



ANNA UNIVERSITY
Chennai-25.
Syllabus for

B.E.(Full Time) Metallurgical Engineering

GE037 Intellectual Property Rights (IPR) 3 0 0 100

1 . UNIT I 5

Introduction - Invention and Creativity - Intellectual Property (IP) - Importance - Protection of IPR - Basic types of property (i. Movable Property ii. Immovable Property and iii. Intellectual Property).

2 . UNIT II 10

IP - Patents - Copyrights and related rights - Trade Marks and rights arising from Trademark registration - Definitions - Industrial Designs and Integrated circuits - Protection of Geographical Indications at national and International levels - Application Procedures.

3 . UNIT III 10

International convention relating to Intellectual Property - Establishment of WIPO - Mission and Activities - History - General Agreement on Trade and Tariff (GATT).

4 . UNIT IV 10

Indian Position Vs WTO and Strategies - Indian IPR legislations - commitments to WTO-Patent Ordinance and the Bill - Draft of a national Intellectual Property Policy - Present against unfair competition.

5 . UNIT V 10

Case Studies on - Patents (Basumati rice, turmeric, Neem, etc.) - Copyright and related rights - Trade Marks - Industrial design and Integrated circuits - Geographic indications - Protection against unfair competition.

Total No of periods: 45

TEXT BOOK

1. Subbaram N.R. " Handbook of Indian Patent Law and Practice ", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.

REFERENCES

- 1. Eli Whitney, United States Patent Number : 72X, Cotton Gin, March 14, 1794.*
- 2. Intellectual Property Today : Volume 8, No. 5, May 2001, [www.iptoday.com].*
- 3. Using the Internet for non-patent prior art searches, Derwent IP Matters, July 2000. [www.ipmatters.net/features/000707_gibbs.html.*

1 . UNIT I	9
Historical Background - Constituent Assembly of India - Philosophical foundations of the Indian Constitution - Preamble - Fundamental Rights - Directive Principles of State Policy - Fundamental Duties - Citizenship - Constitutional Remedies for citizens.	
2 . UNIT II	9
Union Government - Structures of the Union Government and Functions - President - Vice President - Prime Minister - Cabinet - Parliament - Supreme Court of India - Judicial Review.	
3 . UNIT III	9
State Government - Structure and Functions - Governor - Chief Minister - Cabinet - State Legislature - Judicial System in States - High Courts and other Subordinate Courts	
4 . UNIT IV	9
Indian Federal System - Center - State Relations - President's Rule - Constitutional Amendments - Constitutional Functionaries - Assessment of working of the Parliamentary System in India.	
5 . UNIT V	9
Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens - Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	

Total No of periods: 45

TEXT BOOKS

1. *Durga Das Basu, " Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.*
2. *R.C.Agarwal, " (1997) Indian Political System ", S.Chand and Company, New Delhi.*
3. *Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.*
4. *K.L.Sharma, " (1997) Social Stratification in India: Issues and Themes ", Jawaharlal Nehru University, New Delhi.*

REFERENCES

1. *Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.*
2. *U.R.Gahai, " (1998) Indian Political System ", New Academic Publishing House, Jalaendhar.*
3. *R.N. Sharma, " Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.*
4. *Yogendra Singh, " (1997) Social Stratification and Charge in India ", Manohar, New Delhi.*

1 . UNIT I 22

ORAL COMMUNICATION - Practical use of language in simulated real - life situations through role playing - social skills - interaction with employers, peers and subordinates - Group dynamics - Listening techniques - Phonological aspects of language use - pronunciation, stress and intonation.

Introducing oneself and others, narrating events - Making telephonic conversation - Making requests, Asking questions, Making recommendations using modal verbs, Expressing causal relations with suitable discourse markers, Giving instructions using imperatives, Expressing purposes and functions, obligation and preferences, Accepting offers and Counselling, Interpreting advertisements, Describing processes using sequential expressions. (Lecture:8, Practicals 14)

2 . UNIT II 12

Presenting one's ideas at meetings and conferences, Making extempore talks, Public speaking, Body language, Strategic competence, Use of audio - visual aids and multimedia presentations. (Lecture : 6, Practical 6)

3 . UNIT III 8

Technical Writing - the structure of organised writing - paragraph writing, coherence, cohesion (use of Discourse Markers) and punctuation, Use of titles, nonverbal devices - Layout - Revision strategies - Reading techniques.

