CURRICULUM
OF
Metallurgy and Materials Engineering
B.E/B.S

2008

HIGHER EDUCATION COMMISSION
ISLAMABAD.
# Table of Content

1. Introduction 6
2. Objective 8
3. Goals 8
4. Rationale 8
5. Frame Work/Template for BE/BS in Metallurgy and Materials Engineering 10
6. Scheme of Studies for BE/BS in Metallurgy and Materials Engineering 15
7. Details of Courses for BE/BS in Metallurgy and Materials Engineering 17
8. Recommendations 49
9. Annexures – A,B, C & D. 50
PREFACE

Curriculum development is a highly organized and systematic process and involves a number of procedures. Many of these procedures include incorporating the results from international research studies and reforms made in other countries. These studies and reforms are then related to the particular subject and the position in Pakistan so that the proposed curriculum may have its roots in the socio-economics setup in which it is to be introduced. Hence, unlike a machine, it is not possible to accept any curriculum in its entirety. It has to be studied thoroughly and all aspects are to be critically examined before any component is recommended for adoption.

In exercise of the powers conferred by sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide notification No. D773/76-JEA (cur.), dated December 4th 1976, appointed the University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at the bachelor level and onwards to all degrees, certificates and diplomas awarded by degree colleges, universities and other institutions of higher education.

In pursuance of the above decisions and directives, the Higher Education Commission (HEC) is continually performing curriculum revision in collaboration with universities. According to the decision of the special meeting of Vice-Chancellor’s Committee, the curriculum of a subject must be reviewed after every 3 years.

A committee of experts comprising of conveners from the National Curriculum Revision of HEC in Basic, Applied Social Sciences and Engineering disciplines met in April 2007 and developed a unified template to standardize degree programs in the country to bring the national curriculum at par with international standards, and to fulfill the needs of the local industries. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education. The new BS degree shall be of 4 years duration, and will require the completion of 130-136 credit hours. The engineering degree will devote 65-70% of the curriculum towards engineering courses, and 35--30% to non Engineering courses.

For the purpose of curriculum revision various committees are constituted at the national level, comprising of senior teachers nominated by universities, degree awarding institutions, R&D organizations and respective accreditation councils. The National Curriculum Revision Committee for Metallurgy and Materials Engineering in a meeting held on March 11-13, 2008 at HEC Regional Centre, Karachi in continuation of its earlier meetings held on July 31 – August 2, 2007 revised the curriculum in light of the unified template. The final draft prepared by the National Curriculum Revision Special Committee, duly approved by the competent authority, is being circulated for implementation in the concerned institutions.

DR.RIAZ-UL-HAQ TARIQ
Member Academics

April 2008
CURRICULUM DEVELOPMENT

Abbreviations Used:
NCRC. National Curriculum Revision Committee
VCC. Vice-Chancellor’s Committee
EXP. Experts
COL. Colleges
UNI. Universities
PREP. Preparation
REC. Recommendations
LI Learning Innovation
R&D Research & Development Organization
HEC Higher Education Commission
Introduction

The final meeting of National Curriculum Revision Committee (NCRC) of Metallurgy and Materials Engineering was held at Higher Education Commission Regional Centre, Karachi from March 11-13, 2008 to finalize the draft curriculum for B.E./B.S. degree programme. The committee consisted of the following members:

1. Prof. Dr. M. Saleem Shuja, Convener
   Rector,
   The University of Lahore,
   1 Km Raiwind Road,
   Lahore

2. Prof. Dr. M. Moazam Baloch Member
   Department of Metallurgy & Material Engineering,
   Mehran University of Engineering & Technology,
   Jamshoro

3. Dr. Ejaz Ahmad, Member
   Principal Engineer, Materials Division,
   PINSTECH, PO Nilore,
   Islamabad

4. Prof. Dr. Yaseen Iqbal Member
   Department of Physics
   University of Peshawar,
   Peshawar

5. Prof. Dr. Muhammad Nasim Member
   Principal
   Dawood College of Engineering & Technology,
   Karachi

6. Prof. Dr. Amir Azam Khan Member
   Head of Materials Engineering Department
   National University of Sciences and Technology (NUST),
   Sector H-12,
   Islamabad

7. Eng. Muhammad Moinuddin Ali Khan Member
   General Manager (Quality Assurance),
   Peoples Steel Mills Ltd.,
   Karachi
The meeting started at 9:00 AM on March 11th 2008, with the recitation of Holy Quran by Mr. Tahir Ali Shah, Assistant Director (Curriculum), Higher Education Commission, Islamabad. He briefed the committee about the aims of the meeting regarding the revision of the present curriculum.

Mr. Muhammad Rafiq Rai, Regional Director, HEC, Karachi, welcomed the participants of the meeting on behalf of the Chairman, Higher Education Commission. He assured the participants for providing all possible assistance and secretarial support to enable the committee in finalizing the draft curriculum of the subject at the undergraduate level.

Prof. Dr. M. Saleem Shuja, Convener of the committee, welcomed the participants and thanked them for their continuous contribution in reviewing and finalizing the curriculum. He also thanked all the following participating universities/organizations for sending their representatives to participate in the meetings:

1. Bahauddin Zakariya University, Multan
2. Dawood College of Engineering and Technology, Karachi
3. Mehran University of Engineering and Technology, Jamshoro
4. National University of Sciences & Technology (NUST)
5. NED University of Engineering and Technology, Karachi
6. Peoples Steel Mills Ltd. Karachi  
7. PINSTECH, Islamabad.  
8. The University of Lahore, Lahore  
9. University of Engineering and Technology, Lahore  
10. University of Karachi, Karachi  
11. University of Peshawar, Peshawar

The committee reviewed and finalized the draft curriculum in the light of suggestions of the participants and the recent developments in the field of Metallurgy and Materials Engineering. Emphasis was given to the suggestions put forward by the participants from different universities, industries and R&D organizations to finalise the curriculum of Metallurgy and Materials Engineering at the undergraduate level.

OBJECTIVES

The main objective of the undergraduate program in Metallurgy and Materials Engineering is to produce engineers with the following attributes:

a. Dynamic leadership and effective communication skills.

b. High moral values and good engineering ethics.

c. Broad based engineering knowledge

d. Problem solving approach.

e. Creative and innovative thinking for research and development.

f. Sufficient skills to optimise human, technological and natural resources.

g. Suitable to work successfully in the industry

GOAL

The curriculum has been reviewed in order to prepare academically sound graduates for being successful teachers, research workers and engineers in the practical field. Apart from the engineering courses a sufficient number of courses in language, communication skills, ethics, social and management sciences have been incorporated into the curriculum to enhance the quality and performance of the graduates.

It is also expected that having followed this curriculum the graduates would be sufficiently equipped to successfully pursue post graduate studies.

RATIONALE

Metallurgy and Materials Engineering is the *avant garde* of engineering in the modern world. New materials starting from atomic and nano level to the macro level are being developed each day to improve the life of a common man. The purpose of this undergraduate engineering program is to produce engineers to face these challenges in a way to bring Pakistan among the top countries in the world.
SALIENT FEATURES

The curriculum revision is based on following considerations:
The curriculum for the undergraduate program has been revised on the basis of HEC and PEC directives. The salient features of the revised curriculum are given below:

Duration: 4 years
Number of Semesters: 8
Number of weeks per semester: 18 (16 for teaching and 2 for examinations)
Total number of credit hours: 134
Number of credit hours per semester: 15 – 18
Engineering Course: 67.9 %
Non-Engineering Course (Maximum): 32.1 %

The entire curriculum of Metallurgy and Materials Engineering at undergraduate level has been designed on the following lines:

- The curriculum design is based on the concept of foundation, breadth and depth courses so that streams for different specializations can be created within each discipline.
- Foundation courses: the foundation courses are the courses that all students in a given discipline of engineering must take. These courses provide students with the fundamental concepts and tools to pursue their studies at the higher level.
- Breadth Courses: the breadth courses introduce students to different specialties in the given discipline of engineering early in their studies. Before taking the breadth courses, the students should be advised that their choices will affect taking follow up courses because of pre-requisite requirement.
- Depth Courses: The depth courses offer specialization within each engineering discipline. All depth courses must integrate a substantial design component.
- The students may select electives from any of the areas of specialization with some guidelines from their respective advisors.
- All courses are also identified as engineering or non-engineering.
- A university can offer a degree programme in Metallurgy and Materials Engineering at undergraduate level by selecting all the prescribed foundation, breadth and the depth courses and the elective courses of the disciplines in which the university has the requisite faculty and lab facilities.
- This design of the curriculum will facilitate the universities to optimize the utilization of faculty and resources and produce engineers with greater in-depth knowledge in the selected areas.
# FRAME WORK TEMPLATE FOR BE/BSc/BS METALLURGY AND MATERIALS ENGINEERING

