

List of Figures

Fig. No.	Name of Figure	Page No.
2.1	Surface roughness (R_y) for all the conditions tested ($r_e = 0.4\text{mm}$)	13
2.2	Comparison of the fitted values and the estimated values with Eq.	14
2.3	The fitted values vs. the observed values	14
2.4	Predicted values versus observed values.	16
2.5	Deviation of RA, CNN and Equation values from the observed values	16
2.6	Normal probability plot of residuals for Ra data.	17
2.7	Plot of residuals vs. predicted response for Ra data.	17
2.8	Mold part	18
2.9	Cutting with various edge geometry CBN tools	19
2.10	Central composite design for three factors	20
2.11	Response contours of surface roughness and metal removal Q	20
2.12	Inputs and outputs of the network	21
2.13	Conventional geometry	22
2.14	Wiper shape	22
2.15	Wiper insert design: r_{e1} and r_{e2} are the radii of wiper curvature	24
2.16(a)	Effective rake angle = 6° , nose radius = 0.4 mm	26
2.16(b)	Effective rake angle = 6° , nose radius = 0.8 mm	26
2.16(c)	Effective rake angle = 6° , nose radius = 1.2 mm	26
2.17	Type of edge preparations used in CBN and ceramic cutting tools	27
2.18	3D surface graph for the surface roughness at Coolant = 2.4 l/min, as speed and feed varies	28
2.19	3D surface graph for the surface roughness at feed = 50mm/min as speed and coolant varies	29
2.20	3D surface graph for the surface roughness at speed = 300 rpm as coolant and feed varies	29

2.21	Microstructure of the Al–SiC (20 p) MMC	31
2.22	Coating layers of Insert 1	32
2.23	Coating layers of Insert 2	32
2.24	Surface roughness profile	34
2.25	Central composite design for three factors	35
2.26	Experimental scheme	37
2.27	Comparison of inserts with conventional and wiper (multi-radii)	39
2.28	Pre prepared work pieces in AISI 1045 used in turning tests	39
2.29	Microstructure of Ti–6Al–4V	40
2.30	CVD coated carbide insert	40
2.31	Effect of cutting speed and feed on Ra	41
2.32	Effect of hardness and DOC	41
2.33	3D surface plots for surface roughness	43
3.1	Simply supported beams centrally loaded	56
3.2	Variation of V_{σ} and V_{δ} with L^2/b ratio for cast iron and mild steel	59
3.3	Variation of angle of twist as a function of aperture shape and size	68
3.4	Comparison of cross section deformation with and without end covers plate	70
3.5(a)	Stiffness variation with different ribbing arrangement with and without end covers	70
3.5(b)	Stiffness variation as a function of different ribbing arrangement	70
3.6	Columns with vertical internal and external stiffeners	71
3.7	Columns with horizontal stiffeners	73
3.8	Effect of bolt arrangement and external bottom stiffeners	74
3.9	External vertical bottom stiffeners	75
3.10	Effect of stiffener base width on stiffness/weight ratio and rigidity	76
3.11	Lumped model of portal frame	85
3.12	Lumped models	87

4.1	Bed with meshing and load	92
4.2	Bed with stress result	93
4.3	Bed with Displacement result	93
4.4	Basic modes of vibration for Bed	93
4.5	Head with meshing and load	98
4.6	Head with Displacement result	98
4.7	Head with Stress result	98
4.8	Basic modes of vibration for Head	99
4.9	Saddle with meshing and load	103
4.10	Saddle with Displacement result	104
4.11	Saddle with Von Mises stress result	104
4.12	Basic modes of vibration for Saddle	105
4.13	Results of sensitivity analysis (Head)	108
4.14	Displacement and stress result after optimization for Head	111
4.15	Displacement result after optimization for Bed	115
5.1(a)	Idealized model of surface roughness with sharp corner cutting tool	130
5.1(b)	Cross section through surface irregularities	130
5.2	Effect of minor cutting edge angle on surface roughness	132
5.3	Idealized model of surface roughness for round corner tool	132
5.4	Comparison of experimental results with an idealized model of surface roughness	133
5.5	Effect of cutting speed on the surface roughness for turning M.S.	134
5.6	Surface roughness and waviness depending on cooling and lubrication conditions and cutting parameters	136
5.7	Surface roughness tester SJ-400	137
5.8	Wiper inserts edge geometries and improvement in surface roughness	139
5.9	Effect of feed on the effectiveness of a wiper inserts	140
5.10	Fitted value Vs observed value (AISI 1040 steel and Al)	145

