

Detail of Courses

A) ENGINEERING DOMAIN

COMPUTING

Introduction to Computing 3 (2, 1)

Objective:

To give working knowledge & skills of coding (C++ / Fortran/ VB / Matlab etc), how to avoid common coding pitfalls, to use and create own functions and classes. The course will enable students to recognize the advantages of using pointers and references & to understand the fundamental ideas of object oriented design (OOD).

Contents:

Introduction to computer hardware and software, Introduction to programming languages, Equation solvers and procedural computations, Communication and networking. Constants and variables, Arithmetic operations, Intrinsic functions, Algorithm design, Flowcharts, and Pseudo codes, IF statements, Do loop, While loop, Data files, Formatted Input and Output, Logical and character data type, Arrays: One-dimensional, Two-dimensional; Subprograms: Functions and subroutines, Numerical applications,

Recommended Books:

1. C++ How to Program by Paul Deitel and Harvey Deitel, 10th Edition
2. Microsoft Visual Basic .NET Programmers cookbook by Mathew McDonald, 2003.
3. Microsoft Visual Basic 2013 Step by Step by Michael Halvorson.
4. Fortran 90/95 for Scientists & Engineers by Stephan J. Chapman, 2003.
5. MATLAB for Engineers by Holly Moore, 5th Edition, 2017.
6. An Engineers guide to MATLAB, 3rd Edition by Edward B. Magrab, 2011.

Suggested Lab:

Hands on Experience using software.

Computer Simulations 3 (1, 2)

Prerequisites: Introduction to Computing, Probability and Statistics

Objective:

The course enables the students to become proficient in simulation model building and use of computer simulation as problem solving technique.

Hands-on experience on computer simulation using software like ARENA, SIMIO, FLEXSIM, WITNESS etc.

Contents:

Introduction and simulation concepts, fundamental concepts (entities, attributes, resources, queues, statistical accumulators, events), simulation with hand, modules (create, entity data, process flow chart, resource data, queue data, dispose flow chart and connecting flow chart modules), Building model (electronic assembly and test system, enhanced electronic assembly and test system), Input analyser, Output module, animation, intermediate modelling, small manufacturing system model (building model of data and logic modules) and statistical analysis of output from steady state simulation of small manufacturing systems, entity transfer, variables and expressions and call centre model.

Recommended Books:

1. Simulation with ARENA by W. David Kelton, R. Sadowski, N. Zupick, 6th Edition. 2015.
2. Discrete Event System Simulation by Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, 5th Edition, 2009.
3. Simulation Modelling and Analysis with ARENA, Altiook, T. and Melamed, 2011.
4. System Simulations by Geoffrey Gordon, 2nd Edition, 2015.

Suggested Lab:

Hands on Experience using software.

Computer Aided Manufacturing 3 (2, 1)

Prerequisites: Machine Design and CAD, Manufacturing Processes

Objective:

To objective is to expose the students to the use of computer software and hardware in the translation of computer aided design models into manufacturing instructions for numerically controlled machine tools.

Contents:

Conventional Numerical Control, NC Part Programming, Computer Controls in NC, Group Technology and Process Planning, Programmable Logic Controllers, Design for Manufacturing.

Suggested Labs:

Process planning, programming machine tools using G&M codes and simulation of machining operations.
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Recommended Books:

1. Computer Aided Manufacturing by T C Cheng, Richard A, Wysk and H P Weng, 3rd Edition, 2005.
2. Principles of CAD/CAM/CAE systems by Kunwoo Lee, 1999.
3. CAD/CAM Theory and Practice by Zeid Ibrahim, 2nd Edition, 2009.

B) ENGINEERING FOUNDATION

Operations Research 4(3, 1)

Prerequisites: Applied Linear Algebra

Objectives:

The primary emphasis is on linear programming and its applications, covering modeling, fairly complex problems & solving those using computers, understand transportation and assignment problems, determining optimum solution of constrained resource allocation problems.

Contents:

Application of Linear Algebra to Industrial Problems, Introduction to Linear Programming, Graphical method of solving L.P. problems, Simplex method, Duality and Sensitivity Analysis, Solving large scale problems using computer, Transportation and Assignment Problems, Network problems, shortest path, minimum spanning tree, maximum flow problems, Queuing theory.

Recommended Books:

1. Operations Research by H. A. Taha, 8th Edition, 2009.

2. Quantitative Analysis for Management, by Barry Render, Ralph M. Stair, Michael E. Hanna, Trevor, S. Hale, 12th Edition, 2014.
3. Operation Management-Strategy and analysis by Krajewsky and Ritzman, 6th Edition.
4. Operation Management: Processes and Supply Chain by Krajewsky, Manoj K, Malhotra, Larry P. Ritzman, 11th Edition, 2015.
5. Operations Research by S. Kalavathy, 4th Edition, 2016.
6. Operations Research: Applications and Algorithms by Wayne L. Winston, 4th Edition, 2003.

Suggested Labs:

1. Familiarization with software like LINDO, TORA , LPEra, etc.
2. Mathematical modeling of real life problems.
3. Solving an LP problem using graphical method.
4. Solving a given LP problem and finding the relationship between solutions of Primal and Dual formulations.
5. Performing sensitivity analysis.
6. Solving assignment and transportation problems using Simplex Method.
7. Studying the effect of problem formulation on the number of iterations.
8. Comparison of actual number of iterations with the maximum possible iterations for a given formulation.

Metrology & Statistical Quality Control 4 (3, 1)

Prerequisites: *Probability and Statistics*

Objective:

The course exposes the students to the principles of measurement, gauges and modern quality concepts and their practical use, the basic statistical & probability techniques and their usages in quality applications.

Contents:

General principles of measurement, Geometric dimensioning and tolerances, Gauges and comparators, Interferometers and associated devices, Surface texture measurement, Study of frequency distributions and probability models in quality control, Sources of variation, Preparation and use of various control charts, Process Capability Indices, Construction of different sampling plans, Methods to quality improvement and analysis of quality costs, Computer applications in SQC.

Recommended Books:

1. Quality Control by D. H. Besterfield, 9th Edition, 2009.
2. Introduction to Statistical Quality Control by Douglas C. Montgomery, 7th Edition, 2012.

3. Engineering Metrology and Measurements, by N V Raghavendra and L, Krishna Murthi, 1st Edition, 2013.

4. Statistical Methods for quality improvement by Thomas P. Ryan, 3rd Edition, 2011.

Suggested Labs:

Use of gauges and measuring instruments such as Vernier callipers, micro meters, gauge blocks, slip gauges, Go, No-Go gauges etc.

Applications of comparators and surface measuring instruments, Coordinate Measuring Machines, Data collection, tally sheets, Pareto analysis, fishbone diagrams. Control charts for variables and attributes using Minitab.

Mechanics of Materials 4 (3, 1)

Prerequisites: *Materials Engineering*

Objective:

This course allows engineers to predict failures and understand the physical and mechanical properties of materials. Students are exposed to basic engineering design concepts.

Contents:

Mechanics of Deformable Bodies, Deformation, Strain, General stress-strain relationships, Elastic load-deformation behaviour of materials, Lateral strain, Thermal strain, Bending: Pure bending, Moment-curvature Relationship, Beam Deflection; Torsion and Twisting, Energy Methods, Stress and strain transformations, Mohr's stress/strain circle, Stress and strain transformation in composites, Yield and failure criteria of materials.

Recommended Books:

1. Mechanics of Materials, by Beer, Johnston and Dewolf, 7th Edition, 2014.

2. Mechanics of Materials, by Hibbeler, R. C. 10th Edition, 2016.

3. An Introduction to the Mechanics of Solids, by Lardner, T. J., Archer, R.R., Crandall S. H., and Dahl N.C, 3rd Edition, 2012.