## Non-Engineering Domain

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<tr>
<th>Knowledge Area</th>
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<th>Name of Course</th>
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<th>Lab CH</th>
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<th>Total Credits</th>
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**Industrial Training**

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**SUB TOTAL**

|              | 26 91 100 67.92 |

**GRAND TOTAL**

|              | 41 134 |
## Summary

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## Scheme of Study
for BE/BSc/BS Metallurgy and Materials Engineering

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<td>Numerical Analysis and Computer Programming</td>
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**Final year Credit Hours** 33

**Total Credit Hours** 134
Title of the Course: **English-I (Functional English)**  
Credit Hours: 3-0-3  
Course Outline: **Annex-A**

Title of the Course: **English-II (Communication Skills)**  
Credit Hours: 3-0-3  
Course Outline: **Annex-A**

Title of the Course: **English-III** *(Technical Report Writing and Presentation Skills)*  
Credit Hours: 3-0-3  
Course Outline: **Annex-A**

Title of the Course: **Pakistan Studies**  
Credit Hours: 2-0-2  
Course Outline: **Annex-B**

Title of the Course: **Islamic Studies/Ethics**  
Credit Hours: 2-0-2  
Course Outline: **Annex-C**  
Lab Outline: N/A  
Recommended Books:

Title of the Course: **Social Science-I (Social Psychology)**  
Credit Hours: 3-0-3  
Pre-requisites:  
Specific Objectives of Course: The impart knowledge of social psychology of attraction; attitudes and prejudice; altruism and aggression; personal and social identities; conformity; group influence and their applications in the real world.  
Course Outline:  
Principles of sociology and psychology with emphasis on the individual and his/her reciprocal interaction with groups, basic psychological factors, attribution and perception of others, attitudes and attitudinal change, social attitudes, altruism, helping others, aggression, hurting others, prejudice, disliking others, discrimination and stereotypes, language and communication, society and cultures, culture and personality, small groups and their relation to the individual, leadership and group dynamics. Attraction, attitudes and prejudice; altruism and aggression; personal and social identities, conformity, group influence.  
Lab Outline: N/A  
Recommended Books:
Title of the Course: Social Science-II (Engineering Economics)
Credit Hours: 3-0-3
Pre-requisites:
Specific Objectives of Course: To impart knowledge of engineering economy.
Course Outline:
Introduction of engineering economy and the economic environment. Consumer and producer goods, measures of economic worth, Price, Supply, & Demand relationship; Production; Factors of production; Laws of return. Cost Concepts & Analysis: Sunk & opportunity costs; Fixed, variable, and incremental costs; Recurring & nonrecurring costs; Direct, indirect, and overhead costs; Standard costs; Unit cost of production. Time Value of Money: Simple interest; Compound Interest; Cash flow diagrams; Interest formulas; Nominal versus effective, interest rates; Depreciation and Depletion: Purpose of depreciation; Types of depreciation; Production Concepts & Mathematical Models: Manufacturing lead time, Production rate; Capacity; Utilization; Availability; Work in process; Linear Programming: Mathematical statement of linear programming problems; Graphic solution; Simplex method; Duality problems. Capital Financing and Budgeting: Types of ownership; types of stock; partnership & joint stock companies; Banking & specialized credit institutions. Industrial Relations: Labour problems; Labour organizations; Prevention & Settlement of disputes.
Lab Outline: N/A
Recommended Books.
- Paul, E. Degarmo, “Engineering Economy”, OUP, 2005
Title of the Course: Industrial Safety and Environmental Engineering
Credit Hours: 3-0-3
Pre-requisites:
Specific Objectives of Course: To provide thorough knowledge of industrial safety and engineering environment.

Course Outline:

Lab Outline: N/A
Recommended Books:

Title of the Course: Production Operations Management
Credit Hours: 3-0-3
Pre-requisites:
Specific Objectives of Course: To provide insight in the management skills to the engineers working in the production industry.

Course Outline:
Production /operation functions and the organization. Basic concepts of five Ps. Production strategies, guides and unities. Decision making in operations. Planning and controlling operations. Operational budget making and controlling. Variety management. Quality control and quality management. TQM. Location, design and layout of plant and equipment. Maintenance of equipment. Methods study and work measurement. The importance of forecasting in
production and operations control. Project management techniques. Personnel management. Health and safety management in industry

Lab Outline: N/A

Recommended Books:

Title of the Course: Environmental Management and Control
Credit Hours: 3-0-3
Pre-requisites:

Specific Objectives of Course: To provide thorough understanding of environmental management and its control.

Course Outline:

Lab Outline: N/A

Recommended Books:
- Christopher J. Barrow, “Environmental Management & Control” Rutledge, 2006
Title of the Course: Solid Waste Management  
Credit Hours: 3-0-3  
Pre-requisites:  
Specific Objectives of Course: To provide knowledge of solid waste management produced by materials industry.  
Course Outline:  
Solid wastes definitions, characteristics and perspectives. Types of solid wastes, sources of solid waste management. Engineered systems for solid waste management. Solid waste generation, on site handling, storage and processing. Collection of solid wastes, Transfer and transportation, processing techniques, ultimate disposal. Engineered systems for resource and energy recovery, processing techniques, materials recovery of biological conversion products, recovery of energy from conversion products and energy recovery systems. Plastic waste, composition quantities and disposal alternatives. Recycling of wastes, recycling of plastics, metals and glasses.  
Lab Outline: N/A  
Recommended Books:  
- Elizabeth, M Thomas-Hope “Solid Waste Management” 1998  

Title of the Course: Metallurgical Plants and Quality Control  
Credit Hours: 3-0-3  
Pre-requisites:  
Specific Objectives of Course: To provide knowledge of metallurgical plants and the quality control procedures used.  
Course Outline:  
Metallurgical plant location, Factors affecting location; Multiplant location; Plant layout; product and process layout analysis; Layout comparison. Type of Pollutants and their treatment, Overview of Environmental impacts of Iron and Steel making, Hot rolling, Forging, Cold rolling, Annealing and Tempering, Coating and Plating plants. Environmentally friendly metallurgical plants. Occupational Health and Safety Impacts of Metallurgical plants. Basic procedures and remedies. Applications of computers for environmental and Pollution Control and Waste management in metallurgical plants. Fundamentals of statistics and analysis techniques. Probability distributions. AQL, AOQL, L TPD, attributes sampling, variable sampling, selection of proper sampling plan. Reliability and maintainability, inspection of different types of materials and products for evaluation of quality reliability of flaw detection by non-destructive inspection, quality control applications of non-destructive inspection. Introduction to standards. Familiarization of standards for testing of materials, ASTM, BS,
JIS GOST and ISO. Pakistan Standards, Quality assurance for final products, Measures for quality control.

**Lab Outline:** N/A

**Recommended Books:**

**Title of the Course:** Applied Physics

**Credit Hours:** 2-3-3

**Pre-requisites:**

**Specific Objectives of Course:** To provide in-depth knowledge of the subject.

**Course Outline:**

Thermometry, heat transfer, heat insulation, properties of materials for use in building geometrical optics, the focal length of a lens, magnification, compound lenses, resolving power, laws of illumination and photometry, sextant spectrometer. Principles of refracting telescope, polarization of light. Waves and oscillation, sound waves, resultant to two simple harmonic motions, response and beats, acoustics and its application, interference, wave length and frequency, units and measurement of intensity, reflection and refraction of sound, reverberation time. Magnetic effect of current, CGS and practical units, relation between magnetism and electricity, magnetic field due to current in a long wire, force on a current carrying conductor in magnetic field, laws of electromagnetic induction, galvanometer, ammeter, voltmeter, ammeter, condensers and dielectrics, Magnetic materials, B-H curves, hysteresis, magnetic circuits calculations, solenoids, pull of an electromagnet, principles of diode & triode, cathode ray tube and photo-multiplier tube. Atomic & nuclear physics, atomic structure, nuclear structure, radioactivity, nuclear theory, fission & fusion.

