COMPUTATIONAL TESTING OF WEAR RATE OF DIFFERENT MATERIAL WITH VARIABLE OPERATING PARAMETERS

Manoj Sahebrao Hajare[1], Kiran Suresh Deore[2], Lalita Mahadev Aage[3]

[1]*Assistant Professor, SITRC,Sandip Foundation,Nashik*
[2]*Students of SITRC, Sandip Foundation, Nashik*
[3]*Students of SITRC, Sandip Foundation, Nashik*

Abstract

In this paper research study has been made on the computational testing of wear rate for different materials (Cu, ss410 and Al) under the different condition of load applied, Speed and time. The set up of pin on disc tribometer has been used to study the wear rate of materials. The experiments has been performed on a group of specimens under different cases of times (5 to 15) minutes, and under different loads (3 to 7) Kg, and different speeds (500 to 1100)rpm the set up is connected with Data Acquisition System which gives wear rate of material computationally. By fixing any two parameters with one variable parameter experiment is performed [2]. Graphical representation of wear rate along with friction force and coefficient of friction is given by WINDUCOM software and the results will show the wear rate relation with (time, speed and load) and the comparisons of one material with other materials

Keywords: *Wear, ss410, copper, Al, hardened steel, speed*

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1. INTRODUCTION

Wear is a loss of material obtained at contacting surfaces of material having relative motion between them. When two materials comes in contact with each other friction force is applied on the surface, but friction is related to energy loss. Both friction and wear causes surface damage of material results reduce in reliability. A different type of wear occurs at different surfaces.

The main types of wear are [1]:

1) Abrasive Wear**:** This type of wear occurs due to presence of hard particles in contacting material or in lubricating layer.
2) Adhesive Wear**:** When two surfaces slides on each other and they are separated with lubricating film due to improper lubrication
3) Surface Fatigue**:** Wear cracks are in occurs due to mechanical tension in contacting body surfaces. In this paper adhesive wear is investigated at different conditions of time, speed and load applied.

1.1 A Different Types of Materials Used in Experiment are:

Metals**:** Copper and Aluminum are the non ferrous metals which are most widely used for various applications in electrical, mechanical and computer also for household equipments. Metals have important properties such as good conductors of electricity, high heat transfer rate so their applications are wide.

Alloys**:** Alloys are nothing but combination of two or more different metals. Alloys are made to improve properties of parent metals for various applications.SS410 is alloy of ferrous metal Cast Iron.

1.2 Properties of Copper, Aluminum and SS410 [8]:

1.2.1 Copper:

1) It is soft malleable and ductile material with reddish brown appearance.
2) Specific gravity of the material is 8.9 and melting point is 1083 ^{0}C .
3) Tensile strength varies from 150MPa to 400MPa.
4) It is good conductor of electricity.

1.2.2 Aluminum:

1) It is white metal produced by electrical process from oxide (alumina).
2) It is light metal having specific gravity 2.7 and melting point 658^{0}C
3) Tensile strength of material varies from 90MPa to150MPa.
4) Metal is weak and soft in its pure form but when mixed with alloy it becomes hard and rigid.

1.2.3 SS410:

1) It is cast iron alloy with dusky appearance.
2) Its tensile strength is 450Mpa.
3) Hardened for maximum heat and corrosion resistance.

1.3 Wear Failure and its Effect:

Definition [5]: If one surface is slide over another then the asperities come into contact and there is a possibility that wear can occur.

Wear can occur in different moving machine element such as rotating shafts, brake, lathe, clutch pedal etc.

Effects [1]:
1) Wear affects on mechanical system or parts like pump shaft, IC engines, brakes and valves their efficiency, operation and reliability.
2) So that to achieve better reliability more focus is on moving parts like bearings seals, piston cylinder and other moving parts.
3) In system like braking mechanism small amount of wear causes failure of system.

2. EXPERIMENTAL:

Methods of wear testing [7]:
1-Optical method
2- Weighing method
3- Mechanical method

Set up for pin on disc apparatus: [3]

4- Radio tracer techniques (measurement of radioactive pick-up method.