4. Mechanical Behavior of Materials, by Dowling, N. E., 4th Edition, 2012.

Suggested Labs:

1. To study the Universal testing machine.

2. To determine the shear strength (single and double) of metallic and non metallic (wood etc.) specimen.

3. To determine the hardness of different metallic specimens using a) Brinell b) Rockwell c) any other testing equipment.

4. To determine Modulus of Elasticity of a) rectangular section b) I-section beam using bending test.

5. To determine the Modulus of Elasticity of a metallic specimen using tensile test.
6. To determine the stiffness of a) leaf b) helical coil spring by plotting load vs deflection graph.

Basic Industrial Electronics 3 (2, 1)

Objective:

This course will provide an overview of basic industrial electronics.

Basics and Applications of Circuit Analysis, Semiconductor devices such as diodes, transistors, power transistors with reference to their terminal characteristics, Switches, Transducers, Operational amplifier principles and applications, Digital logic , Digital systems and microprocessors, Modulation and Demodulation.

Books Recommended:

1. Modern Industrial Electronics by Timothy J. Maloney, 5th Edition, 2003.
2. Industrial Electronics by Colin D. Simpson,, 1st Edition, 1996.
3. Electronics Devices by Thomas L Floyd, 9th Edition, 2011

Engineering Drawing and Graphics 1 (0, 1)

Objective:

To familiarize the students with the basic concepts of engineering drawing and graphics.

Contents:

Introduction. Types of lines, lettering, dimensioning, drawing instruments, planning of drawing sheet. Orthographic projections, plane of projections, projection of straight lines, traces of a line, true length of a line, inclination to both the planes, projection of oblique and auxiliary planes. Loci of Points and Generated Curves. Development of Solids. Intersection of Surfaces. Intersection of solids. Axonometric Projections. Types, Isometric projections of solids, planes, typical examples. Projection in Auxiliary Planes. Auxiliary planes and views, projection of points, line, plane. Projection of Solids, development of surfaces.

Recommended Books:

1. Engineering Drawing and Graphics by T. E. French, C. J. Vierck, R. J. Foster, 1993.
2. Practical Geometry & Engineering Graphics by Abbot, 1989.

3. Technical Drawing with Engineering Graphics, by Giesecke F. E., Mitchell A, Spencer, H C, 15th Edition, 2016.

4. Engineering Drawing, by N D Bhatt, 53rd Edition, 2014.

3. Engineering Graphics by Craft, Meyers & Boyer, 1989.

Machine Design & CAD 3 (2, 1)

Pre requisites: Engineering Drawing and Graphics

Objectives:

The course equips the students by providing strong inter-relationship with machines, their system of operations and the types of material used for any particular work, keeping in view the component design/manufactured

should be durable and economical in cost and also meet the other requirements.

Contents:

Introduction: Design methodology, design standards, design and safety, Stress concentrations

Design of Shafts, pulleys, belts, keys, cotters, couplings, Welded and riveted joints. Design of various bearing

Fundamentals of CAD:

Introduction, the design process, application of computers for design, creating the manufacturing data base, benefits of CAD.

Recommended Books:

1. Shigley's Mechanical Engineering Design, by Richard Budynas, Keith Nisbett, 10th Edition, 2014.

2. Design of Machine Elements, by Spotts, M.F. Shoup, T.E., Hornberger, L.E., Jayram, S.R. and Venkatesh, C.V.,", Pearson Education, 8th Edition, 2003.

3. Machine Design, by R L Norton, 2013.

Suggested Lab:

Use of AutoCad/ Solidworks/ProE.

Workshop Practice 2 (0, 2)

Objective:

The main focus is to be hands-on training of Workshop practice namely Machine shop including CNC, Wood working, fitting shop, fabrication & foundry etc.

Contents:

Basic Processes in Fitter Shop, Bench-fitting practice; Exercise in marking and fittings, Basic Processes in Wood Work Shop, Use of carpenter's tools; Exercises in preparing simple joints; Use of measuring instruments.

Basics of Electric Shop, Functions of Forge & Foundry Shop, Machine Shop, Soldering, Brazing and Welding. Smith's forge; Exercise in bending, upsetting and swage. Heat treatment, Moulding and casting. Simple machine shop processes, such as turning, shaping, milling, Introduction to CNC Machines.

Recommended Books:

1. Workshop Technology Part 1-6 by W. A. J. Chapman, 5th Edition, 1985
2. Workshop processes, Practices and Materials by Bruce J. Black, 3rd Edition, 2004

Production Planning and Control 3(2, 1)

Prerequisites: *Operations of Manufacturing Systems*

Objective:

The course enables the students to use various forecasting methods & their applications, different production planning models & capacity requirement planning.

Contents:

Forecasting methods and their applications to various industrial and management problems, Analysis and design of production and scheduling control systems, machine sequencing, Flow shop, Job shop, Open shop, Algorithms for production planning and re-planning, Stochastic inventory models, Aggregate planning, Capacity requirements planning, Introduction to mixed production models.

Recommended Books:

1. Operations Management: Sustainability and Supply Chain Management by Heizer, Render and Munson, 12th Edition, 2017.
2. Principle of Production Control by J. L. Burbige, 2nd Edition, 1978.
3. Manufacturing Planning & Control by Vollmann, William Berry & Whybark, 4th Edition, 1997.
4. Factory Physics by Hopp & Spearman, 3rd Edition, 2011.

Suggested Labs:

Hands on work using any relevant software.

Work Study and Methods Engineering 3 (2, 1)

Prerequisites: Production Systems Design

Objective:

Course gives fundamental concepts and techniques to analyze the work and find ways to improve the methods used.

Contents:

Introduction to work analysis and design, Methods engineering: study of the basic work measurement techniques, applications and limitations of the stop-watch time study, learning curve, Development and use of process flow charts, pre-determined motion time studies (PMTS), micro motion analysis, Human factors underlying the design of specific human-machine systems, Techniques of work optimization, energy expenditure and bodily functions.

Recommended Books:

1. Time and Motion Study What, Why and How-to by Jack Greene, 2011.
2. Time and Motion study by I. L. O.,
3. Work Systems: The Methods, Measurement and Management of Work by M P Groover, 2016.
4. Motion and Time Study: Design and Measurement of Work by Ralph M. Barnes, 7th Edition, 2009.

Suggested Labs:

1. Study through videos
2. Study of simple assembly operations
3. Estimation of process duration through PMTS
4. Development and use of process flow charts
5. Any other lab on discretion of the instructor.

Materials Engineering 4 (3, 1)

Objective:

To familiarize the students with various industrial materials, their properties and structural changes during manufacturing processes.

Contents:

Types of materials, crystalline & amorphous materials, Solid solutions and phase diagrams, application of materials. Ferrous and Non-Ferrous Metals and alloys, their major properties and their heat treatment. Ceramics, Glasses, Rubbers & Refractory Materials, Polymers, Composites, Environmental Degradation, corrosion. Indigenous materials.

Recommended Books:

1. Basic Principles of Material Engineering by William F. Smith.
2. Fundamentals of material science and engineering: An integrated approach by W. D. Callister and D. G. Rethwisch, 5th Edition, 2015.

Suggested Labs:

Lab work to expose students to micro and macro examination of materials including sample cutting, grinding, polishing, mountings, heat treatment, study of micro structure, determination of grain size and phase analysis.

C). MAJOR BASED CORE (BREADTH)**Industrial Facilities Design 3 (2, 1)**

Prerequisites: *Work Study and Methods Engineering, Production Planning and Control*

Objective:

To enable the students to understand facility design, Material handling equipment analysis, warehousing, layout and location and flow of material, Exposure to relevant computer software.