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**
Title of the Course: Calculus
Credit Hours: 3-0-3
Pre-requisites: 
Specific Objectives of Course: To build the basic calculus and analytical geometry background
Course Outline:

Lab Outline: N/A
Recommended Books:
Title of the Course: Differential Equations  
Credit Hours: 3-0-3  
Pre-requisites:  
Specific Objectives of Course: Develop fundamental skills of solving ordinary differential equations, and developing differential equations for real-world problems  
Course Outline:  
Lab Outline: N/A  
Recommended Books:  

Title of the Course: Mathematical Methods  
Credit Hours: 3-0-3  
Pre-requisites:  
Specific Objectives of Course: To provide in-depth knowledge of mathematical methods.  
Course Outline:  
Rectangular Coordinate Systems in three dimension, direction cosines, plane (straight line) and sphere. Taylor’s Theorem for functions of two variables without proof. Maxima and minima of functions of two variables. Lagrange’s method of multipliers. Double integration, change of order,

Cartesian Tensors, understanding

**Lab Outline:** N/A

**Recommended Books:**

**Title of the Course:** Applied Chemistry

**Credit Hours:** 2-3-3

**Pre-requisites:**

**Specific Objectives of Course:** To provide thorough understanding of chemistry which is essential for Materials/Metallurgical engineers.

**Course Outline:**

**Lab Outline:** Lab Manuals will be available in the concerned laboratory
Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Statistical Methods & Estimation
Credit Hours: 3-0-3
Pre-requisites:
Specific Objectives of Course: To introduce the concept of statistics, randomness and probability and build on these concepts to develop tools and techniques to work with random variables
Course Outline:
Statistical treatment of data, frequency distribution and graphs, measures of central tendency, measures of variation. Probability, samples, spaces and events, counting probability, the axioms of probability, some elementary theorems, conditional probability, Bay’s theorem, mathematical expectation and decision making. Probability distribution, random variables, the binomial distribution, Poisson approximation to the binomial distribution, Poisson processes, probability densities, normal distribution, statements “T” distribution. Sampling distribution, populations and samples. Curve fitting regression analysis by least square method, correlation, linear, polynomial, power, regression analysis by least square method, incorporation of linear polynomial, exponential or power function. Correlation coefficient of determination. Application and exponential model of reliability and life testing.
Lab Outline: N/A
Recommended Books:

Journals/Periodicals
World Wide Web
Title of the Course: Introduction to Computer Systems
Credit Hours: 2-3-3
Pre-requisites:
Specific Objectives of Course: This course focuses on a breadth-first coverage of computer: introducing software engineering and information technology.
Course Outline:
Number Systems, Binary numbers, Boolean logic, History and basic components of computer system, approaches to solving problems using computers, Von Neumann Architecture, Algorithm definition, design, and implementation, Programming paradigms and languages, basic elements of C++ language, programming practice and case studies Graphical programming, Overview of Software Engineering and Information Technology, Operating system, Compiler, Computer networks and internet, Computer graphics, AI, Social and legal issues.
Lab Outline: Lab Manuals will be available in the concerned laboratory
Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Numerical Analysis and Computer Programming
Credit Hours: 3-3-4
Pre-requisites:
Specific Objectives of Course: To enable students using structured programming techniques in suitable programming languages and implement numerical solutions using computer-based techniques.
Course Outline:
Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Computer Application in Materials Engineering

Credit Hours: 1-3-2

Pre-requisites:

Specific Objectives of Course: To provide knowledge of applications of computer in Materials engineering.

Course Outline:
Basic computer modeling and simulation techniques, Computer modelling and simulation of blast furnace and basic oxygen converter operations. Computer modeling for microstructures, Phase transformation, mechanical properties and materials processing including rolling, forging, casting, extrusion and machining operations.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Engineering Drawing and Graphics

Credit Hours: 2-3-3

Pre-requisites:

Specific Objectives of Course: To provide in-depth knowledge of engineering drawings and graphics.

Course Outline:
Introduction to subject, use of instruments, Planning of drawing sheets, the projection of simple solids in simple position, the oblique and auxiliary
plans, lettering, dimensioning, the principle requirement of working drawing. Geometrical drawing & graphics: Isometric and pictorial of solid figures, making of free hand sketches from solid project and from orthographic projections. Section of solid, tangent planes, two surface in contact, intersection of surface and interpretation of solids development of surfaces.
Machine drawing: Screw thread systems, keys and cutters, coupling and simple bearings, hanger, wall bracket, pipes and pipes fittings, shafts, connecting rods, piston and piston rod, valves stuffing boxes, pulling thread gearing.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Workshop Practice
Credit Hours: 1-3-2
Pre-requisites:
Specific Objectives of Course: To impart knowledge of workshop techniques.
Course Outline:
Bench fitting: Description, proper use and maintenance of the fitting tools: use and care of measuring instruments, Preparation of some specific jobs.
Forging: Hand forging, Use and maintenance of forging tools, the fore anvils, hammers, chisels, fullers, swages, punches, drifts, tongs, Prepare some specific jobs using forging methods. Use of power hammer, drop and press forging, riveting. Wood working: Use & care of wood working tools, clamps, saws, planes, files, rasps, chisels, drills, bits, planning, nailing, screwing, jointing, doweling. Use and care of natural wood, chipboard, plywood, hardboard etc. Metal forming: Cold working processes for sheet metals; e.g. pressing stamping, embossing, drawing, bending, piercing etc. Use of common presses and dies. Foundry practice: Bench and floor sand casting; sand and binders, sand conditioning, moulding tools, flasks, boards, spurs, cutters, reamers, bellows, brushes, vent pins, trowels, spoons, etc., Preparation and care of patterns, metal melting and pouring. Safety and care: Precautions necessary in many shops machine accidents, general cleanliness of shop, proper appraisal, accident alarms and evacuation.
Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
- Raymond Francis Yates “Model Making Including Workshop Practice” The Norman W. Henley publishing company, 2007

Journals/Periodicals
World Wide Web

Title of the Course: Introduction to Engineering Materials
Credit Hours: 3-0-3

Pre-requisites:

Specific Objectives of Course: To introduce type of materials used in engineering.

Course Outline:
Introduction to engineering materials, their scope and role in industrial development, raw materials for engineering materials: their availability and demand, Atomic bonding, Crystal structures of metals, Introduction to polymers, ceramics and composite materials. Processing, properties and applications of metallic, polymeric, ceramic and composite materials. An introduction to new breeds of engineering materials e.g., shape memory materials, smart materials, electrical, magnetic and optical materials. Materials of aerospace and transportation industries.

Lab Outline: N/A

Recommended Books:

Journals/Periodicals
World Wide Web
Title of the Course: Mechanics of Materials
Credit Hours: 3-0-3
Pre-requisites:
Specific Objectives of Course: To develop knowledge of mechanics of materials.

Course Outline:

Lab Outline: N/A
Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Physical Metallurgy
Credit Hours: 3-3-4
Pre-requisites:
Specific Objectives of Course: To develop understanding of physical metallurgy of materials.

Course Outline:
Crystallography; Space lattice, Crystal system, Unit cell, Packing density, Coordination number, Allotropy, Rotational and Reflection Symmetries, Crystal planes and direction, Crystalline defects, Twining, Ordered and Disordered solutions. Crystallization; Solidification, Grain boundaries, Grain size, Cast structure, Segregation, Shrinkage defects, Phase diagrams; Phase rule, Binary system, Ternary system, Solid Solution,Interstitial solid solution and Substitutional solid solution, Factor affecting
the limit of solubility, Intermediate compound, Mixture, Iron -Carbon
Diagram, Microstructure and properties of steel and Cast Iron,
Microstructure of Copper based and Aluminum based alloys and their
relationship to the properties, Metallurgical Microscope, Objective lenses
and their short comings, Polarized light microscopy.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
- Reed Hill, R.E. and Abbaschian, R., “Physical Metallurgy
- Sydney, H. Avener, “Introduction to Physical Metallurgy”, McGraw-
- Cahn, R. W. and Haasen, P., “Physical Metallurgy”, North-Holland,
- Porter, D.A and Easterling, K.E, "Phase Transformations in Metals
- Smallman, R.E. and Bishop, R.J., “Modern Physical Metallurgy and
  Arnold, 1999.

Journals/Periodicals
World Wide Web

Title of the Course: Materials Thermodynamics
Credit Hours: 3-0-3
Pre-requisites:
Specific Objectives of Course:
Course Outline:
First law of thermodynamics, enthalpy, internal energy. Second law,
entropy, Third law Gibbs and Helmholtz free energies. Use of
thermodynamic data. Equilibrium, quasi-static equilibrium. Relationship
between heat and work. Reversible and irreversible processes.
Measurement of heat reactions, Phase equilibria in single and
multicomponent systems. Behaviour of solutions, non-ideal solutions,
thermodynamics of phase diagrams. Experimental methods of evaluating
thermodynamics functions, estimation and calculation of the values of
thermodynamic functions, free energy of formation, free energy diagrams.
The Arrhenius equation, the activated complex theory, collision theory,
calculation of reaction rates. Heterogeneous reactions, gas-solid reactions,
liquid-solid reactions, liquid-liquid reactions at slag-metal interface, gas-
liquid reactions.