2.1 Mechanical Method

Pin on disc tribometer [6]:
This is laboratory method of wear testing comes under mechanical method of testing of wear. For the testing on pin on disk apparatus the specimens were a pin with a rounded tip and circular disk which rotate as per given speed in its working range .the position of flat circular disk is exactly perpendicular to test specimen. A pin is held against the disk. The test machine causes rotation of disk while pin is stationary. The sliding path is a circular with fixed wear track radius on the disk surface. The pin is pressed against the disk at a specified load with the help of an arm or lever and attached weights as per design.

Fig: 1 experimental set up of pin on disc tribometer.

2.1.1 Technical Specifications of Machine

Table 1[3] specifications of machine

Test parameter	**Values**
Specimen	Pin size:- 10 &12 mm diameter 32 mm long Ball : spherical ball ¢10
Wear disc size	Diameter 165mm, 8mm Thick
Wear track Diameter	Min:50mm,Max:500
Disc rotation	Min:200rpm,Max:2000rpm
Normal load	Min:5N,Max:200N
Friction force	Min:0N,Max:200N

2.1.2 Testing Conditions:

Wear track diameter: 100mm
Diameter of pin: 10mm

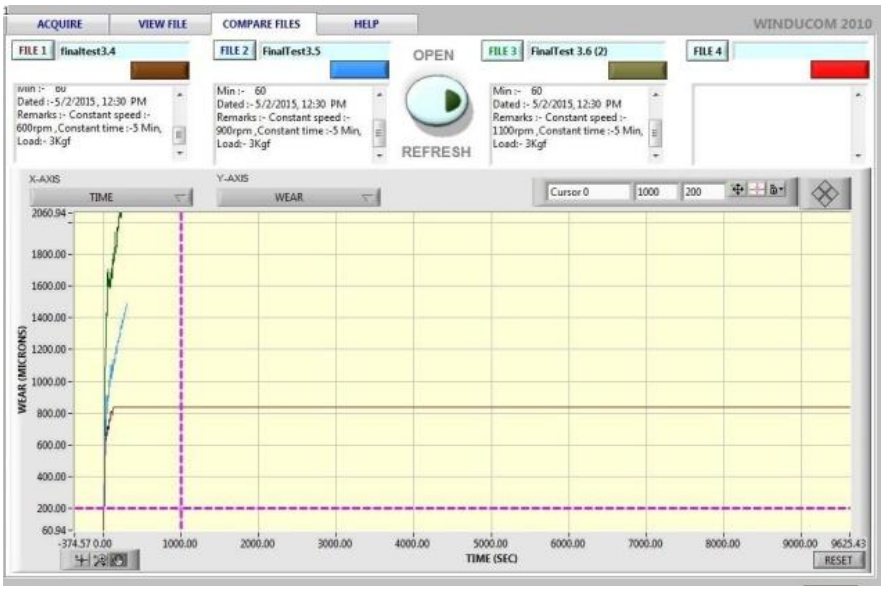
3. RESULT AND DISCUSSION:

3.1 Constant Load: 3kg; Constant Time: 5min; Speed is Variable.

Table: 2

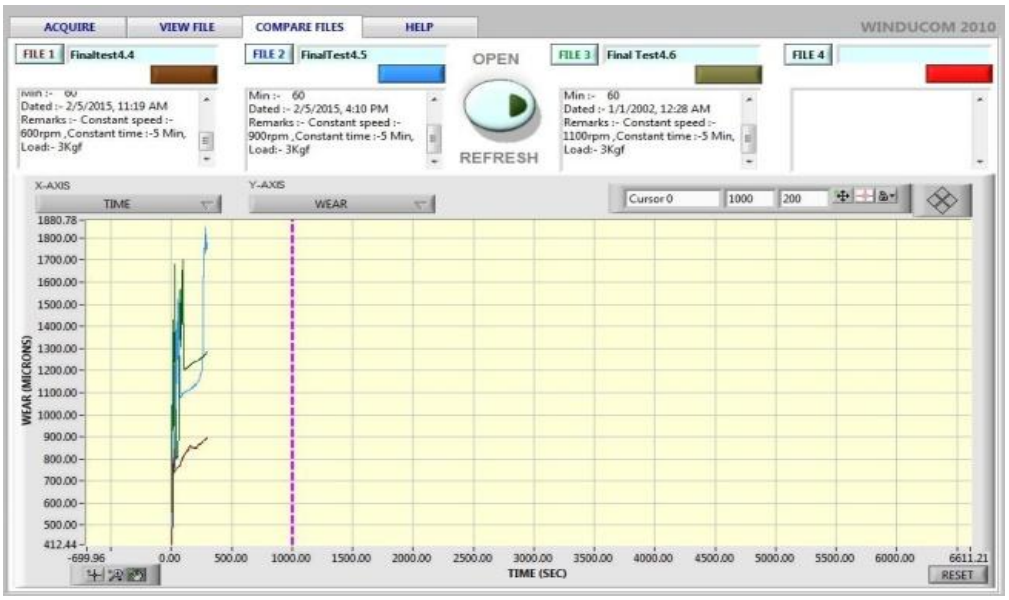
Sr. No	Sped in Rpm	Wear rate in micrometer		
		SS410	Al	Cu
1	600	1148	895	584
2	900	1492	1774	379
3	1100	2218	1283	507