Contents:

Location and Site selection, Facility design stages, processes, material handling equipment and analysis, Area allocation and space requirements, Flow analysis, fabrication of individual parts, total plant flow, Plant layout, Utilities Layout, Computerized facility layout and location, layout algorithms like CRAFT, ALDEP, CORELAP etc, Strategies for storages.

Recommended Books:

1. Manufacturing Facilities: Location, Planning & Design by D. Sule, B.W.S.-Kent , 3rd Edition, 2008.
2. Location Theory and Decision Analysis: Analytics of Spatial Information Technology, by Yupo Chan, 2nd Edition, 2011.
3. Facilities Planning by Tompkins, White, Bozer & Tanchoco, 4th Edition, 2010.

Suggested Lab:

Hands on experience using relevant computer software

Manufacturing Processes 4 (3, 1)

Prerequisites: *Workshop Practice*

Objective:

An analysis course that enables the students to recognize the strong interrelationships between material properties and manufacturing processes.

Contents:

Basic concepts of manufacturing processes, Casting processes, Furnaces, Forming and Joining processes, Welding, Brazing and soldering, Adhesive bonding, Traditional and non-traditional machining operations, capabilities and limitations, Rapid prototyping operations, Manufacturing of parts using polymer, composite and powder metallurgy, Process selection.

Recommended Books:

1. Manufacturing Processes for Engineering Materials by S Kalpakjian and S R Schmid, 6th Edition, 2016.
2. DeGarmo's Material & Processes in Manufacturing by Black and Kohser, 2013.
3. Materials and Designs: The art and science of material selection in product design by M. F. Ashby and K. Johnson, Butterworth and Hienmann, 3rd Edition, 2014.
4. Principles of Modern Manufacturing by M. P. Groover, 5th Edition (SI), 2014.
5. Introduction to Manufacturing Processes by John Schey, 3rd Edition, 1999.

Suggested Labs:

1. To Study various Safety Rules for Machining Shop.
 2. To Study the Different Materials, their properties and uses in Metal Cutting.
 3. To Study various parts and cutting tools used for a Lathe Machine.
 4. To Study Various Operations that can be performed on a Lathe Machine.
 5. To Make a *Screw Jack* (or some other component) according to given dimensions using different machining operations such as Turning, Facing, Threading, Knurling etc.
 6. To Study and perform various welding processes such as Oxyacetylene gas welding and cutting , Electric Arc welding, Spot welding etc.
 7. To Study and perform Non Traditional Machining (NTM) operations such as Electrical discharge machining (EDM) and Wire EDM etc.
 8. Make a check list of the findings related to manufacturing of parts from given drawing
 9. Develop a process plan for the given parts (machined, sheet metals, casting etc.)
- Calculate the blank size of the given sheet metal part.

Instrumentation and Control 4 (3, 1)**Objectives:**

Through problem solving and laboratory practice, this course provides a foundation in continuous-time linear control system theory. Further to that it provides a basic understanding of various gauges, transducers and a rationale for their selection.

Contents:

Basic concepts, characteristics, functions of instruments especially for indicating and recording, length, weight, volume, temperature, pressure, flow level, etc. Measuring errors and calibration.

Introduction to the principles of automatic control systems encountered in Mechanical Engineering; Open-loop and closed loops systems. Control Modelling: Block diagrams, transfer functions, Laplace transforms, root locus, Bode diagram Frequency response.

Design parameters: Response Time, relative stability, Overshoot, settling time etc. Classical control systems modelling Temperature, speed, level, flow, proportional, integral and derivative controls, mode of operation of hydraulic, pneumatic, and electrical components, amplifiers servomotors, process controllers, regulating valves, position transducers, Programmable Logic Controllers.

Recommended Books:

1. Feedback Control of Dynamic Systems by Gene F. Franklin, J. David Powell and Abbas Emami-Naeini, Global Edition, 2014.
2. Modern Control Systems by Richard C. Dorf and Robert H. Bishop, 13th Edition, 2017.
3. Instrumentation by Franklyn W. Kirk, Thomas A. Weedon and Phillip Kirk, 5th Edition, 2010.
4. Modern Control System by Ogata, 5th Edition, 2010.

Suggested Lab:

1. To draw the characteristics of temp measuring sensor (RTD, IC, TC, STT)
2. To draw the characteristics of light intensity measuring device (Photovoltaic, Photodiode, Photocell, Phototransistor)
3. To draw the characteristics of position sensing device (potentiometer)
4. To control the Position of a system (open loop, closed loop)
5. To control the Speed of a system (open loop, closed loop)
6. To Study the effects of Proportional, Integrative and Derivative Components on the Automatic Level Control System
7. PID control of Flow rate: Familiarization with the plant
8. Familiarization with Analogue Servo Trainer and Preliminary Procedures for Operation.
9. Parameter Determination of the Modular Servo System: Gain verification and summarization
10. Use of MATLAB/SIMULINK software for Modelling of open and close loop systems.

Production Systems Design 4 (3, 1)

Prerequisites: *Manufacturing processes*

Objectives:

To familiarize the students with the analysis and design of manufacturing systems.

Contents:

Introduction to Lean Manufacturing, Manufacturing automation fundamentals and strategies, High volume manufacturing systems, Flow lines, Assembly lines, Automated material handling and storage systems, Process planning, Group technology, Cellular manufacturing systems, Computer networks of manufacturing, Computer integrated manufacturing systems, Flexible manufacturing systems, Modelling of manufacturing systems.

Recommended Books:

1. Automation, Production Systems and Computer Integrated Manufacturing by M. P. Groover, Global Edition, 2016.
2. Systems Engineering and Analysis, by Benjamin S. Blanchard and Wolter J. Fabrycky, 5th Editions, 2010.

Suggested Lab:

1. Working applications of switches, sensors, encoders, servo and stepper motors, speed controller and PID controller
2. Use of Manufacturing System Simulation Software.

Operations of Manufacturing Systems 4 (3, 1)

Prerequisites: *Introduction to Engineering Management*

Objective:

The course aims at material requirements, resource planning and inventory management. The course enables the students to apply the acquired knowledge in real situations.

Contents:

Inventory Control, Material requirement planning, Manufacturing resource planning, Enterprise resource planning, Just in time, Total quality manufacturing, Factory dynamics, Push, Pull and hybrid systems, Inventory control in supply chain.

Recommended Books:

1. Factory Physics by Hopp & Spearman, 3rd Edition, 2011.
2. Production and Operations Analysis by Steven Nahmias, 7th Edition, 2015

Suggested Labs:

Tutorials & Case Studies on Inventory Control, MRP, Just in Time, Internal bench marking, CONWIP production lines and supply chain.

D). MAJOR BASED CORE (DEPTH)

Environment, Maintenance and Safety 3(3, 0)

Prerequisites: Human Factors Engineering, Operations of Manufacturing Systems

Objectives:

To up keep the plant and machines by removing every type of trouble and providing safe atmosphere in the organization to improve productivity and to enhance the efficiency and economy of the organization

Contents:

Environment pollution, Air emission management, Waste management, Waste water treatment and control, Soil and ground water protection, Introduction to Pakistan Environment Protection Act 1997 and National Environmental Quality Standards, Key elements of ISO 14000.

Importance of plant maintenance, factors influencing the maintenance, Considerations in designing plant maintenance, Economic aspects of maintenance, care and maintenance of common industrial equipment (like bearings, piping, filters, pumps, compressors, and lubricating systems), maintenance linkage to safety, Different systems/types of maintenance, Laws of Accident Proneness, Accidents preventions. Legal, humanitarian & economic reasons to Prevent Accidents, Safety Measures, Analysis & Procedures, Safety equipment, OHSAS 18000.