Lab Outline: N/A
Recommended Books:


Journals/Periodicals

World Wide Web

Title of the Course: Inspection and Testing of Materials
Credit Hours: 3-3-4

Pre-requisites:
Specific Objectives of Course: To provide thorough understanding of inspection and testing of materials

Course Outline:
Introduction to inspection and testing of materials, its scope and importance, The Brinell test, the Vicker test, the Rockwell test, the Knoop test, the Scleroscope test, conversion tables for various scales of hardness, Stress and strain, load extension diagrams, modulus of elasticity, elastic limit, yield stress, proof stress, work hardening, tensile testing, (equipment and specimens). Compression testing, bend testing, torsion testing, impact testing. Toughness, brittleness and ductility, notched bar impact testing, the Charpy and Izod impact tests, brittle and ductile fractures, The fatigue test, different types of fatigue fractures, Goodman diagram, endurance limit-ultimate tensile strength, The Creep Test. Non destructive testing of materials, Liquid Penetrant, Eddy Current, X ray, Magnaflux, Ultrasonic etc.

Lab Outline: Lab Manuals will be available in the concerned laboratory.

Recommended Books:

Title of the Course: Instrumentation and Control
Credit Hours: 3-3-4
Pre-requisites: -
Specific Objectives of Course: To provide knowledge about the instrumentation and control systems used in materials and metallurgical engineering
Course Outline:

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Heat Treatment and Phase Transformations
Credit Hours: 3-3-4
Pre-requisites:
Specific Objectives of Course:
Course Outline:
Driving force for phase transformation, Diffusional studies, self-diffusion, Volume and grain boundary diffusion. Free energy changes during phase transformation, Concept of Gibbs’s free energy, Critical radius. Liquid-solids

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Engineering Ceramics and Glasses
Credit Hours: 3-3-4
Pre-requisites:
Specific Objectives of Course: to understand processing, design composition, learn about microstructure-property relationship of ceramic materials
Course Outline:
Phase Equilibria, Microstructure Development and Properties, Ceramics Industry in Pakistan, refractories and their applications. Special ceramics, electro ceramics. Types of Glasses, Glass transition, viscoelastic behaviour, glass transition and second order transformation, heat treatment of glasses, glass formability, glass production techniques.

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**
- Rice, R.W., “Ceramic Fabrication Technology”, Marcel Dekker, 2003
- Richerson, D.W., “Modern Ceramic Engineering”, Marcel Dekker, 2000

**Journals/Periodicals**

**World Wide Web**

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**Title of the Course: Manufacturing Technology**
**Credit Hours:** 3-3-4

**Pre-requisites:**

**Specific Objectives of Course:** To understand manufacturing processes available for materials.

**Course Outline:**
Scope and importance of manufacturing technology in Pakistan, Classification of mechanical working processes, Mechanism of plastic deformation, Theory of dislocations, Stamping and Deep Drawing, Weldability, work hardening, forging, tube drawing, sheet metal forming process, machining, rolling principles, rolling of ingot, bloom, billets, sheet and structural components, rolling of bars and rods, thermo-mechanical Treatment, rolling mills design and calculations, manufacturing process and system design, manufacturing defects causes and remedies, quality control in manufacturing processes, CAD/CAM technology. Introduction to Non-conventional manufacturing processes such as water jet cutting, and plasma cutting. Tool design. Surface Measurement and inspection, telesurf tolerances and specification. Material Selection and design, overview, the selection of materials, service conditions materials and primary processes, Secondary process, welding, machining, thermal treatment, finishing Operations.

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**
Title of the Course: Ferrous Metallurgy
Credit Hours: 3-3-4
Pre-requisites: -
Specific Objectives of Course: To provide in-depth knowledge of iron and steel making technology.

Course Outline:

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
- Douglas Alan Fisher ‘Steel Making in America’ United States Steel Corporation’ 2006

Title of the Course: Production and Refining of Materials
Credit Hours: 3-3-4
Pre-requisites:
Specific Objectives of Course: To provide students in-depth knowledge of production and refining of materials.

Course Outline:
Introduction to Non Ferrous metals and its ore deposits in Pakistan, Introduction to Non- Ferrous Extractive Metallurgy its scope and

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**

**Title of the Course:** Selection and Application of Materials

**Credit Hours:** 3-3-4

**Pre-requisites:**

**Specific Objectives of Course:** To provide in-depth knowledge of selection and applications of materials.

**Course Outline:**
Selection and applications of materials, service conditions, materials and primary processes, secondary processes, welding, machining, thermal treatment, finishing operations, strength-to-density and modules-to-density ratios, reading and using specifications, safety and reliability, quality control and quality assurance, help from the computer, prototypes and experimentation, cost analysis for a component, the recycling and reuse of materials. Computer applications in materials selection.
Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Advanced Materials
Credit Hours: 3-3-4
Pre-requisites:
Specific Objectives of Course: To provide students thorough understanding of advanced materials.
Course Outline:

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
- Scott A Guelcher and Hollinger, Jeffrey O., “An Introduction to Biomaterials”, Taylor and Francis, 2005
Title of the Course: Welding and Joining Processes
Credit Hours: 3-3-4

Pre-requisites:

Specific Objectives of Course: To provide knowledge of joining processes of materials.

Course Outline:
Introduction to welding and joining, weld defects, selection of appropriate welding process, effect of heat on metals, pre-heating, stress, strain, weldability, type of joints, types of welds, filler metals, welding problems. Gas welding and equipments. Arc welding, power sources, DC and AC power sources, cables, electrodes, current and circuit polarity, electrode selection, weld deposit. TIG & MIG welding; Introduction, principles, non-consumable tungsten electrodes, gas supply and equipment, and TIG joint preparation, spot welding, electrode wire, gas supply, spray metal transfer method, CO$_2$ – MIG welding, MIG spot welding. Submerged arc and other shielded methods, equipment, current, flux, electrodes, atomic hydrogen welding, plasma arc welding electro slag welding under water shielded metals, arc welding, vapour shielded metal arc welding- Resistance welding, resistance spot welding, multiple spot welding, flash and upset welding, percussion welding, Thermit welding, equipment and techniques, process, ignition powder removing, the weld inspection, Other welding processes; laser welding, electron beam welding, pressure welding and ultrasonic welding. Soldering, brazing, joining of dissimilar materials, plastic welding, adhesive bonding, bonding materials, inspection and testing of weldments. Riveting and fastening processes.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
- Thomas Böllinghaus and Herold. Horst, “Hot Cracking Phenomena in Welds” Springer; 1$^{st}$ ed., 2005

Journals/Periodicals
World Wide Web
Title of the Course: Foundry Engineering
Credit Hours: 3-3-4
Pre-requisites:
Specific Objectives of Course: To provide understanding of foundry process of materials.
Course Outline:
Introduction to Foundry Engineering and Practice, Scope and importance of the subject, Simple foundry plant layout, Tooling, equipment, machines and types of furnaces used in foundry, Selection of suitable moulding and core materials, Properties of moulding and core materials, Analysis, testing and control of moulding and core materials requirements. Types of pattern, pattern making, shrinkage and contraction allowances, melting furnaces i.e. pit furnaces, induction melting furnaces, cupola furnaces, selection and control of melting processes, control of chemical compositions, casting and fettling operation, metal gas interaction, causes of defects in sand casting and their remedies, inspection and quality assurance, introduction to new casting techniques.

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:
- Peter, Beeley “Foundry Technology”, Butterworth-Heinemann; 2nd ed., 200

Journals/Periodicals
World Wide Web

Title of the Course: Corrosion, Protection and Prevention
Credit Hours: 3-3-4
Pre-requisites:
Specific Objectives of Course: To impart knowledge of corrosion protection and prevention techniques.
Course Outline:
General concepts, corrosive environments, atmosphere, water, chemicals, gases, general corrosion, galvanic corrosion, oxygen concentration cell, atmospheric corrosion, chemical corrosion, corrosion in gas, types of scale, mechanism of scale protection, oxide, defect structure, oxidation rates, high temperature corrosion, localized corrosion, pit and crevice corrosion. Mechanically assisted corrosion, stress corrosion cracking, intergranular and transgranular corrosion, corrosion fatigue, hydrogen damage, corrosion in ceramics and plastics and chemical corrosion. Corrosion prevention and protection. Chemical inhibitors and environmental control. Corrosion resistant materials.
Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Materials Characterization
Credit Hours: 3-3-4

Pre-requisites:

Specific Objectives of Course:

Course Outline:

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

Journals/Periodicals
World Wide Web
Title of the Course: Powder Metallurgy  
Credit Hours: 3-3-4  
Pre-requisites:  
Specific Objectives of Course: To provide understanding of powder metallurgy techniques.  
Course Outline:  
Lab Outline: Lab Manuals will be available in the concerned laboratory  
Recommended Books:  

Title of the Course: Surface Engineering and Coating Techniques  
Credit Hours: 3-3-4  
Pre-requisites:  
Specific Objectives of Course: To provide knowledge of surface engineering and coating techniques.  
Course Outline:  

Lab Outline: Lab Manuals will be available in the concerned laboratory

Recommended Books:

Title of the Course: Advanced Steels
Credit Hours: 3-3-4

Pre-requisites:
Specific Objectives of Course: To provide thorough understanding of advanced steels.