Test Result for SS410



Graph 1 Wear rate of SS410

Test Result for AL



Graph 2 Wear rate of Al

Test Result for CU

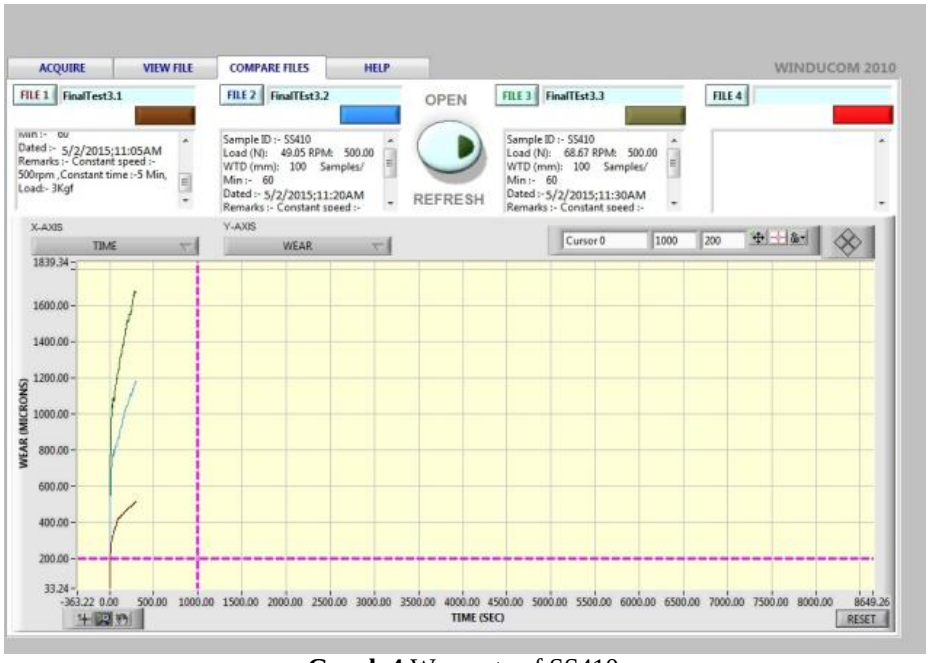
Graph 3 Wear rate of cu

3.2 Constant Speed: 500rpm; Constant Time: 5min; Load is Variable

Table: 3

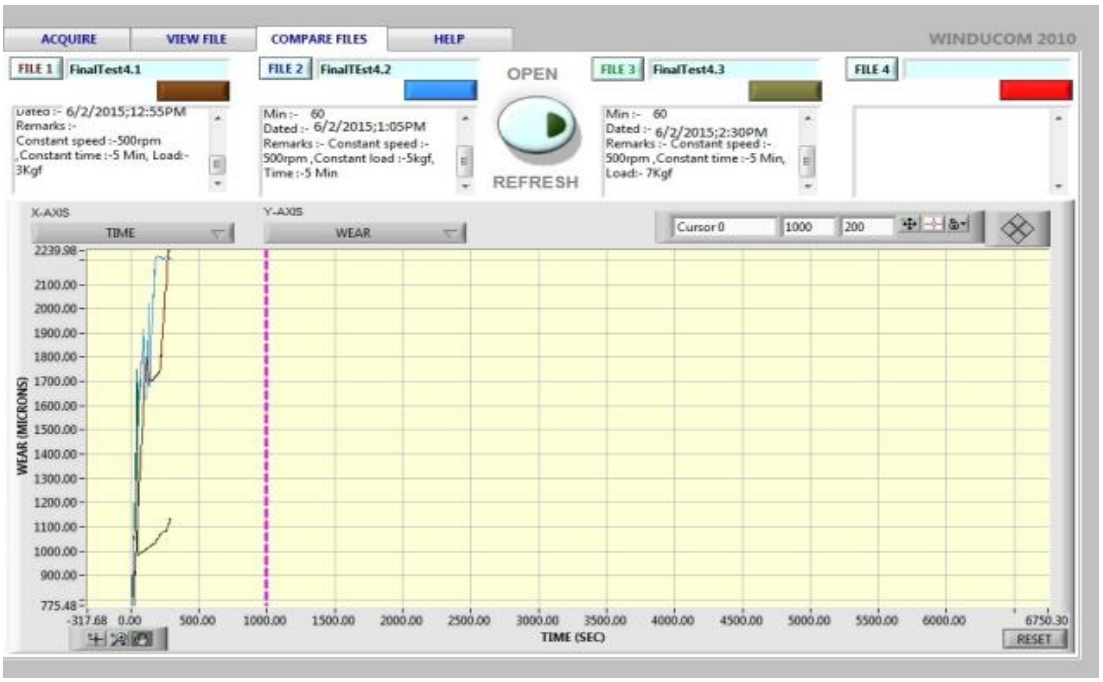
Sr. No	Load in kg	Wear rate in micrometer		
		SS410	Al	Cu
1	3	512	2366	294
2	5	1177	2205	249
3	7	1675	1129	920