Recommended Books:

1. Maintenance Manager's Standard Manual by Thomas A. Wester-Kamp, 2013.
2. A Guide to Effective Industrial Safety by Jack W. Boley, 1977.
3. ISO 14000: the Business Manager's Complete Guide to Environmental Management by Perry Johnson, 1997.
4. Maintenance for Industrial Systems by Ricardo Manzini, Alberto Regattieri, 2010.
5. Introduction to Health and Safety at Work by Phil Hughes, 5th Edition, 2011.

Human Factors Engineering 3 (2, 1)

Prerequisites: Work Study and Methods Engineering

Objective:

The course enables the students to understand and analyze man-machine interaction, including an introduction to the relevant underlying human sciences.

Contents:

Introduction to Human Factors Engineering, Human Characteristics relevant to ergonomics. Information on Human Role in Artificial Intelligence, information by text, graphics and symbols. Anthropometry, Anthropology, Principles of workplace design, Equipment and work space, Failure of design, Climatic Factors, Noise and Vibration, Effects of noise on various organs and their prevention,

visibility (Illumination, contrast, quality, colour etc.) and its effects, Basic concepts of Human Error detection and reduction. The role of controls in advanced technology, Control devices.

Recommended Books:

1. An Introduction to Human Factors Engineering by John D. Lee. And Christopher D. Wickens, 2017.
2. Hand-Book of Industrial Engineering: Technology and Operations, by Salvendy G.,2001.
3. Human Factors Engineering & Design by Sanders & Mc Cormick, 1993
4. Evaluation of Human Work by John R. Wilson and Sarah Sharples, 4th Edition, 2015.

Suggested Labs:

1. Study of various types of workplaces
2. Noise measurement at different places
3. Illumination measurement at different places
4. Any other lab on discretion of the instructor.

E). INTER-DISCIPLINARY ENGINEERING BREADTH (ELECTIVES)

Introduction to Thermo-Fluids 4 (3, 1)

Objectives:

To introduce basics of thermodynamic properties, laws of thermodynamics and their application to power and refrigeration cycles. Introduction of basic modes of heat transfer. Formulation of basic equations for Fluid Engineering problems. To determine the friction energy loss for various pipes/ducts geometries and Fluid engineering applications. Introduction to hydraulic machinery.

Contents:

Introductory concepts & definitions, using energy and the laws of thermodynamics, evaluating properties, Control Volume analysis using energy, Second law of thermodynamics, Vapour power and refrigeration systems, Brayton and Rankine cycles, Regeneration cycles. Psychometric Applications. Modes of heat transfer and their rate equations, Fluids and their properties, Fluid Statics, Pressure measurement: Bourdon pressure gauge, Manometers, Forces on a plane area and curved surfaces. Kinematics of fluid flow: Laminar and Turbulent flow, Flow through pipes: loss of head due to friction in pipes, Moody Charts. Introduction to hydraulic machinery.

Recommended Books:

1. Fundamentals of Engineering Thermodynamics by Michael J. Moran and Howard N. Shapiro, 8th Edition, 2015.
2. Introduction to thermal systems engineering: Thermodynamics, fluid Mechanics and heat transfer by Michael J. Moran, Howard N. Shapiro, Bruce R. Munson, 2003.

3. Fundamentals of Fluid Mechanics by Bruce R. Munson, Donald F. Young and Theodore H. Okiishi, 2012.

Suggested Lab:

- 1) Determination of time constants of various temperature measuring devices
- 2) Study of Ideal Vapour-Compression Cycle
- 3) Study of Rankine Cycle
- 4) Study of Bryton Cycle
- 5) Hydrostatic pressure on submerged plane
- 6) Differential pressure measurements using various manometers
- 7) Reynolds experiment (laminar and turbulent flow)
- 8) Flow from orifice in the side of a tank (Bernoulli's Equation)
- 9) Flow measurement with Venturi meter
- 10) Conservation of momentum (Impact of a Jet)
- 11) Pressure loss calculations in pipe networks
- 12) Conductive heat transfer rate calculations.
- 13) Determination of heat transfer rate in free convection
Determination of heat transfer rate in forced convection

Design of Experiments 3 (3,0)

Prerequisites: *Probability and Statistics*

Objective: The course enables the students to understand modern techniques based on statistical analysis and apply those to improve productivity & quality.

Contents:

Introduction to design of experiments and its applications in industry, Hypothesis testing on means and variances, Analysis of variance, fixed and random effects models, error analysis, Block designs, randomized complete and incomplete block design, Latin square design, factorial design, fixed, random and mixed factors designs, Introduction to response surface methodology. Packages like Minitab & Design Expert can be used.

Recommended Books:

1. Design and Analysis of experiments, by Douglas C. Montgomery, 8th Edition, 2012.

2. Experiments: Planning, Analysis and Parameter design Optimization, Wu and Hamada, 2nd Edition, 2009.

Suggested Labs:

1. Comparison of results of paired t-test with those from pooled and un-pooled variance for a given data set.
2. Coding/ scaling of variables while designing an experiment.
3. Validation of modeling assumptions (normality, constant variance, randomness).
4. Transformation and its effect on the validity of modelling assumptions.
5. Blocking of a nuisance variable.
6. Performing full factorial and fractional factorial analyses and comparison of coefficients by undoing the confounding effect.
7. Contrast formulation and comparisons.
8. Applications of nested design.

F). INTER-DISCIPLINARY ENGINEERING (DEPTH ELECTIVES)

Computer Integrated Manufacturing (CIM) 4 (3, 1)

Prerequisites: CAM, Industrial Facilities Design

Objective:

To expose the students to CIM in general and SME in Specific. The course would make students apply CIM to the local environment and establish strategic alliance in top management support.

Contents:

Introduction to Computer Integrated Manufacturing, components of CIM system, CIM modelling, data flow diagrams and IDEF models, Integration of interconnected networks, computer network protocols, integrated approach to CIM justification and optimization, assessing the impact of investment in CIM, a decision support system for CIM investment, guidelines for implementing CIM, Application of CIM System in small & medium enterprises (SMEs),

Recommended Books:

1. Automation, Production Systems, and Computer Integrated Manufacturing by Groover Mikell, Global Edition, 2016.
2. Computer Integrated Manufacturing by James A. Rehg and Henry Kraebber, 3rd Edition, 2004.
3. CIM justification and optimization by Lin and Nagalingan, 1st Edition, 1999.

Suggested Lab:

- 1) Part programming on CNC machines
- 2) Part storage/retrieval programs and applications
- 3) Automated part identification
- 4) Part handling by robots and AGV
- 5) Use of CMM
- 6) Simulation of CIM
- 7) IDEF models development
- 8) Study of a decision support system

Virtual Reality 4 (3, 1)

Prerequisites: Computer Simulation, Manufacturing Systems

Objectives:

To familiarize the students with the world of virtual manufacturing and enable them to apply the knowledge where real manufacturing facilities are not available (academic level).

Contents:

Virtual reality applications in manufacturing systems design, manufacturing applications of networked virtual reality, virtual reality modelling of occupational safety engineering. Manufacturing systems design optimization using virtual environments, optimization of manufacturing decision support using virtual reality interfaces, analysis and evaluation of virtual environments.

Recommended Books:

1. Virtual and Augmented Reality Applications in manufacturing by Ong, S. K. and Nee, A. Y. C, 2013.
2. Introductory Techniques for 3D computer vision by Trucco, E. and Verri, A., 1st Edition 1998.