Letter Writing: - Personal/Informal letters: Letters to family members and friends Business / Formal letters: Letters thanking the recipients, announcing functions, extending invitations, congratulating associates on important occasions, letters of application (Resumes), apology and complaint, letters to the editor. (Lecture:8, Practical : 0)

4 . UNIT IV 8

Report Writing: - persuasive, explanatory, argumentative and informative, Writing agenda, minutes, memos, project proposals and checklists.

(Lecture : 8, Practical 0)

5 . UNIT V 10

Grammar - study of grammatical items in contexts. Nouns, pronouns, adjectives, comparative adjectives, adverbs, gerund, prepositions, voice, tenses, 'if clauses, direct and indirect speech (reporting verbs), concord Vocabulary - Synonyms, antonyms, homonyms, homophones, hyponyms, affixes, reference words, phrasal verbs and prepositional phrases. (Lecture:10, Practical : 0)

Total No of periods: 60

Text Books:

1. *Doff, Adrian and Jones, Christopher, Language in Use: Classroom Book (Intermediate level). Cambridge: CUP. 1994 (2 audio cassettes).*
2. *Dr.V.Chellammal, Learning to Communicate - a resource book for Engineers and Technologists. Coimbatore: Kamakhya Publications 2002 (1 audio cassette)*

References:

1. *Sung, Abraham. 330 more Model Letters for all occasions Malaysia-Minerva Publications. 2002.*
2. *Bentley, T.J. Report Writing in Business: The Effective Communication of Information. New Delhi: Viva Books Pvt.Ltd., 2001*
3. *Vivanilam, J.V. More Effective Communication: A Manual for Professionals. New Delhi: Response Books. 2000*
4. *Michael, V.P.Communication and Research for Management. Mumbai: Himalaya Publishing House 2001.*
5. *Nauheim, Ferd. How to Write Business Letters. New Delhi; Crest Publishing House 2000.*
6. *Mohan, Krishna, Meera Banerji. Developing Communication Skills. New Delhi: Macmillan 1991.*
7. *Denny, Richard. Communicate to Win. New Delhi: Kogan Page 2002.*

ME431 Total Quality Management

3 0 0 100

1 . PRINCIPLES OF QUALITY MANAGEMENT 8

Definition of Quality - Deming, Moller, Crosby Theories - Services and Product quality - Customer orientation. Evaluation of Total Quality Management -Inspection - QC-TQM System - Human component.

2 . QUALITY PLANNING 8

Planning - SMART Goal setting- Designing for Quality - Manufacturing for Quality - Process control - Cpk - 6 (- Process capability, Scientific Approach to TQM- Data based approach - Quantification - Statistical tools - Quality control tools- New 7 tools.

3 . TQM TECHNIQUES 12

Benchmarking-definition-Types-Steps-Metrics-Case studies. Quality Function Deployment-definition - Steps - Case studies - Corrective techniques - Preventive techniques - Failure Mode and Effect Analysis - 5S. Continuous improvement Techniques- different techniques such as POKA YOKE, etc. - Deming wheel - case studies.

4 . HUMAN DIMENSION OF TQM 10

TQM mindset-Leader, Manager of TQM- Qualities required for TQM-Participation Style - Teamwork - Team development - Motivational aspects - Change management.

5 . SYSTEM COMPONENT OF TQM 7

Documentation - Structure - Information system - ISO 9000 - QS9000 certification - clauses - procedures. TQM Road Map - Criteria - road map - evaluation.

Total No of periods: 45

Text Books:

1. Joel E. Rose, " Total Quality Management ", II Edition, Kogan Page Ltd., USA, 1993.
2. Samuel K Ho, TQM - " An Integrated Approach ", II Edition, Kogan Page Ltd., USA, 1996.

References:

1. John Gilbert, " Total Quality Management ", Afiliated East West Press Pvt Ltd. New Delhi, 1993
2. John Bank, " Total Quality Management ", Prentice Hall of India Pvt. Ltd., New Delhi, 1993.