Test Result for SS410



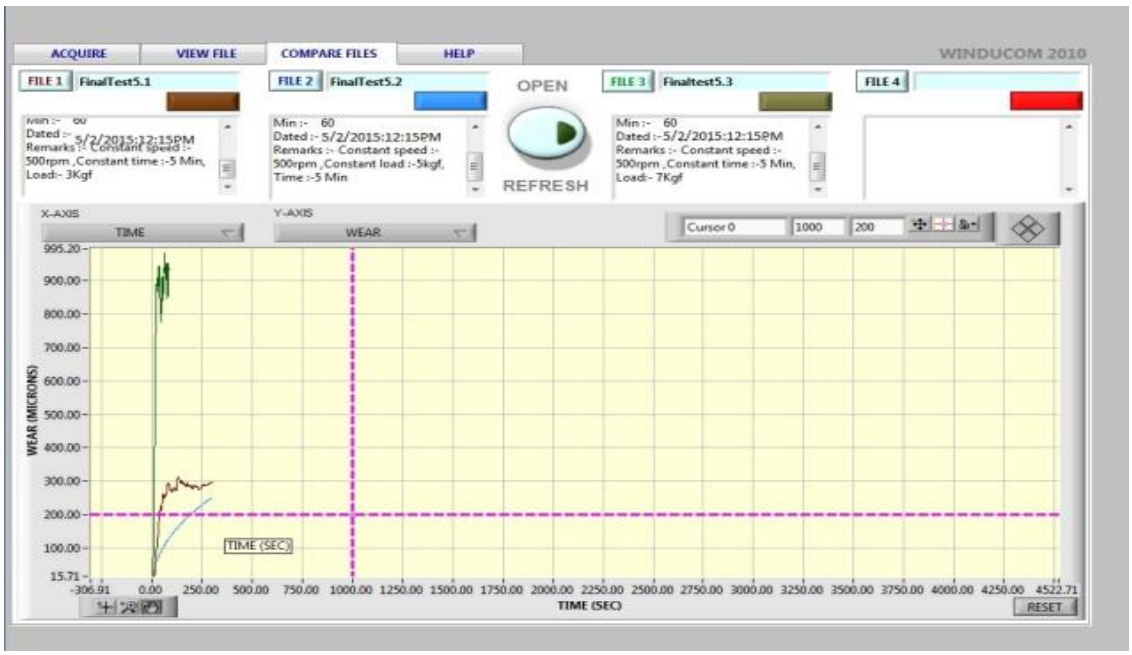
Graph 4 Wear rate of SS410

Test Result for AL



Graph 5 Wear rate of AL

Test Result for CU



Graph 6 Wear rate of Cu