Course Outline:
Introduction: Microstructure and property relationships in steels, High strength low Alloy (HSLA) steels, micro alloyed steels, stainless steels, duplex steels, high yield steels and super alloys.
Production and Processing: Classifications, production and processing principles, thermomechanical processing, advantages and limitations, TMT steels, dual phase steels, IF (interstitial-free) and ultra-low carbon steels for structural and automotive applications, ultra-low-carbon bainitic steels (ULCB), martensitic steels.
Special Steels: Stainless steels, nitrogen containing fine grained steels, orthopedic steels, superduplex corrosion resistant stainless steels, special steels, TRIP steels, maraging steels, tool steels, die steels, special steels for low to moderate temperature applications for nuclear and thermal power plants, heat resistance steels for superheaters, tool and die steels, processing and properties. Design and processing. Ultra-fine grain
refinement in steel.

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**

**Journals/Periodicals**
World Wide Web

**Title of the Course:** Fracture Mechanics and Failure Analysis
**Credit Hours:** 3-3-4

**Pre-requisites:**
**Specific Objectives of Course:** To provide thorough understanding of fracture and failure analysis.

**Course Outline:**
Ductile and Brittle fracture, Tensile fracture, Creep and Creep fracture, fatigue and Fatigue fracture, impact testing, Izod and Charpy test, ductile to brittle transition, effect of temperature, Griffith’s crack theory, micro-voids formation and ductile fracture, cleavage for brittle fracture, cleavage planes, crack opening displacement (COD), stress intensity factor, J integral, elastic-plastic fracture mechanics, Fracture toughness, plane stress and plane strain fracture toughness, real time fracture toughness, fracture re-inforcement mechanisms. Fractography, differentiation among different types of fracture surfaces.

**Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**

**Journals/Periodicals**
World Wide Web
Title of the Course: Fuels and Furnaces  
Credit Hours: 3-0-3  
Pre-requisites:  
Specific Objectives of Course: To impart knowledge of fuel and furnace used in metallurgical industry.  
Course Outline:  
Lab Outline: N/A  
Recommended Books:  
- Dame and King, “Fuels Technology” Edward Arnold, 2000  
Journals/Periodicals  
World Wide Web  

Title of the Course: Mineral Processing  
Credit Hours: 3-0-3  
Pre-requisites:  
Specific Objectives of Course: To provide knowledge of mineral processing processes.  
Course Outline:  
Lab Outline: N/A
Recommended Books:
- M. C. Fuerstenau, & N. Han, Kenneth “Principles of Mineral Processing”. Society for Mining Metallurgy & Exploration, 2003

Journals/Periodicals
World Wide Web

Title of the Course: Nuclear Materials
Credit Hours: 3-0-3
Pre-requisites:
Specific Objectives of Course: To impart knowledge on nuclear materials.
Course Outline:

Lab Outline: N/A
Recommended Books:

Journals/Periodicals
World Wide Web

Title of the Course: Vacuum Technology
Credit Hours: 3-0-3
Pre-requisites:
Specific Objectives of Course: To impart knowledge on vacuum techniques used in the field of materials and metallurgy.
Course Outline:
Vacuum technology: Different units of measuring pressure vacuum regimes, mean free path, collision frequency. Vacuum pumps: Water pumps, positive displacement pumps, rotary and roots pump, vapour
ejector and vapour entrainment pumps, diffusion pump, turbo-molecular pump, ion pumps, sieve pumps, adsorption pumps. Classification and working principles of vacuum measuring devices: Manometers, McLoad gauge, Penning gauge, Pirani gauge. Calculation of vacuum systems, conductance and through put, effective pumping speed, gas flow through pipes and orifices. Sources of leakage, leakage detection and remedies. Application of vacuum in materials processing.. Vacuum induction melting, vacuum arc melting. Metal refining in vacuum, degassing in liquid state, vacuum heat treatment, vacuum sintering, vacuum coating, use of vacuum technology in the production of strategic materials. Design of vacuum furnaces.
Vacuum Coatings: Introduction, purpose of vacuum coating, process of vacuum coating, vacuum coating system by electro bio-bombardment beating, valves used in vacuum technology.

Lab Outline: N/A

Recommended Books:

Journals/Periodicals

World Wide Web

Title of the Course: Composite and Polymeric Materials
Credit Hours: 3-3-4

Pre-requisites:

Specific Objectives of Course: To provide knowledge of composite and polymeric materials.

Course Outline:
Survey and classification of polymeric materials. Review of polymer chemistry, introduction to polymers, classification of polymers, polymerisation, co-polymerisation, structure and properties of thermoplastic and thermosetting polymers, elastomers and rubber, vulcanisation, additives and fillers. Manufacturing, properties and applications of polymers, polystyrene, polybutadiene, polyester, polymethyl methacrylate (PMMA), nylon 6:6, acrylonitrile-butadiene-styrene (ABS), silicon resin, epoxy resin, phenol- formaldehyde and other advanced polymers, forming processes, testing and identification of polymers, fibers, foams and adhesives. Plastics, conductive polymers and plastics, Introduction to Composite materials, classification characteristics, mechanical behavior potential advantages, properties and applications. Composite material design, specific stiffness and strength, and recent developments such as metal matrix composite, ceramic matrix composites, carbon fiber reinforced composite, production and processing of fibres and
other reinforcements, polymeric matrix composites, processing principles and design of ply and laminate structures, filament winding and pultrusion. **Lab Outline:** Lab Manuals will be available in the concerned laboratory

**Recommended Books:**

- McCrum, N.G. and Buckley, C., “Principles of Polymer Engineering”, OUP, 2002
- Rodger, Brendan, “Rubber Compounding: Chemistry and Applications”, Taylor and Francis, 2004

**Title of the Course: Senior Design Project Part-1**

**Credit Hours:** 0-9-3

**Pre-requisites:**

**Specific Objectives of Course:** To provide students learning of research techniques used in the industry.

**Course Outline:**

Selected problems from the industry and current materials research issues regarding selection processing, designing, manufacturing and development. Fabrication of prototype/models and laboratory experimentation shall be assigned to individual students/ Grading shall be the reports produced by individual students and their evaluation through an oral examination

**Lab Outline:** Experimental work will be carried out in the relevant laboratories/industry according to the nature of the project

**Recommended Books:**

Reference book and journal for latest literature survey and methodology

**Title of the Course: Senior Design Project Part-1I**

**Credit Hours:** 0-9-3

**Pre-requisites:**

**Specific Objectives of Course:** Same as Part-I

**Course Outline:**

Same as Part-I

**Lab Outline:** Experimental work will be carried out in the relevant laboratories/industry according to the nature of the project

**Recommended Books:**

Reference book and journal for latest literature survey and methodology
RECOMMENDATIONS

After thorough deliberations the committee proposed the following recommendations:

1. In order to ensure uniformity in all the universities/educational institutions offering degrees in Metallurgy and Materials Engineering, the programme should have 65-70 percent engineering courses and 30-35 percent of non-engineering courses.

2. The courses/curriculum must be revised regularly after every three years.

3. Board of studies of the universities/institutes should be allowed to incorporate new developments and ideas in the course contents.

4. The universities should be encouraged to co-opt the industry representatives in the Board of Studies.

5. Final year projects should be relevant to the industry.

6. A suitable mechanism must be developed for facilitating the students to obtain internship with various industries and public sector organizations.

7. Universities/Institutes should arrange short visits of students to industries in order to enhance their confidence about the relevance of engineering subjects.

8. To facilitate the provision of high quality education, the latest textbooks and educational software should be provided to the students on affordable prices. HEC should provide funds to the Universities/Institutes for this purpose.

9. The training of teachers in teaching methodologies should be increased. University-Industry interaction and regular participation of teachers in relevant conferences must be ensured. Universities should take necessary steps and provide financial resources for this purpose.