1 . LINEAR MODELS	15
The phases of operations research study- Linear programming - Graphical method - Simplex algorithm - Duality - Transportation problems - Assignment problems - Applications to problems with discrete variables.	
2 . NETWORK MODELS	6
Network models - Shortest route - Minimal spanning tree - Maximum flow models - Project network - CPM and PERT networks - Critical path scheduling - Sequencing models.	
3 . INVENTORY MODELS	6
Inventory models - Economic order quantity models - Quantity discount models - Stochastic Inventory models - Multi product models - Inventory control models in practice.	
4 . QUEUEING THEORY	8
Queueing models - Queueing systems and structures - Notation - parameter - Single Server and multi server models - Poisson input - Exponential service - Constant rate service - Infinite population - Simulation.	
5 . DECISION MODELS	10
Decision models - Game theory - Two person zero sum games - Graphical solution - Algebraic solution - Linear programming solution - Replacement models - Models based on service life - Economic life - Single/ Multi variable search technique - Application of OR models - Case studies.	
6 . TUTORIALS	15

Total No of periods: 60

Text Books:

1. H.A.Taha, " *Operations Research* ", Prentice Hall of India, 1999, Sixth Edition.
2. S.Bhaskar, " *Operations Research* ", Anuradha Publishers, Tamil Nadu, 1999.

References:

1. Shennoy, Srivastava, " *Operation Research for Management* ", Wiley Eastern, 1994.
2. M.J. Bazara, Jarvis, H. Sherali, " *Linear Programming and Network Flows* ", John Wiley, 1990.
3. Philip and Ravindran, " *Operational Research* ", John Wiley, 1992.
4. Hillier and Lieberman, " *Operations Research* ", Holden Day, 1986.
5. Frank, S.Budnick, Dennis, McLeavy, " *Principles of Operation Research for Management* ", Richard D Irwin, 1990.

1 . CREATIVE THINKING AND ORGANIZING FOR PRODUCT INNOVATION 8

The product-design function. The process design function. Locating ideas for new products. Selecting the right product. Qualifications of the production design engineer, Creative thinking curiosity and imagination.

2 . CRITERIA FOR PRODUCT SUCCESS 8

Areas to be studies preparatory to design market research functional design. The value of appearance - Principles and laws of apperance - Incorporating quality and reliability into the design. Man Machine considerations-Designing for case of maintenance.

3 . COST AND PRODUCT DEVELOPMENT 9

Sources of funds for development cost - Product costs - Estimating product costs - Kinds of cost procedures- Value Engineering - Cost reduction.

4 . PATENTS 8

Classes of exclusive rights-Patents-Combination versus aggregation-Novelty and Utlity-Design patents-patent disclosure-patent application steps-Patent office prosecution- Sales of patent rights-Trade marks-Copy rights.

5 . QUALITY CONTROL AND RELIABILITY 12

Quality Control procedure-Inspection and test equipment- Statistical quality control Techniques- Manufacturing Reliability-Probability the tool of eliability- Reliability operations- Developing a quality-control and reliability programme.

Total No of periods: 45

Text Book:

1. *BENJAMIN W.NIEBEL and ALANB.DRAPER-Product Design and Process Engineering-McGraw Hill Book Company.*

References:

1. *S.DALELA and MANSOOR ALI, Industrial Engineering and Management Systems, Standard Publishers Distributors, 1997.*
2. *A.ZAIDI, SPC Concepts, Methodologies and Tools, Prentice Hall of India Pvt.Ltd., 1995.*
3. *PRADHEEPH.N. KANDWALA, Fourth Eye.*

1 . PRODUCTION AND PROPERTIES OF X-RAYS: 7

Electromagnetic radiation - Continuous spectrum and characteristic spectrum - Filters - Absorption - Production and detection of X-Rays - safety precautions.

2 . DIFFRACTION OF X-RAYS: 10

Directions of diffracted beams- Bragg's law - Diffraction Methods - Laue, rotation crystal and powder methods. Intensity of diffracted beams - Atomic scattering factor - structure factor - Lorentz factor - Multiplicity factor Absorption and temperature factors - cameras, Laue, Debye-scherrer, Seeman Bohlin focussing cameras, High and Low temperature cameras. diffractometer - General features and general optics. Counters : proportional , scintillation and Geiger counters.