5.11	Fitted value Vs observed value (AISI 410 steel and Al)	145
5.12	Relative error of the fitted values vs. Computed values (AISI 1040 steel and Aluminium)	146
5.13	Relative error of the fitted values vs. Computed values (AISI 410 steel and Aluminium)	146
5.14	Comparison of the fitted values and the estimated values (AISI 1040 steel and Aluminium)	146
5.15	Comparison of the fitted values and the estimated values (AISI 410 steel and Aluminium)	147
6.1	3^2 Design	149
6.2	3^3 Design	149
6.3	3 D Response surface showing the expected yield (η) as a function of feed (x_1) and depth of cut (x_2)	152
6.4	A contour plot of a response surface	152
6.5	The sequential nature of RSM	154
6.6	Turning center Jobber X_L	155
6.7	Material: AISI 1040 Steel (500X)	157
6.8	Main effect plot for Roughness	162
6.9	Interaction plot for Roughness	162
6.10	Normal probability plot of R_a	163
6.11	Residual Vs. Fitted surface roughness	162
6.12	Predicted and Experimental values for Surface Roughness	163
6.13	Estimated contour plots for R_a (Const.: r and d)	164
6.14	Estimated contour plots for R_a (Const.: f and d)	164
6.15	Estimated contour plots for R_a (Const.: f and r)	164
6.16	3Dsurface plot for R_a Vs r & v	164
6.17	3Dsurface plot for R_a Vs v & f	165
6.18	3Dsurface plot for R_a Vs v & d	165
6.19	Comparison of experimental and predicated values for R_a	166
6.20	Response optimization for surface roughness parameter	166

6.21	Material: AISI 410 Steel (500X)	168
6.22	Main effect plot for Roughness	173
6.23	Interaction plot for Roughness	173
6.24	Normal prob. plot of residual for Ra	173
6.25	Residual Vs. Fitted roughness values	173
6.26	Predicted and Experimental values for Surface Roughness	174
6.27	Esti. Contour plots for Ra (Const.: r and d)	175
6.28	Esti. Contour plots for Ra (Const.: f and d)	175
6.29	Esti. Contour plots for Ra (Const.: f and r)	175
6.30	3D surface plot for Ra Vs v and f	175
6.31	3Dsurface plot for Ra Vs r and v	175
6.32	3Dsurface plot for Ra Vs r and d	175
6.33	Comparison of experimental and predicated values for Ra	176
6.34	Response optimization for surface roughness parameter	177
6.35	Material: M.S (500X)	179
6.36	Main effect plot for Roughness	184
6.37	Interaction plot for Roughness	184
6.38	Normal prob. plot of residual for Ra	184
6.39	Residual Vs. Fitted roughness values	184
6.40	Predicted and Experimental values for Surface Roughness	185
6.41	Esti. Contour plots for Ra (Const. r and d)	186
6.42	Esti. Contour plots for Ra (Const. f and d)	186
6.43	Esti. Contour plots for Ra (Const. f and r)	186
6.44	3Dsurface plot for Ra Vs f and v	186
6.45	3Dsurface plot for Ra Vs r & d	186
6.46	3Dsurface plot for Ra Vs r & v	186
6.47	Comparison of experimental and predicated values for Ra	187

6.48	Experimental scheme.	188
6.49	Response optimization for surface roughness parameter	188
6.50	Material: Aluminium (100 x)	190
6.51	Main effect plot for Roughness	194
6.52	Interaction plot for Roughness	194
6.53	Normal prob. plot of residual for Ra	195
6.54	Residual vs. Fitted surface roughness values	195
6.55	Predicted and Experimental values for Surface Roughness	195
6.56	Estimated contour plots for Ra (Const.: r and d)	196
6.57	Estimated contour plots for Ra (Const.: f and d)	196
6.58	Estimated contour plots for Ra (Const.: f and r)	197
6.59	3D surface plots for Ra Vs r & v	197
6.60	3D surface plots for Ra Vs d & f	197
6.61	3Dsurface plots for Ra Vs r & d	197
6.62	Comparison of experimental and predicated values for Ra	198
6.63	Response optimization for surface roughness parameter	199