10. Computing and IT facilities along with relevant software, databases and online technical research journals should be available for faculty members of all the universities/institutes.
Annex “A”

COMPULSORY COURSES IN ENGLISH FOR BE/BSc IN ENGINEERING DISCIPLINE

Semester – I

Functional English

Objectives: To enhance language skills and develop critical thinking

Course Contents

Basics of Grammar
Parts of speech and use of articles
Sentence structure, Active and passive voice
Practice in unified sentence
Analysis of phrase, clause and sentence structure
Transitive and intransitive verbs
Punctuation and spelling

Comprehension
Answers to questions on a given text

Discussion
General topics and every day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening
To be improved by showing documentaries/films carefully selected by subject teachers

Translation skills
Urdu to English

Paragraph writing
Topics to be chosen at the discretion of the teacher

Presentation skills
Introduction

Note: Extensive reading is required for vocabulary building

Recommended books:

1. Functional English
a) Grammar

b) Writing

c) Reading/Comprehension

d) Speaking

**Semester II**

**Communication Skills**

**Objectives:** To enable the students to meet their real life communication needs

**Course Contents**

**Paragraph writing**
Practice in writing a good, unified and coherent paragraph

**Essay writing**
Introduction

**CV and job application**

**Translation skills**
Urdu to English

**Study skills**
Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

**Academic skills**
Letter / memo writing and minutes of the meeting, use of library and internet recourses

**Presentation skills**
Personality development (emphasis on content, style and pronunciation)
Note: documentaries to be shown for discussion and review

**Recommended books:**

**Communication Skills**

a) **Grammar**

b) **Writing**

c) **Reading**
   2. Reading and Study Skills by John Langan
   3. Study Skills by Riachard Yorky.

**Semester III**

**Technical Writing and Presentation Skills**

**Objectives:** To enhance language skills and develop critical thinking

**Course Contents**

**Presentation skills**

**Essay writing**
- Descriptive, narrative, discursive, argumentative

**Academic writing**
- How to write a proposal for research paper/term paper
- How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

**Technical Report writing**
Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended books:
Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing


b) Presentation Skills

c) Reading
   The Mercury Reader. A Custom Publication. Compiled by Northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Semester III
   Technical Writing and Presentation Skills

Objectives: To enhance language skills and develop critical thinking

Course Contents

Presentation skills

Essay writing
Descriptive, narrative, discursive, argumentative

Academic writing
How to write a proposal for research paper/term paper
How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)
Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

Recommended books:
Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing


d) Presentation Skills

e) Reading
   The Mercury Reader. A Custom Publication. Compiled by norther Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).
ISLAMIC STUDIES (Compulsory)

COURSE PROFILE

<table>
<thead>
<tr>
<th>S.NO</th>
<th>TITLES</th>
<th>DETAIL</th>
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<tbody>
<tr>
<td>1</td>
<td>Name of Course</td>
<td>Islamic Studies (Compulsory)</td>
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<tr>
<td>2</td>
<td>No. of Credit Hours</td>
<td>2 Credit Hours</td>
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<tr>
<td>3</td>
<td>Nature of Course</td>
<td>Compulsory at Graduation Level</td>
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<tr>
<td>4</td>
<td>Total Teaching Weeks</td>
<td>18</td>
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<td>5</td>
<td>Objectives of the Course</td>
<td>This course is aimed at:</td>
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<tr>
<td></td>
<td></td>
<td>1-To provide Basic information about Islamic Studies</td>
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<td>2-To enhance understanding of the students regarding Islamic Civilization</td>
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<td>3-To improve Students skill to perform prayers and other worships</td>
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<td>4-To enhance the skill of the students for understanding of issues related to faith and religious life</td>
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<tr>
<td>6</td>
<td>Components of Teaching of the Course</td>
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</table>

LEVEL OF COURSE  GRADUATION
NAME OF DEGREE  BS
NAME OF COURSE  ISLAMIC STUDIES
SEMESTER  AS PER REQUIREMENT OF THE UNIVERSITY
NO. OF CREDIT  2
TOTAL TEACHING HOURS  AS PER HEC REQUIREMENTS
NO. OF PERIODS PER WEEK  2
TOTAL TEACHING PERIOD OF COURSE  18 WEEKS

UNIT NO.1:  INTRODUCTION TO QURANIC STUDIES
1) Basic Concepts of Quran
2) History of Quran
3) Uloom-ul -Quran

UNIT No.2 :  STUDY OF SELECTED TEXT OF HOLLY QURAN
1) Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4) Verses of Surah Al-Furqan Related to Social Ethics (Verse No.63-77)
5) Verses of Surah Al-Inam Related to Ilkam(Verse No-152-154)

UNIT No.3 : STUDY OF SELECTED TEXT OF HOLLY QURAN

1) Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
2) Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
3) Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

UNIT NO.4: SEERAT OF HOLY PROPHET (S.A.W) I

1) Life of Muhammad Bin Abdullah ( Before Prophet Hood)
2) Life of Holy Prophet (S.A.W) in Makkah
3) Important Lessons Derived from the life of Holy Prophet in Makkah

UNIT NO.5: SEERAT OF HOLY PROPHET (S.A.W) II

1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life Holy Prophet in Madina
3) Important Lessons Derived from the life of Holy Prophet in Madina

UNIT NO.6: INTRODUCTION TO SUNNAH

1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Uloom –ul-Hadith
5) Sunnah & Hadith
6) Legal Position of Sunnah

UNIT NO.7 SELECTED STUDY FROM TEXT OF HADITH

UNIT NO.8 INTRODUCTION TO ISLAMIC LAW & JURISPRUDENCE

1) Basic Concepts of Islamic Law & Jurisprudence
2) History & Importance of Islamic Law & Jurisprudence
3) Sources of Islamic Law & Jurisprudence
4) Nature of Differences in Islamic Law
5) Islam and Sectarianism

UNIT NO.9: ISLAMIC CULTURE & CIVILIZATION

1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture & Civilization
3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

UNIT NO.10: ISLAM & SCIENCE

1) Basic Concepts of Islam & Science
2) Contributions of Muslims in the Development of Science
3) Quranic & Science
UNIT NO.11: ISLAMIC ECONOMIC SYSTEM
1) Basic Concepts of Islamic Economic System
2) Means of Distribution of wealth in Islamic Economics
3) Islamic Concept of Riba
4) Islamic Ways of Trade & Commerce

UNIT NO.12: POLITICAL SYSTEM OF ISLAM
1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

UNIT NO.13: ISLAMIC HISTORY
1) PERIOD OF KHALIFA-E-RASHIDA
2) PERIOD OF UMMAYYADS
3) PERIOD OF ABBASIDS

UNIT NO.14: SOCIAL SYSTEM OF ISLAM
1) BASIC CONCEPTS OF SOCIAL SYSTEM OF ISLAM
2) ELEMENTS OF FAMILY
3) ETHICAL VALUES OF ISLAM

REFERENCE BOOKS:
1) HAMEED ULLAH MUHAMMAD, “EMERGENCE OF ISLAM”, IRI, ISLAMABAD
2) HAMEED ULLAH MUHAMMAD, “MUSLIM CONDUCT OF STATE”
3) HAMEED ULLAH MUHAMMAD, “INTRODUCTION TO ISLAM”
4) MULANA MUHAMMAD YOUSAF ISLAHI, “Principles of Islamic Jurisprudence” Islamic Research Institute, international Islamic University, Islamabad (1993)
8) Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001)
Pakistan Studies (Compulsory)

(As Compulsory Subject for Degree Students)

Introduction / Objectives

The course has been designed as a compulsory subject for the students studying for Bachelor’s degree, general or professional. The course is of 3 credit hours carrying 100 marks (recommended). The teaching work is comprised of three dimensions: Historical Perspective (20%); Government and Politics (40%); and Contemporary Pakistan (40%).

The course framework is issue-oriented. It has many dimensions, the historical and ideological background of Pakistan, the process of governance and national development as well as the issues arising in the modern age and posing challenges to Pakistan. The course has been designed with a vision that Pakistan Studies should open a window to future.

Course Outline

1. Historical Perspective
   b. Factors leading to Muslim separatism
   c. People and Land
      i. Indus Civilization
      ii. Muslim advent
      iii. Location and Geo-Physical features.

2. Government and Politics in Pakistan
   Political and constitutional phases:
   a. 1947-58
   b. 1958-71
   c. 1971-77
   d. 1977-88
   e. 1988-99
   f. 1999 onward

3. Contemporary Pakistan
   a. Economic institutions and issues
   b. Society and social structure
c. Ethnicity

d. Foreign policy of Pakistan and challenges

e. Futuristic outlook of Pakistan

Books Recommended
COURSES FOR SOCIAL SCIENCE

Sociology and Development
(For Engineers)

Objectives: The main objective of this course is to apprise potential engineers about social factors that contribute towards enhancing their professional performance for the good of society and the country. This course is culture specific and has to be taught within the context of local and national socio-economic environment. The engineers are expected to supervise several people in different capacities and their understanding about human behaviour is critical for their optimum performance. Modification of human behaviour or getting work done from subordinates and seniors remain a major challenge for all the professional engineers. This course will enhance understanding about the determinants of human behaviour, which ultimately will result in improved individual efficiency.