3 . MEASUREMENT TECHNIQUES: 8

Elementary steps - Indexing cubic and other crystals - Determination of no of atoms in unit cell and atom positions (introduction only) precise lattice parameters measurement Calibration - Errors - phase diagram determination - order-disorder transformation - residual stress measurements

4 . TEM: 10

Principles and applications - Description of the electron microscopes resolving power - electron optics - Aberrations - Specimen preparation - electro chemical thinning - ion milling - replica technique- bright and darkfield imaging - selected area diffraction - EDX, WDX and EEL techniques of compositional analysis

5 . SEM: 10

Constructional features - detectors - secondary electron and back scattered electron detectors - compositional and topological contrast - applications in failure analysis - channeling pattern - EPMA - principles of STM

Total No of periods: 45

Text Books:

1. Cullity, B.D., "Elements of X-Ray Diffraction ", Addison Wesley Publishing Co., Massachusetts, 1968.
2. Cherepin and Mallik " Experimental Techniques in Physical Metallurgy", Asia Publishing House, New Delhi, 1967.
3. Thomas G., "Transmission electron microscopy of metals" , John Wiley, 1996.

1 . CHARACTERISTICS OF NUCLEAR MATERIALS	10
Radiation, fission, reactor and reactor elements - Characteristics of fission materials - Density, Melting point - Electrical and Thermal Conductivity - Fission cross section - cladding materials - moderators - coolants - heat exchangers - Arrestors.	
2 . FUEL MATERIALS	10
Extraction and processing of U,Th,Pu, Zr, B for nuclear purpose - enrichment of U -Diffusion method - centrifuge method- neutron diffraction studies.	
3 . CLAD MATERIALS	10
Fuel rods:manufacture of fuel rods, fabrication of fuel rods,Oxide fuel element- - carbide elements - their reprocessing, cladding materials requirements of Cladding materials - aluminium, Stainless steel and Zirconium alloys - their preparation and fabrication.	
4 . COOLANTS	8
Coolant materials:Use of Liquid metals, Liquid metal corrosion - production and use of heavy Water, beryllium and reactor components, their simultaneous radiation damage and its control.	
5 . WASTE DISPOSAL	7
Radio active waste disposal- dosimeters - pneumatic hands.- disposal of gas, liquid and solid wastes	

Total No of periods: 45

References:

1. *Kopelman., "Materials for nuclear Reactors", McGraw Hill, 1970.*
2. *Kenneth Jay., "Nuclear Power - Today and Tomorrow", Methven,1961.*

- 1 . CLASSIFICATION AND MANUFACTURE OF TOOL STEELS: 8**
Classification - AISI system Production techniques - problems in melting - Powder Metallurgy route, Refining methods like VAR and ESR - forming of tool steels.
- 2 . HEAT TREATMENT OF TOOL STEELS: 10**
Spheroidising - selection of quenching and tempering parameters -precautions - Effect of retained austenite - Multiple tempering ,sub-zero treatment and cryo treatment - surface treatments -defects in tool steels- Over heated and burnt structures - Decarburisation.
- 3 . PROPERTIES AND TESTING OF TOOL STEELS: 10**
Mechanical propertieess of tool steels, strength , hardness and toughness - properties at elevated temperature - microstructure - distribution of carbides - coating thickness - micro hardness - adhesion and scratch resistance
- 4 . ADVANCED TOOL MATERIALS: 10**
Sintered tungsten carbide tools- ISO classification - Uses of P,M and K grades - cermet - ceramics , mixed and reinforced grades - cubic boron nitride - poly crystalline diamond - Manufacturing techniques - properties
- 5 . SURFACE TREATMENTS AND COAT INGS: 7**
Sulphidising of tool steels - TiN coating by PVD - coating of carbide tools - mono and multi layer coatings of TiC, TiN, Alumina and DLC by PVD and CVD processes - selection of tool materials

Total No of periods: 45

Text Books:

1 Payson, "Metallurgy of Tool Steel", John Wile & Sons, NewYork, 1982.

References:

1 Roberst Haymaker and Johnson, "Tool Steels", ASM International 1992.

2 Davis. J.R, "ASM Speciality Hand book-Tool Materials", American Society of Metals, Metals Park, Ohio, USA, 1995.

1 . SHELL MOULDING: 10

Various special casting techniques -Shell moulding machines - Pattern equipment - Sands, resins and other materials used for shell moulding -Application of shell moulding - Advantages of shell moulding over other methods of moulding.