Suggested Lab:

1. The working of manufacturing and automation modeling using CAD/CAM and computer-integrated manufacturing methods
2. Working of Virtual CIM Laboratory
3. Working of industrial robots in virtual environment
4. Working of highly automated manufacturing system/factory in virtual environment
5. Study the operation of automated manufacturing systems in virtual environment
6. Virtual reality modeling of occupational safety engineering

Metal Forming and Cutting Analysis 4 (3, 1)

Prerequisites: Manufacturing Processes

Objective:

The course aims to give the students the basic understanding of forming and machining processes. Students will learn how to classify the processes, effect of tool material and tool geometry. Exposure to design of jigs and fixtures.

Contents:

Objectives of Metal Forming Processes, Classification of processes, Sheet metal formability, Analysis of bending, Drawing; Rolling, Extrusion and Forging Processes, Evaluation of machining performance and its optimization, Objectives of metal cutting processes, Cutting mechanisms, Material removal operations, Cutting tool materials and geometry, Effects of different cutting parameters on tool life and cutting forces, Tool design, Jigs and fixtures design.

Recommended Books:

1. Manufacturing Engineering & Technology by Kalpakjian & Schmid, 7th Edition, 2013.
2. Metal forming: Mechanics and Metallurgy, W. F. Hosford, R. M. Caddell, 4th Edition, 2014.
3. Fundamentals of Metal Machining and Machine Tools by W. A. Knight and G. Boothroyd, 3rd Edition, 2005.
4. Principles of Metal Manufacturing Processes by J. Beddoes, M. Bibby, 1st Edition, 1999.
5. Manufacturing Processes 4: Forming by F Klocke, 2013.
6. Mechanical Metallurgy by G. E. Deiter, 3rd Edition, 1986.

Suggested Labs:

1. To Study various Safety Rules for a Machining Shop.
2. Transformation of given Specimen into the Shape through Machine as per given Specification using different material removal processes.
3. To analyse wear patterns on different types of tools (lathe, Milling, drilling etc.) using tool makers (or any type of available) microscope.
4. To perform different type of sheet metal shearing/bending operations (Punching, Piercing), Blanking, Notching, Perforating, Slitting, v-bending, edge bending etc.) using power (any type of available) press

Tool and Die Design 4 (3, 1)

Prerequisites: Mechanics of Materials

Objective: This course would familiarize the students with: Jigs and Fixtures, Dies for various sheet metal operations, Fixtures for welding and riveting

Contents:

Tool and die design, Tool materials, Work holding principles, Jigs and Fixtures design, Tools for inspection and gauging, Forming and drawing tools, Tool design for joining processes, Computers in tool design. Terminology for press working operations, Mechanical, hydraulic and pneumatic presses, Design of piercing, Blanking and shearing dies, Design of bending, forming and drawing dies, Design of Plastic injection dies, dies for pressure die casting.

Recommended Books:

1. Fundamentals of Tool Design, Society of Manufacturing Engineers, J. Nee (Editor), 6th Edition, 2010.
2. Die Design Fundamentals by B. Boljanovic, 2005.
3. Jig and Fixture Design by E. Hoffman, 5th Edition, 2004.
4. Jigs and Fixtures Design Manual by Prakash Hiralal, 2nd Edition, 2004.

Suggested Labs:

1. To Study/survey different metals for making/manufacturing of tools
2. To study different clamping, locating and locking components for jigs fixtures
3. To Study the working of power/hydraulic press.
4. To design a blanking die for a typical part.
5. To study the function of compound dies
6. To Study of Progressive Dies
7. To study the function of different components of an injection mould and their working principles.
8. Designing of Plastic Injection Moulds using CAD software.

Automation and Robotics 4 (3, 1)

Prerequisites: Instrumentation & Control, Production Systems Design

Objective:

The course will enable students to understand control fundamentals, design of control system focusing process control, manufacturing systems, interfacing etc.

Contents:

Process control fundamentals, Relay logic and various control devices, Architecture of programmable logic control units, Introduction to distributed control system (DCS) and SCADA Sensors for industrial processes, D/A and A/D converters, Industrial processes interfacing with micro-processors, practical applications, Introduction to Robotics, Robot anatomy, Robot configuration, accuracy & Repeatability, Robot specifications, end effectors, Kinematics and Dynamics, Characteristics of Robot applications, Robot Cell Design, types of Robot Applications.

Recommended Books:

1. Industrial Automated System: Instrumentation and Motion Control by T. L. M. Bartelt, 2010.
2. Computer Automation in Manufacturing by Thomas O. Boucher, 2013.
3. Automation, Production Systems & Computer Integrated Manufacturing by Mikell P. Groover, 4th Edition 2014.

Suggested Lab:

1. Practicals on various control devices.
2. PLC introduction and Programming (Ladder Diagram)
3. Simulation and Interfacing with Programmable Logic Controller (PLC)
4. SCADA System (Automation Applications)
5. Study and use of Robot for various applications
6. Any other lab on discretion of the instructor.

Reliability Analysis 3 (3, 0)

Prerequisites: Probability and Statistics

Objective:

The course will enable students to analyze failure mode & effects, to optimize reliability and to develop system reliability models.

Contents:

Introduction to Reliability Engineering, Catastrophic failure models and reliability functions, Failure distributions, Failure data analysis, System reliability evaluation techniques, Reliability optimization, Fault tree analysis, Reliability testing; Load-strength interference models.

Recommended Books:

1. An Introduction to Reliability & Maintainability Engineering by C. E. Ebeling, 2nd Edition 2009.
2. Practical Reliability Engineering by P.O Connor and A. Kleyner, 5th Edition, 2012.
3. Reliability in Engineering Design by K. C. Kapur & L. R. Lamberson, 1977.

G). INTER-DISCIPLINARY MANAGEMENT (DEPTH ELECTIVES)

Human Resource Management 3 (3, 0)

Objectives:

To understand the historical evolution of Human Resource Management and the different motivational theories, applications and influences in an organization and to equip students with the process of man power planning, recruitment, industrial relations and administration.

Contents:

Theory and practice of HRM, Work groups and their implications for motivation and job satisfaction, Theories of motivation, Manpower planning, Recruitment and selection process, Training and Development, Appraisal Methods. Principles of wage and salary administration, Job analysis & Description, Job Design, Industrial Relations, Causes of Industrial disputes and their resolutions.

Recommended Books:

1. Managing Human Resources by Wayne Cascio, 10th Edition, 2016.
2. Fundamental of Human Resource Management by De Cenzo and Robbins, 2012
3. Elements of Personnel Management by Pratt, K. J. and Bennett, S. G., 1990.
4. A Guide to the Human Resource Body of Knowledge (HRBoK) by Reed and Ulrich, 2017.

Total Quality Management 4 (3, 1)

Objective:

To make the students understand the philosophy of total quality management and ways of its implementation in the organisation.

Contents:

Understanding quality, commitment and leadership, design for quality, planning for quality, quality system requirements, quality measuring tools and the improvement cycle, Quality assurance, ISO 9001, Six sigma, Kaizen, Balanced score card.

Recommended Books:

1. Total Quality Management with text cases by John S. Oakland, 3rd Edition, 2003
2. Total Quality Management by D.H. Besterfields and C.Besterfield-Michna , 3rd Edition , 2002.
3. Total Quality Management: Key Concepts and Case Studies by D. R. Kiran, 1st Edition, 2016.

Suggested Labs:

Use of Minitab/SPSS/Excel

Logistic & Supply Chain Management 3 (3, 0)

Prerequisites: Production Planning and Control

Objective:

The aim of the course is to help students learn how to develop facility requirement profile and to eliminate the non value added activities.

Contents:

The logistical system of material management, Developing a value based Supply Chain, optimization of Supply Chain, Strategic relationships in logistics, process methodology, Issues concerning marketing channels functions, Determining the facilities requirement profile, Managing logistics facilities. Developing the logistics organization for effective supply chain management, Customer service and Customer retention.