3.3 Constant Load: 3kg; Constant Time: 5min; Time is Variable.

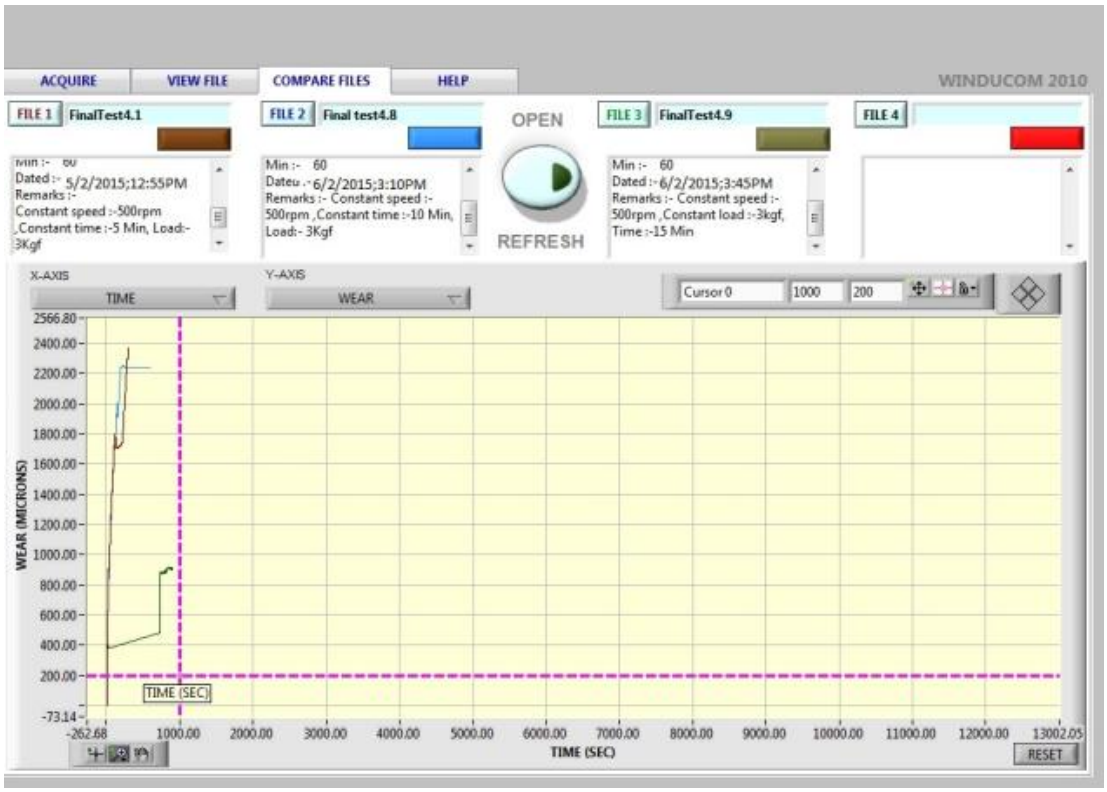
Table: 4

Sr. No	Time in Min	Wear rate in micrometer		
		SS410	Al	Cu
1	5	512	2366	294
1	10	1037	2241	224
2	15	942	910	461