1. Introduction to Sociology
   1.1 What is sociology?
   1.2 Nature, Scope, and Importance of Sociology
   1.3 Social Interactions
   1.4 Social Groups
   1.5 Social Institutions

2. Culture and Related Concepts
   2.1 Definition of Culture
   2.2 Types of Culture
   2.3 Elements of Culture
   2.4 Role of Culture in Organization
   2.5 Socialization and Personality

3. Interpersonal Relations
   3.1 Interpersonal Behaviour
   3.2 Formation of Personal Attitudes
   3.3 Language and Communication
   3.4 Motivations and Emotions
   3.5 Public Opinion

4. Social Stratification
   4.1 Factors of Social Stratification
   4.2 Caste and class
   4.3 Power, Prestige, and Authority
   4.4 Social Mobility
   4.5 Migration

5. Human Ecology
   5.1 Ecological Processes
   5.2 Ecosystem and energy
   5.3 Ecosystem and Physical Environment
5.4 Solid Waste Disposal
5.5 Pollution

6. Population Dynamics
   6.1 World Population Growth and Distribution
   6.2 Population Dynamics in Pakistan
   6.3 Causes and Consequences of Urbanization
   6.4 Population Policy in Pakistan
   6.5 Population and Development

7. Community Development
   7.1 Meaning, Scope, and Subject Matter of Community Development
   7.2 Processes of Community Development
   7.3 Community Development Programs in Pakistan
   7.4 Community Organization and Related Services
   7.5 Cooperation and Conflict in Community Development

8. Deviance and Crime
   8.1 Crime as a Social and Cultural Phenomenon
   8.2 Crime and Social Organization
   8.3 Organized Crime
   8.4 Culture Based Crime
   8.5 Economics of Crime

9. Sociology of Change and Development
   9.1 What is Social Change and Development?
   9.2 Dynamics of Social Change
   9.3 Role of NGOs in Development
   9.4 World System and Development
   9.5 Gender and Development

Recommended Readings

Objectives: The students are expected to learn anthropological skills for application by professional engineers and other related practitioners. Societal growth needs are to be understood within our own cultural environment. Such a body of applied knowledge will result in improving the professional performance of would-be engineers. As culture and society play an important role towards all human activities, this course will help students relate technical skills to the societal needs and requirements.

I Introduction
1. Anthropology and Social Anthropology
2. Fields of Anthropology
3. Anthropological Research Methods
4. Social Anthropology and other Social Sciences
5. Significance of Social Anthropology

II Culture
1. Definition, Properties and Taxonomy
2. Evolution of Growth and Culture
3. Evolution of Man: Religious and Modern Perspectives
4. Evolution of Culture
5. Culture and Personality

III Evolution and Growth of Culture
1. Evolution of Man
2. Schools of Thought in Cultural Anthropology
3. Acculturation
4. Enculturation
5. Ethnocentrism and Xenocentrism
IV Language and Culture
1. Communication
2. Structural Linguistics
3. Historical Linguistics
4. Relationship between Language and Culture
5. Ethnography

V Economic System
1. Global Economic System
2. The Allocation of Resources
3. The Conversion of Resources
4. The Distribution of Goods and Services
5. Poverty and Inequality

VII Marriage and Family
1. Marriage and Mate Selection
2. The Family: Types and Functions
3. Kinship System
4. Structure and Function of Family
5. Gender Relations

VIII Political Organization
1. Political Sociology
2. Origin of Political Organization and Organizational System
3. Types of Political Organizations
4. Power Politics and Factionalism in Pakistan
5. Resolution of Conflict

IX Religion and Magic
1. The Universality of Religion
2. Comparative Religions
3. Religion and Society
4. Religious Beliefs and Practices
5. Witchcraft and Sorcery

XI Culture Change
1. Forms of Art
2. Expressive Culture
3. Process of Cultural Change
4. Cultural Change in the Modern World
5. Cultural Change in Pakistani society

Recommended Books

**Psychology courses for B.Sc/B.E in Engineering Programme**

Course-I  **Understanding Psychology and Human Behaviour**  3 credit hrs

- What is Psychology?
- Nature, Scope and Application with Special Reference to Pakistan
- Different Schools of Psychology
- Methods of Psychology
- Learning
- Intelligence and Artificial Intelligence
- Personality and its Assessment
- Understanding Maladjustive Behaviour
- Positive Emotional States and Processes
- Stress Management and Anger Management

**Books Recommended**


Course II  Professional Psychology  3 credit hrs
- Introduction to Professional Psychology
- Psychological Testing
- Educational Psychology
- Industrial/Organizational Psychology
- Social Psychology
- Health Psychology
- Clinical Psychology
- Positive Psychology
- Legal, Ethical, and Professional Issues.

Books Recommended

PROFESSIONAL ETHICS

Course Description:
Prerequisite: None
Corequisite: None

This course introduce contemporary and controversial ethical issues facing the business community. Topics include moral reasoning, moral dilemmas, law and morality, equity, justice and fairness, ethical standards, and moral development. Upon completion, students should be able to demonstrate an understanding of their moral responsibilities and obligations as members of the workforce and society.

Course Objectives:

At the completion of the course requirements, the student will be able to:
  a. Define business ethics
  b. Describe the evolution of business ethics
  c. Describe major ethical perspectives
  d. Understand and apply an ethical decision-making framework
  e. Understand social responsibility from several dimensions
  f. Understand how the organization influences ethical decision-making
  g. Examine how significant others influence ethical decision-making
  h. Develop an effective ethics programme.
  i. Understand international business ethics.
Course Outline:


Ethical issues in Business: Foundation of Ethical Conflict, Classifications of Ethical Issues, Ethical Issues Related to Participants and Functional Areas of Business, Recognizing an Ethical Issue.

Applying Moral Philosophies to Business Ethics: Moral Philosophy Defined, Moral Philosophy Perspectives.


The Role of Opportunity and Conflict: Opportunity, Conflict.


International Business Ethics: Ethical Perceptions and International Business, Culture As a Factor in Business, Adapting Ethical Systems to a Global Framework: Cultural Relativism, the Multinational Corporation, A universal Set of Ethics, Ethical Issues Around the Globe.

Text Books:

• Introduction to Organizational Behaviour
  o Organizational Disciplines and topics
  o Psychological Perspective
  o Social-Psychological Perspectives

• Structure and Control in Organization
  o Introduction
  o Bureaucracy
  o Managerial Work
  o Contingency theory
  o Organizational Design

• Individual and Work Learning
  o Learning Theories
  o Learning and Work

• Stress
  o Types of Stress and Work
  o Occupational Stress Management

• Individual Differences
  o Personality and its factors
  o Personality dimensions and social learning
  o Intelligence

• Motivation and Job Satisfaction
  o Needs at Work
  o Theories of Motivation and job satisfaction
  o Correlates of Job satisfaction
  o Correlates of Job satisfaction

• Group and Work
  o Social Interaction
  o Dramaturgy and impression Management
  o Social Skill

• Group and Inter group Behaviour
  o Group Structure & Norms
  o Group Processes
  o How throne Studies

• Leadership
  o Leadership as an attribute
  o Leadership Style
• Patterns of Work
  o Work-the classical approach
  o Marx, Weber, & The critique of labor
  o Foucault & Disciplinary Power

• Conflict and Consent in Work
  o The labor Process debate
  o Work place control and resistance
  o Industrial conflict and industrial relations

• Organizational culture
  o Organizational culture and strategic management
  o Exploring organizational culture
  o Evaluating concept of culture

Books Recommended:

INTRODUCTION TO SOCIOLOGY

- The Nature of Sociology
  - The study of social life
  - Exploring the global village
  - Sociology as a science
  - The Sociological imagination
  - The development of Sociology
  - Pioneers of Sociology
  - Nature, scope and subject matter of Sociology
  - Brief historical development of Sociology
  - Society and community
  - Relationship with other social sciences
  - Social Interaction Processes

- Social groups
  - Definition and functions
  - Types of social groups

- Social institutions
  - Definition
  - Structure and function of social institutions
  - Inter-relationships among various social institutions

- Culture and related concepts
  - Definition and aspects of culture
  - Elements of culture
  - Organization of culture
  - Other concepts, cultural relativism, sub cultures, ethnocentrism, culture lag