Recommended Books:

1. Managing the Supply Chain: A strategic Prospective by J. L. Gattorna and D. W Walters, 1996
2. Logistic and Supply Chain Management by Martin Christopher, 5th Edition, 2016.
3. Supply Chain Management (Theories & Practices) by R. P. Mohanty, 2005.

Marketing Management 3(3, 0)

Objective:

To understand the intricate relationships of various factors which influence the Marketing Environment and also the determining factors which help in understanding the consumers' behaviour.

Contents:

Role and scope of marketing, classification of marketing activities, needs, wants and demands, exchange process, Customer value & satisfaction, Retaining Customers, Social influence on consumers, Informational influences on consumers, Consumer Behaviour and Market Segmentation, Principal Marketing Strategies, Strategic Alternatives, Selecting the pricing objectives, Factors affecting price sensitivity, Selecting a Pricing Method, Setting Advertising objectives and methodologies.

Recommended Books:

1. Marketing Management by Parag Diwan, 2001.
2. Marketing Management by P. T. Kotler and K. L. Keller, 15th Edition, 2016.

Financial Management 3 (3, 0)

Prerequisites: Managerial Accounting

Objective:

The objective of this course is to introduce to the students the basic tools and techniques required in modern financial management. The course will improve the analytical skills of the future managers.

Contents:

Scope and importance of Financial Management, Functions of Financial Manager, Valuation, Ordinary, Due and Perpetuity, Amortization of Loan, Bond Valuation, Financial Statements, Trend Analysis, Common size and Index Analysis, Funds Analysis, flow and Funds statement. Sources and Uses of Funds, Working Capital Management, Factors influencing working capital requirements, Cash Management, Motives for holding cash, Speeding up cash receipts, slowing down cash payments, Receivable Management, Credit & Collection policies, Analyzing the credit applicant, Inventory Management and control, Short term Financing. Spontaneous financing, Factoring A/R Capital Budgeting process.

Recommended Books:

1. Fundamentals of Financial Management by J. V. Horn and J. M. Wachowicz, 13th Edition, 2008.
2. Fundamentals of Finance with Microsoft Excel by S. Benninga, H. A. Rehman, Z. A. Wahid, N. Ahmad, 2012.
3. Fundamental of Financial Management by Brigham and Houston, 12th Edition, 2012.
4. Financial Management: Principles and Applications by J. Keown, 12th Edition, 2014.

Managerial Accounting 3 (3, 0)

Objectives:

To train the students to prepare balance sheet, profit and loss statements.

To assess and analyse any business organization financially with the help of financial reports and utilize the resources and assets effectively to make them profitable.

Contents:

Managerial accounting, Money measurement concept, Financial accounting and managerial accounting, Balance sheet, Financial statement, Income Statement, Book keeping, Debit & Credit, Applications to investment decisions, Return on investment, Cash in-flow, Economic life, Rate of return, Investment turnover and profit margin, Tests of investment utilization, Assets and their types, liabilities and owners equity, cost accounting and control, basic frame work of budgeting.

Recommended Books:

1. Managerial Accounting by Ray H. Garrison, Eric W. Noreen and Peter Brewer, 15th Edition, 2014.
2. Managerial Accounting by Jack L Smith, Robert M. Keith & William L Stephens, 1988.
3. Managerial Accounting by Stacy Whitecotton and Robert Libby, 2016.

Entrepreneurship 3 (3, 0)

Objective:

After studying this course the students should be able to evaluate & improve their entrepreneurial potential and be able to generate and test innovative ideas suitable for commercialization.

Contents:

Role of Entrepreneurship in Economic Development, Characteristics of Successful Entrepreneurs, Types of Start-ups. Creativity, Methods of generating innovative ideas. Legal Issues including Patents, Trademarks, Copyrights, Trade Secrets, Licensing, Liability, Insurance, Contracts etc. The Concept of Planning Model, Pre-start-up Stage, Start-up Stage, Early Growth Stage, Later Growth Stage, Fundamentals of a Feasibility Plan. Role of Manufacturing, Products and Technology, Identifying Opportunities.

Recommended Books:

- 1) Entrepreneurship. by Hisrich, Peters & Shepherd, 8th Edition, 2009.
- 2) Effectual Entrepreneurship by S. Read, S. Saraswathy, N. Dew and R. Wittbank, 2nd Edition, 2016
- 3) Fundamentals of Entrepreneurship by S. Ariffin, I. A. Wahab, Z. Hambali, 2012.
- 4) Entrepreneurship by Bruce Barringer, 5th Edition, 2015.
- 5) The Financial Times Guide to Business Startups 2017/18: the most Comprehensive Guide for Entrepreneurs by Sara Williams, 30th Edition, 2016.

Management Information Systems 4 (3, 1)

Prerequisites: Introduction to Computing

Objective:

To enable the students to understand the industrial information and retrieval systems, collecting and recording, analyzing and presenting data, data processing technologies, databases and security issues.

Contents:

Analysis, design and implementation of Industrial information and retrieval systems with special emphasis given to manufacturing systems, gathering, recording, analyzing and presenting the data requirements of an organization, Data processing technologies, Databases and their applications, Data protection, Networking, Backup and security.

Recommended Books:

1. Management Information Systems by K. C. Laudon & J. P. Laudon, 4th Edition, 2015
2. Management Information System by Terrence Lucy, 9th Edition, 2005.

Suggested Lab:

Use of Microsoft Access to create databases

Organizational Behaviour 3 (3, 0)

Prerequisites: Human Resource Management

Objective:

To make the students aware of organizational structures and work environment.

Contents:

Organizational behaviour with reference to global and cultural diversity. Behaviour and perception of individuals, Attitudes and job satisfaction, Basic motivation concept, Group behaviour, Team work, Communication, Leadership, power and Politics, Conflict and negotiations, Organization structure, Technology, Work design and stress management, Approaches to managing organizational change.

Recommended Books:

1. *Organizational Behaviour by Robbins*; Stephen R, 2005.

H). NON-ENGINEERING DOMAIN

HUMANITIES

English-I (Functional English) 3 (3, 0)

Objectives:

To enhance language skills and develop critical thinking

Course Details:

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:

a) Grammar

1. Practical English Grammar by A. J. Thomson and A. V. Martinet. Exercises. Third edition. Oxford University Press. 1997. ISBN 0194313492
2. Practical English Grammar by A. J. Thomson and A.V. Martinet. Exercises. Third edition. Oxford University Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Françoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.

c) Reading/Comprehension

1. Reading. Upper Intermediate. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 453402 2.

d) Speaking

English II (Communication Skills) 3 (3, 0)

Objectives:

To enable the students to meet their real life communication needs

Course Details:

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:

a) Grammar

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2. Third edition. Oxford University Press 1986. ISBN 0 19 431350 6.

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills.

Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).

2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).

c) Reading

1. Reading. Advanced. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills. Third Impression 1991. ISBN 0 19 453403 0.

2. Reading and Study Skills by John Langan

3. Study Skills by Richard Yorke.

English III

(Technical Report Writing and Presentation Skills) (3, 0)

Objectives:

To enhance language skills and develop critical thinking

Course Details:

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 and presentation

Note: Extensive reading is required for vocabulary building

Recommended Books:

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992. ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.
3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

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 Scharon. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

Engineering Economics 3 (3, 0)

Objective:

The course would expose students to Engineering Economy techniques, primarily related to performing analysis, synthesizing and coming to a conclusion on projects of all sizes covering a wide range of engineering oriented examples.

Contents:

Introduction to engineering economics, Micro and macroeconomics, Break even analysis, Balance sheet, Cost and investment analysis, Basis for comparison of alternatives, Time value of money, Decision making in present economy, Evaluating replacement alternatives, Cash flow, Interest formulas and equivalence, Depreciation, Economic analysis of operations, Economic analysis of projects.