Test Result for SS410

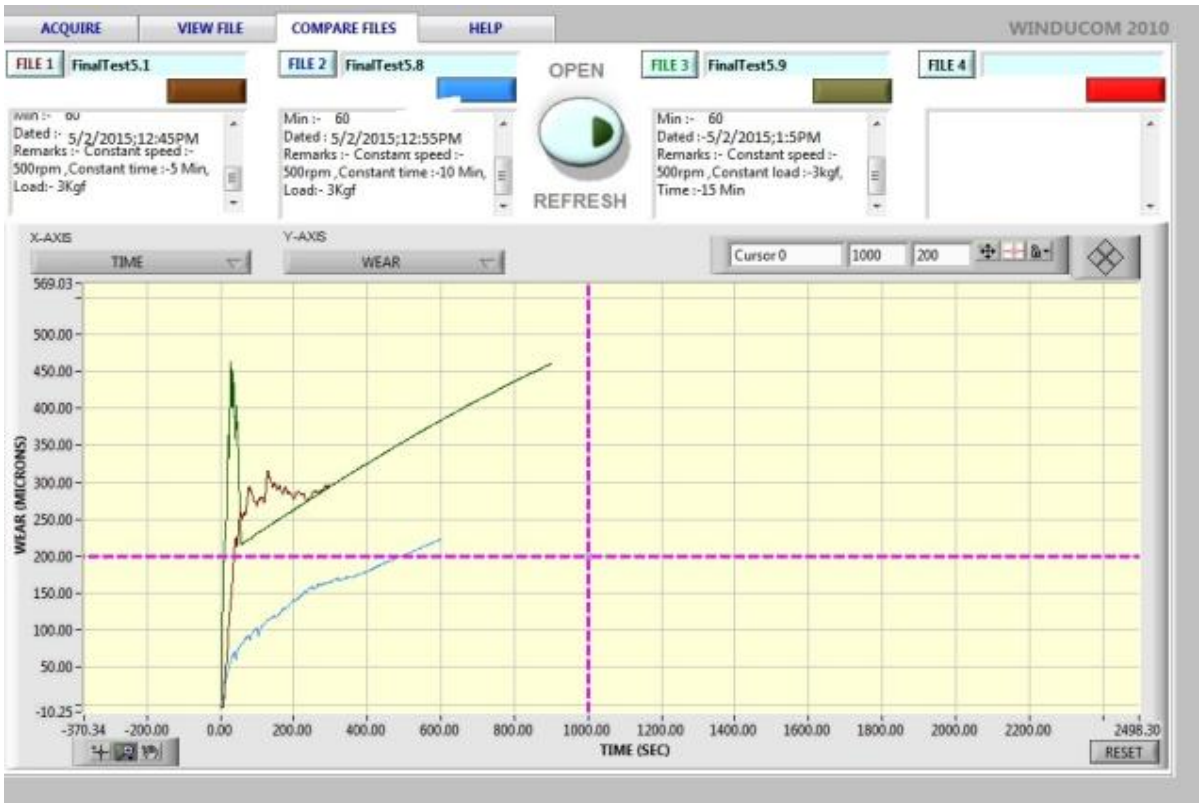
Graph 7 Wear rate of SS410

Test Result for AL



Graph 8 Wear rate of Al

Test Result for CU



Graph 9 Wear rate of Cu

4. CONCLUSION

1) For variable speed range, SS410 shows increase in wear rate corresponding to speed, while Al shows first increase in wear but after increasing in speed wear rate decreases.
2) Experimental results shows the Al and SS410 have maximum wear rate than Copper when any parameter is vary
3) Copper has better wear resistance property than Al and SS410.Cu can used instead of these two in some applications.
4) Wear rate of Al decreases with increase in time hence it can be used for long time operation with constant speed and load.
5) Wear rate of Copper At first decreases with respect to time but it rapidly increases as time further increases.
6) All the Graphs of SS410 give smooth curves of wear rate while distinguish patterns of curves can observed in Cu and Al.
7) Maximum value of wear is given by Al at 500rpm, 3kg load and 5min time while SS410 gives exactly opposite result that is shows lowest wear rate.

REFERENCES:

[1] Friction, wear, lubrication. A textbook in Tribology K.C Ludema Professor of Mechanical Engineering, The University of Michigan Ann Arbor CRC Press Boca Raton New York London Tokyo.

[2] Effect of loads, sliding speeds and times on the wear rate for different materials. Hani Aziz Ameen1, Khairia Salman Hassan2 and Ethar Mohamed Mhdi Mubark.

[3] Experimental lab manual on tribnology mechanical department NDMVP College.

[4] Y.Tsyu, Microstructure of Wear, Friction and solid lubrication, Tech. Reproof Mechanical Eng. Lab. Japan, Volume.3, No.81, 1975.

[5] Sliding friction and wear behaviour of polytetrafluoroethylene and its composites under dry conditions H. Unal a, A. Mimaroglu b,*, U. Kadıoglu a, H. Ekiz a Faculty of Technical Education, University of Sakarya, Esentepe Kampusu, Adapazari, Turkey.

[6] TRIBOLOGICAL BEHAVIOUR OF EN8 STEEL IN PRESENCE OF ZnO NANOFLUID Dr.Sanjay Shrivastava1, Rupesh Kumar Malviya2, Manish Verma3Dept of Mech Engg.

[7] Wear study on SS316 L.Ti-6-Al-4V,PEEK,Polyurethane and Alumina used as Bio-material.

[8] A book of “Material science and metallurgy” O.P. Khanna.