- Socialization and personality
  - Role and status
  - Socialization
  - Culture and personality

- Deviance and social control
  - Definition and types of deviance
  - Juvenile delinquency
  - Formal and information methods of social control

- Social stratification
  - Approach to study social stratification
  - Caste class and race as basics of social stratification

- Major perspectives in Sociology
  - Functionalist perspective
- Conflict perspective
- Interactional perspective

- Social Control and deviance
  - Agencies of social control

- Social stratification
  - Determinants of social stratification
  - Social mobility, types and definition
  - Dynamics of social mobility

- Concept of social movement
  - Theories of social movement
  - Social and cultural change

- Social and cultural change
  - Definition of social change
  - Dynamics of social change
  - Impact of globalization on society and culture
  - Resistance to change

- Collective behaviour
  - Definition
  - Characteristics
  - Causes
  - Types
  - Social movements
  - Mob and crowd behaviour

Books Recommended


CRITICAL THINKING 3 Credit Hrs

- The Power of Critical Thinking
  - Claims and Reasons
  - Reasons and Arguments
  - Arguments in the Rough
• The Environment of Critical Thinking
  o Perils of Haunted Mind
  o Self and the Power of the Group
  o Subjective and Social Relativism
  o Skepticism

• Making Sense of Arguments
  o Arguments Basics
  o Patterns
  o Diagramming Arguments
  o Assessing Long Arguments

• Reasons for Belief and Doubt
  o Conflict Experts and Evidence
  o Personal Experience
  o Fooling Ourselves
  o Claims in the News

• Faulty Reasoning
  o Irrelevant Premises
  o Genetic Fallacy, Composition, Division
  o Appeal to the Person, Equivocation, Appeal to Popularity
  o Appeal to Tradition, Appeal to Ignorance, Appeal to Emotion
  o Red Herring, Straw Man

• Unacceptable Premises
  o Begging the Question, False Dilemma
  o Slippery Slope, Hasty Generalization
  o Faulty Analogy

• Deductive Reasoning: Propositional Logic
  o Connectives and Truth Values
  o Conjunction, Disjunction, Negation
  o Conditional, Checking for Validity
  o Simple Arguments, Tricky Arguments
  o Streamlined Evaluation

• Deductive Reasoning: Categorical Logic
  o Statements and Classes
  o Translations and Standard Form
  o Terms, Quantifiers
  o Diagramming Categorical Statements
  o Sizing up Categorical Syllogisms

• Inductive Reasons
  o Enumerative Induction
  o Sample Size, Representativeness, Opinion Polls
• Analogical Induction
• Casual Arguments, Testing for Causes
• Casual Confusions

• Inference to the Best Explanation
  • Explanations and Inference
  • Theories and Consistency
  • Theories and Criteria
  • Testability, Fruitfulness, Scope, Simplicity
  • Conservatism

• Judging Scientific Theories
  • Science and Not Science
  • The Scientific method, Testing Scientific Theories
  • Judging Scientific Theories
  • Copernicus versus Ptolemy, Evolution Versus Creationism
  • Science and Weird Theories
  • Making Weird Mistakes
  • Leaping to the Weirdest Theory, Mixing What Seems with What is
  • Misunderstanding the Possibilities
  • Judging Weird Theories
  • Crop Circles, Talking with the Dead

BOOKS RECOMMENDED


INTRODUCTION TO PHILOSOPHY

• Definition and Nature of Philosophy
• Theory of Knowledge
  • Opinion and Knowledge
  • Plato, the Republic Selection
  • Knowledge through Reason
  • Descartes Meditation on First Philosophy
  • Knowledge through Experience
  • Hume an Inquiry concerning Human Understanding (Selection)
  • Experience Structured by the Mind
  • Kant Critique of Pure Reason (Selection)
  • Knowing and Doing
  • James Pragmatism (Selection)
  • Knowledge and Emotion
- Philosophy of Religion
  - Proving the Existence of God
  - Anselm, Aquinas, Paley, Dawkins (Selection)
  - Justifying Religious Beliefs
  - Pascal Pensees (Selection)
  - James The Will to Believe Selection
  - Freud The Future of An Illusion (Selection)
  - Confronting the Problems of Evil
  - Mackie Evil and Omnipotence (Complete)
  - Hick Philosophy of Religion (Selection)

- Metaphysics
  - Idealism and Materialism
  - Berkeley Three Dialogues Between Hylas and Pholonus (Selection)
  - Armstrong Naturalism, Materialism and First Philosophy (Selection)
  - The Mid-Body Problem
  - Descartes Meditations on First Philosophy (Selection)
  - O’Hear Introduction to the Philosophy of Science (Selection)
  - Dennett The Origins of Selves (Complete)
  - Pali Canon (Selection)
  - Penelhum Religion and Rationality (Selection)

- Freedom to Choose
  - Libertarianism
  - James The Dilemma of Determinism (Selection)
  - Taylor Metaphysics (Selection)
  - Determinism
  - Horsers Meaning and Free Will (Selection)
  - Skinner Walden Two (Selection)
  - Compatibilism
  - Stace Religion and the Modern Mind (Selection)
  - Radhakrishnan Indian Philosophy (Selection)

- Ethics
  - Fulfilling Human Nature
  - Aristotle Nicomachean Ethics (Selection)
  - Loving God
  - Augustine The Morals of the Catholic Church and the City of God (Selection)
  - Following Natural Law
  - Aquinas Summa Theologiae (Selection)
  - Doing One’s Duty
  - Kant Fundamental Principles of the Metaphysics of Morals (Selection)
- Political and Social Philosophy
  - The State as Natural
  - Plato the Republic (Selection)
  - Aristotle Politics (Selection)
  - The State as a Social Contract
  - Hobbes Philosophical Rudiments Concerning Government and Society (Selection)
  - Locke the Second Treatise of Government (Selection)
  - Liberty of the Individual
  - Mill On Liberty (Selection)
  - Alienation in Capitalism
  - Marx Economic and Philosophic Manuscripts of 1844 (Selection)
  - Justice and Social Trust
  - Rawls A Theory of Justice (Selection)
  - Nozick Anarchy, State, and Utopia (Selection)
  - Held Rights and Goods (Selection)
  - Women in Society
  - Wollstonecraft A Vindication of the Rights of Women (Selection)
  - De Behaviour The Second Sex (Selection)
  - The Value of Philosophy
  - Russel The Problems of Philosophy (Selection)
  - Midgley Philosophical Plumbing (Selection)

**BOOKS RECOMMENDED**

MANAGEMENT COURSES

ENTREPRENEURSHIP

Course Objective:

Entrepreneurship is an important component in the process of economic development. The purpose of this course is to analyse the theories of entrepreneurship and to go for case studies of successful entrepreneurs.

Course Contents:

Introduction: The concept of entrepreneurship, The economist view of entrepreneurship, The sociologist view, Behavioural approach, Entrepreneurship and Management

The Practice of Entrepreneurship: The process of entrepreneurship, Entrepreneurial Management, The entrepreneurial business, Entrepreneurship in service institutions, The new venture

Entrepreneurship and Innovation: The innovation concepts, Importance of innovation for entrepreneurship, Sources of innovative opportunities, The innovation process, Risks involved in innovation

Developing Entrepreneur: Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, The environment, Socio cultural factors, Support systems

Entrepreneurship Organization: Team work, Networking organization, Motivation and compensation, Value system

Entrepreneurship and SMES: Defining SMEs, Scope of SMEs, Entrepreneurial, managers of SME, Financial and marketing problems of SMEs

Entrepreneurial Marketing: Framework for developing entrepreneurial marketing, Devising entrepreneurial marketing plan, Entrepreneurial marketing strategies, Product quality and design

Entrepreneurship and Economic Development: Role of entrepreneur in the economic development generation of services, Employment creation and training, Ideas, knowledge and skill development, The Japanese experience

Case Studies of Successful Entrepreneurs
PRINCIPLES OF MANAGEMENT

Course Objectives:

This is a rudimentary course for the students of business administration. The focus of attention will be given to learning fundamental principles of management and of managing people and organization in a historical as well as contemporary world. Students are expected to develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.

Course Contents:

- Introduction, overview and scope of discipline
- The evolution and emergence of management thought
- Management functions
- Planning concepts, objectives, strategies and policies
- Decision making
- Organizing; departmentalization, line/staff authority, commitments and group decision making
- Staffing: principles of selection, performance, career planning
- Leading: Motivation, leadership, communication
- Controlling: the system and process and techniques of controlling
- Management and Society: future perspective

Text Books:

- Stephen P. Robins, Mary Coulter: Management
- H. Koontz Odonnel and H. Weihrich: Management
- Mc Farland: Management: Foundation and Practice