Recommended Books:

1. Engineering Economy by Leland T. Blank, Anthony J. Tarquin McGraw-Hill

2. Fundamentals of Engineering Economics (2nd Edition), Chan S. Park, Pearson Education.
3. Engineering Economy (15th Edition) by William G. Sullivan, Elin M. Wicks and C. Patrick Koelling, Pearson Education.

Logic and Critical Thinking 3 (3, 0)

Objective:

The primary objective of this course is to impart a functional ability to reason well; to improve analytical skills and instincts, familiarizing with elementary methods of argument composition, analysis and reasoned decision making.

Contents:

The Power of Critical Thinking

- o Claims and Reasons, Reasons and Arguments, Arguments in the Rough

The Environment of Critical Thinking

- o Perils of Haunted Mind, Self and the Power of the Group, Subjective and Social Relativism, Scepticism

Making Sense of Arguments

- o Arguments Basics, Patterns, Diagramming Arguments, Assessing Long Arguments,

Reasons for Belief and Doubt

- o Conflict Experts and Evidence, Personal Experience, Fooling Ourselves, Claims in the News

Faulty Reasoning

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

Unacceptable Premises

- o Begging the Question, False Dilemma, Slippery Slope, Hasty Generalization, Faulty Analogy

Deductive Reasoning: Propositional Logic

- o Connectives and Truth Values, Conjunction, Disjunction, Negation, Conditional, Checking for Validity, Simple Arguments, Tricky Arguments, Streamlined Evaluation

Deductive Reasoning: Categorical Logic

- o Statements and Classes, Translations and Standard Form, Terms, Quantifiers, Diagramming Categorical Statements, Sizing up Categorical Syllogisms

Inductive Reasons

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

Inference to the Best Explanation

o Explanations and Inference, Theories and Consistency, Theories and Criteria, Testability, Fruitfulness, Scope, Simplicity, Conservatism

Judging Scientific Theories

o 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

Recommended Books:

1. Vaughn Lewis, 2005, The Power of Critical Thinking, Oxford University Press.
2. Paulsen David W., Cederblom Jerry: 2000, Critical Reasoning, Wadsworth
3. Restall Greg. 2005, Logic: An Introduction, Routledge

Numerical Analysis and Computer Applications 3 (2, 1)

Prerequisites: *Probability & Statistics, Introduction to Computing*

Objective:

To enable the students to apply their knowledge of calculus for solving such mathematical problems that cannot be solved using analytical techniques.

Contents:

Finite differences and operators form, Interpolation and extrapolation; Lagrange's interpolation, Numerical differentiation based on differences, Numerical integration: Trapezoidal and Simpson's approximations, Romberg integration process, Numerical Solution of non-linear equations; Bracketing and iteration methods, Direct solution of system of linear equations; Gauss-elimination, Direct and indirect factorization, symmetric factorization, tri-diagonal factorization, Iterative methods like Jacobi's iteration and Gauss-Seidel iteration, Single and Multi-step methods, Higher order differential equations, System of differential equations, Numerical solution of linear and nonlinear boundary value problems.

Some of the computer experiments are listed below. The concerned faculty members may add or remove experiments.

Environment pollution, Air emission management, Waste management, Waste water treatment and control, Soil and ground water protection, Introduction to Pakistan Environment Protection Act 1997 and National Environmental Quality Standards, Key elements of ISO 14000.

NAME OF THE EXPERIMENT

1. To find the roots of non-linear equation using bisection method and fixed point iteration procedures.
2. To find the roots of non-linear equation using Newton's method and secant method.

3. To solve the system of linear equations using Gauss elimination method and Gauss-Jordan method
4. To integrate numerically using trapezoidal rule and Simpson rule.
5. To integrate numerically using Romberg integration and Gaussian quadrature
6. Implementation of Lagrange interpolation with different degree polynomials
7. Implementation of Newton's divided difference formulas
8. Curve fitting by least – square approximations.
9. To find the largest eigenvalue of a matrix by Power - method.
10. Implementation of Euler method and modified Euler method
11. Implementation of Runge Kutta methods of order 2 and 3
12. Implementation of Adam Bashforth two steps and three steps methods
13. Implementation of Adam Bashforth four steps methods
14. Implementation of Adam Multon two steps and three steps methods
15. Performance comparison of implicit and explicit multi-steps and single step methods
16. Preparation of lab report

Recommended Books:

1. Numerical Methods for Engineering, Science and Mathematics by Mumtaz Khan
2. Ordinary & Partial Differential Equations with Numerical Techniques for Engineering, Science and Mathematics by Mumtaz Khan.
3. Numerical Methods for Engineers and Scientists by N C Chappra, McGraw Hill.

Pakistan Studies 2 (2, 0)

Objectives:

- To develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideological background of Pakistan.
- To study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Contents:

1. Historical Perspective

- a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
- 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: 1947-58, 1958-71, 1971-77,

1977-88, 1988-99, 1999 onward

3. Contemporary Pakistan

Economic institutions and issues, Society and social structure, Ethnicity, Foreign policy of Pakistan and challenges, Futuristic outlook of Pakistan

Recommended Books:

1. Burki, Shahid Javed. *State & Society in Pakistan*, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. *Issue in Pakistan's Economy*. Karachi: Oxford University Press, 2000.
3. S.M. Burke and Lawrence Ziring. *Pakistan's Foreign policy: An Historical analysis*. Karachi: Oxford University Press, 1993.
4. Mehmood, Safdar. *Pakistan Political Roots & Development*. Lahore, 1994.
5. Wilcox, Wayne. *The Emergence of Banglades.*, Washington: American Enterprise, Institute of Public Policy Research, 1972.
6. Mehmood, Safdar. *Pakistan Kayyun Toota*, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.
7. Amin, Tahir. *Ethno - National Movement in Pakistan*, Islamabad: Institute of Policy Studies, Islamabad.
8. Ziring, Lawrence. *Enigma of Political Development*. Kent England: WmDawson & Sons Ltd, 1980.
9. Zahid, Ansar. *History & Culture of Sindh*. Karachi: Royal Book Company, 1980.
10. Afzal, M. Rafique. *Political Parties in Pakistan*, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.
11. Sayeed, Khalid Bin. *The Political System of Pakistan*. Boston: Houghton Mifflin, 1967.
12. Aziz, K. K. *Party, Politics in Pakistan*, Islamabad: National Commission on Historical and Cultural Research, 1976.
13. Muhammad Waseem, *Pakistan Under Martial Law*, Lahore: Vanguard, 1987.
14. Haq, Noor ul. *Making of Pakistan: The Military Perspective*. Islamabad: National Commission on Historical and Cultural Research, 1993.

Islamic Studies/Ethics 2 (2, 0)

Objectives:

The course is to enhance vision and facilitate application of Islamic ideology in the real world. The student should be able to find solutions to problems within Islamic practices comfortably instead of alien. Know how a Muslim could essentially use Islamic tools in the world and earn eternal peace as grater value assumption.

Contents:

(A) ISLAMIC STUDIES (For Muslims)

QURAN SHARIF.

Fazail Quran (Importance of Quran) as the ultimate source of knowledge for the betterment of mankind.

Importance of Sunnah, as practical demonstration of Al-Quran and Huqooq-ul-Ibaad.

DEEN-E-ISLAM.

Tauheed, Risalat and Aakherat for eternal peace of mankind.

Concept of Rizk-e-Halal (verses from Al-Quran) and Professional Ethics in the light of Al-Hadith.

Importance of Prayers, Fasting Zakat, Hajj and Jihad in professional performance.

