abrasive jet machining – electric discharge machining – laser cutting – electrochemical machining – Economics of metal machining: terms of machining costs – optimum cutting speeds for-minimum costs – maximum profit – maximum production rate. – Dynamometer design: lathe dynamometer, milling – drilling dynamometers, Grinding dynamometer – laboratory experiments.
(Source: Program Specification)

3. **Course Topics**		
1st topic	1. Review of Machining Tools Machine tools and machining operations, engine lathe – shapers - planners – machines using multi-point tool – Drilling – Milling- Gear Cutting – broaching . Machines using abrasives: Grinding machines	3 weeks
2nd topic	2. Cutting Mechanics, Chip Formation, and Tool Geometry chip formation process – forces acting on cutting tools – shear angle relationships – friction in metal cutting- temperatures in cutting zones	3 weeks
3rd topic	3. Tool Materials- Tool life and Cooling Crater wear – flank wear – tool life criteria	3 weeks

4thtopic	4. Machining Economics Terms of machining costs – optimum cutting speeds for-minimum costs – maximum profit – maximum production rate	3 weeks
5thtopic	٥. Non conventional Cutting Abrasive jet machining – electric discharge machining – laser cutting – electrochemical machining	2 weeks

4. Grades Distribution

Assesment Methods		**Percentage**	
Final Exam		80 mark	
Term work		45 mark	
Term work Assessments	**Written Exam**	**15**	45 mark
	Tutorial assessment	**5**	
	Project assessment	**10**	
	Report assessment	**5**	
	Quiz assessment	**10**	
Total		**125 mark**	

5. List of References

1	Course notes and handouts
2	Text books ("Machining Technology: Machine Tools and Operations," Helmi Youssef and Hassan El
3	Extra Readings ("Machining: Fundamentals and Recent Advances," J. Paulo Davim, Springer, 2008).
4	Course notes and handouts