2 . CENTRIFUGAL CASTING: 8

Types of centrifugal casting processes - Calculation of mould rotary speeds - Techniques, equipments and production processes - Advantages and limitations of centrifugal casting methods.

3 . INVESTMENT CASTING: 7

Introduction - Pattern and mould materials used - Techniques and production of investment moulds - Shaw process - Full mould process - Applications of investment casting process.

4 . DIE CASTING: 10

Die casting machines- gravity and pressure die casting - cold and hot chamber -Operation and details-Die materials-Metals cast by die casting method- casting of aluminium,magnesium and zinc alloys - compo, rheo and thixo processes - advantages of die casting.

5 . ORGANIC AND OTHER PROCESSES: 10

Cold box and Hot box ,No bake processes . Fluid sand process, V process - Graphite moulding process, Magnetic Moulding, Impulse moulding, high pressure moulding, - Metal injection moulding.

Total No of periods: 45

Text Books:

1. Beeley, P. R. ,"*Foundry Technology*", Butterworths, London, 1982.
2. Clegg.A J ,"*Precision Casting Processes*", Pergamon Press, London.,U.K, 1991.

References:

1. Heine, loper and Roscnthal, "*Principles of Metal Casting*", Tata McGraw Hill Publishings Co. Ltd , New Delhi. 1995.
2. Dumond. T C, "*Shell Moulding and Shell Moulded Castings*", Reinhold Publishing Corporation Inc., 1984.
3. Doehler.E.H, "*Die Casting*",McGraw Hill Book Co. NewYork. 1991.
4. .Barton H K, "*Die Casting Processes*", Odhams Press Ltd, 1985.
5. .ASM Metals Hand Book "*Casting*", Volume 15, ASM International, 10th edition, 1991.

1 . RADIANT ENERGY WELDING 10

Electron - beam welding: background of the process, guns, weld environment, welding in different degrees of vacuum, equipment and safety, joint design, applications. Laser beam welding, process parameters, applications and limitations.

2 . PLASMA ARC WELDING 10

Plasma - arc welding: Theory and principles, Transferred - arc and non-transferred arc techniques equipment and tooling, joint design advantages, disadvantages, economics, materials and applications.

Needle arc - micro plasma welding: characteristics of process, operating characteristics, fixturing and joint design shielding, weld penetration and shape, applications.

3 . EXPLOSIVE WELDING 8

Explosive welding: Theory and key variables, parameters, weld quality, equipment and tooling, advantages and limitations, joint design, materials and applications.

Adhesive Bonding: Theory and key parameters, Physical characteristics, metal - adhesive, equipment, design, economics of process, materials and applications.

4 . FRICTION AND DIFFUSION WELDING 10

Friction welding: Basic principles, process variants, different stages of friction welding, mechanism of bonding, influence of process parameters, weld quality and process control, joining of dissimilar materials, advantages, limitations and applications.

Diffusion Welding :Theory and principle of process, key variables, intermediate materials, deformation welding, equipment and tooling, joint design, economics, advantages and limitations materials and applications.

5 . VACUUM BRAZING 7

Vacuum brazing: Theory mechanisms and key variables, equipment and tooling, stop-off and parting agents, advantages, limitations, economics materials and applications.

Total No of periods: 45

References:

- 1. Schwartz M.M., "Metals Joining manual",*
- 2. Metals hand Book - Vol.6"Welding and Brazing",ASM, Ohio.*
- 3. Parmar R.S.,"Welding Processes and Technology",Khanna Publishers, NewDelhi, 1998.*

1 . SOLIDIFICATION OF METALS AND ALLOYS	8
Solidification of castings - Effect of solidification range on freezing pattern - Effect of moulding materials and cooling rate on freezing pattern - Shrinkage of casting and directional solidification of castings. Fluidity - Definition. factors affecting and measurement fluidity.	
2 . CAST IRONS	10
Graphitization Types and sizes of graphite for Grey Cast Iron and S.G.Iron. Effect of normal elements and alloying elements in Cast Irons Compositional aspects and properties of Austenitic Cast Irons. High silicon Cast Irons. High chrome Cast Iron and Ni-Hard cast irons Production of S.G Iron. Austempered S.G Iron. C.G Iron. Malleable Cast Iron and Alloy Cast Irons, Brief Introduction on Indian and ASTM standards for Grey Cast Iron. S G Iron.	
3 . METALLURGY OF STEELS:	10
Effect of alloying elements on castability of steels. Compositional aspects and properties of alloy steels - specifications of cast steels - Low alloy steels and stainless steels stresses: Origin, effects and stress relieving operations - precautions to be taken in moulding and melting of steels - Gating and riser design for steel casting . grain refinement of steels - defects in castings: Appearance, their causes and remedies	
4 . METALLURGY OF NON-FERROUS CAST ALLOYS:	7
Specifications, Composition, properties and phase diagrams of Copper. Aluminium, Magnesium, zinc alloys and Nickel base alloys - modification and grain refinement: Al alloys - defects in castings: Appearance, their causes and remedies	
5 . MELTING PROCEDURE AND COMPOSITION CONTROL:	10
Cast Irons. Plain carbon steels, stainless steels. Al alloys. Mg alloys Nickel alloys, Zinc alloys and copper alloys, Slag-Metal reactions - Desulphurisation - Dephosphorisation - Inoculation and inoculating techniques - gases in metals and degassing techniques .	
Total No of periods: 45	

Text Books:

1. Heine.R.W, Loper.C.R. and Rosenthal.P.C., "Principles of Metal Castings", Tata - McGraw Hill Publishing Co, 1995.
2. Beeley.P.R., "Foundry Technology", Butterworths, London, 1982.

References:

1. ASM Metals Hand book, "Casting", Volume 15, ASM Internatinol, 10th edition, 1991.
2. Flinn.R A., "Fundamentals of Metal Casting", Addison Wesley Inc , 1983.
3. The Foseco , "Foundryman's Hand book", Pergamon Press. 10th edition, 1995.
4. Murphy.A.J., Ed., "Non Ferrous Foundry Metallurgy". 1984.

1 . PLATING PROCESSES: 10

Fundamentals of Electrodeposition, plating of nickel, chromium, tin and copper - pulsed plating - Hydrogen embrittlement, plating adhesion, electroless plating - electrochemical conversion coating, metallizing, selective plating for repair, plating properties, Hard anodizing

2 . HARDFACING PROCESSES: 10

SMAW, GTAW, GMAW, FCAW, SAW, PAW, Oxy-Acetylene Welding, Furnace fusing, Thermal -spray, flame spray processes - HVOF, Detonation gun and jet kote processes - hard facing consumables - chromium carbide - stellite - buffer layer materials. tribology : friction, Wear and Lubrication, Types of wear and wear testing

3 . SPECIAL DIFFUSION PROCESSES: 7

Principle of diffusion processes - Boring, Aluminising, Siliconising, Chromising, Sursulf - Selection of diffusion processes - Characteristics of diffused layer - micro structure and micro hardness evaluation - properties and applications.

4 . THIN FILM COATINGS: 8

Physical vepour deposition processes - Thermal evaporation - sputter coating - Ion plating - Chemical vepour deposition - reactive sputtering - TiC, TiN, Alumina , CBN , Diamond and DLC coatings. Structure, properties and applications.

5 . HIGH ENERGY MODIFICATION AND SPECIAL PROCESSES: 10

Electron beam hardening/glazing, Laser beam hardening/ glazing ion inplantation , Composite surface created by laser and Electron beam. Surface cements, Wear tiles, Electro spark deposition, fused carbide cloth, thermal/chemical, Ceramic coatings, centrifugal cast wear coatings, Wear sleeves and Wear plates

Total No of periods: 45

Text Books:

1 Kenneth G.Budinski, "Surface Engineering for Wear Resistance", Prentice Hall, Englewood Cliff, 1990.

References:

1 ASM Metals Handbook, Vol 5, "Surface Engineering", 1994

2 Ernest Rabinowicz, "Friction and Wear of Materials", 2nd edition, John Wiley & Sons, NY, 1995.