Uswatul Hassanah as vision for workplace and social environmental improvement

Learning from Makki and Madani life of Prophet Muhammad (SAWW) and Sahaaba as leadership and team for commitment and continuous improvement.

Core policies behind Spreading of Islam اسلام تبليغ and the application of

Philosophical thoughts behind Mithaqe-Madina, ميثاق مدينة Fateh-e-Mecca,

lutajjaH dna حاتف همك حجة الوداع -vida for regional and global relations.

Islamic lawfulness, Heritage, Solutions to humanitarian problems, future, oneness, political solidarity as road map to civic civilization.

Importance of honest character, practicing ways for avoiding of sins according to Islam.

Application of Sidq, صدق Tawakkal, توكل Taqua, تقوى the fulfilment of

promise, ايذاعمل Simplicity, سادگی respect, obedience, equality and the

forgiveness.

(B) Ethics (For Non-Muslims)

Ethical techniques of world religions with special reference to Hinduism, Budhism, Judaism, Christianity and Islam. One hundred ethical presentations from Quran and sayings of the Prophet.

Islam's attitude towards minorities

Promotion of moral values in the society.

A brief review of ethical systems in philosophy

I). MANAGEMENT SCIENCES

Introduction to Engineering Management 3 (3, 0)

Objective:

The course would enable students to widen their knowledge and understanding of a range of current and developing engineering management issues, management principles and practices.

Contents:

The vision and mission of management, The management process and strategy, Strategic management, The planning process, Organization structures, Human factors, Motivation & leadership, Basics elements of control, Managing, designing and new product development, Managing the supply systems, Marketing, introduction to entrepreneurship.

Recommended Books:

1. Managing Engineering and Technology by Babcock and Morse, Prentice Hall
2. Management by Herald Koontz
3. Management by Robbins Coulter
4. ISO-10007 Quality management systems-Guidelines for configuration management.
5. MIL-HDBK-61A (SE) Military handbook-configuration management guidance.
6. MIL-STD 31000 Technical data packages.
7. Engineering Management by Fraidoon Mazda, Pearson.

Project Management 4 (3, 1)

Prerequisites: *Engineering Economics, Introduction to Engineering Management*

Objective:

The course enables the students to understand and implement modern project management techniques (using software) related government regulations.

Contents:

Project management concepts, project proposals and feasibility, initiating, Planning, execution, monitoring and control, closing and Exit strategy, knowledge areas as per PMBOK/PRINCE-2, introduction to any Project Management's Software.

Recommended Books:

1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling by Harold Kerzner, John Wiley

2. Case studies in project management, 2nd edition, by Harold Kerzner, John Wiley

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3. Project Management Body of Knowledge (PMBOK) 4th edition, by P.M.I.

Suggested Labs:

Hands on practice using M.S. Project/Primavera etc.

J). NATURAL SCIENCES

Calculus 3 (3,0)

Objective:

To learn fundamentals of mathematics, calculus and analytical geometry.

Contents:

Complex Numbers, De'Moivre's Theorem, Functions: Hyperbolic, Trigonometric and Exponential Functions, Differentiation and its Application to Rate, Speed and Acceleration, Leibnitz's Theorem, Equations of Tangents and Normals, Curvature, Radius and Centre of Curvature, Maxima and Minima of Function, Convexity and Concavity, Taylor's and McLaurin's Series and Expansion of Functions, Errors and Approximations and Limiting Values of Functions, Partial Differential, Euler's Theorem, Integral Calculus: Standard Integrals, Integration by Substitution, by Partial Fractions and by Parts, Integration of Trigonometric Functions, Definite Integrals, Two and three dimensional integration, Volumes of Solids of Revolution

Recommended Books:

1. Schaum's series, Calculus, Schaum's Series (Latest Edition)
2. Schaum's series, Complex, Schaum's series, (Latest Edition)
3. Antom, H. Calculus and Analytic Geometry, John Wiley and Sons. (Latest Edition)
4. Talpur, Calculus and Analytic Geometry, Feroz Sons (Latest Edition)
5. Yousuf, S. M. Mathematical Methods, Ilmi Kutab Khana (Latest Edition)
6. Mathematics for Engineers by Robert D. Wesley, McGraw-Hill
7. Multivariate Calculus by Robert T. Smith, Roland B. Minton, McGraw-Hill

Applied Linear Algebra 3 (3, 0)

Objective:

To familiarize the students with vectors, matrices, determinants, linear combinations and spaces and enable them to understand the related Geometry.

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Contents:

Vector Algebra, Matrix Algebra, Determinants, Linear System of Equations, Linear Transformations, Eigen-values and Eigenvectors

Recommended Book:

1. Linear Algebra and its Applications by David C Lay, Addison-Wesley

Differential Equations 3 (3, 0)

Objective:

To introduce basic techniques pertaining to matrices and formulation/solution of differential equations.

Contents:

Ordinary Differential Equations:

Basic concepts of ordinary differential equation, General and particular solutions, Initial and boundary conditions, Linear and nonlinear differential equations, Solution of first order differential equation by separable variables and its applications in our daily life situations, The techniques like change of variable, homogeneous, non-homogeneous, exact, non-exact, linear and nonlinear Bernoulli could be used in case of complications. Solution of second order differential equation by theory of operators and its applications as forced and free oscillations, The extension of second order solution criteria to higher order differential equations, Solution of the system of differential equations by theory of operators and its applications in our daily life situations, Laplace solution of ordinary differential equations.

Partial Differential Equations:

Basic concepts, Linear and nonlinear p.d. equations, Quasi linear and Quasi nonlinear p.d. equations, Homogeneous and non-homogeneous p.d. equations, Solutions of p.d. equations, Boundary and initial conditions as Dirichlet condition, Neumann condition, Robbins/Mixed condition, Classification of p.d. equations as Elliptic, Parabolic and Hyperbolic.

Analytic solution by separation of variables of the Steady-state Two-Dimensional Heat equation/Laplace equation and Unsteady-State One-Dimensional Heat equation/Diffusion equation with homogeneous and non-homogeneous boundary conditions. D' Alembert's solution of two-dimensional wave equation with homogeneous and non-homogeneous boundary conditions.

Fourier series:

Periodic waveforms and their Fourier representations, Calculating a Fourier series, Fourier series of odd and even functions, half range Fourier series, Fourier series solution p.d. equations.

Recommended Books:

1. Modern Differential Equations by Abell and Braselton, McGraw-Hill
2. Advanced Engineering Mathematics by Louis C. Barrett, McGraw-Hill
3. Ervin and Kreyszig, E. Advanced Engineering Mathematics, John Wiley and Sons, (Latest Edition).
4. Speigal M. R., Theory and Problems of Laplace Transforms, Schaum's Outline Series.

Engineering Mechanics 3(2, 1)**CONTENTS:**

Foundations of Mechanics: Fundamental concepts and definitions.

Force Systems: Force, rectangular components, moment, resultant couple (two and three dimensional systems).

Equilibrium: Mechanical systems, isolation and equilibrium conditions for two and three dimensional systems.

Structures: Plane trusses, method of joints, method of sections, frames.

Friction: Types of friction, application of friction in wedges, screws, journal bearings, thrust bearings, flexible belts.

Virtual Work: Introduction, work, virtual displacement and virtual work, principle of virtual work, potential energy and stability.

Recommended Books:

1. Vector Mechanics for Engineers: Statics and Dynamics, by Ferdinand Beer and Johnston, Jr., E. Russell, 2015.
2. Engineering Mechanics (Statics) by R. C. Hibbler, 13th Edition, 2012.
3. Engineering Mechanics Dynamics & Mastering Engineering Package, by Russell C. Hibbeler, 12th Edition, 2009.
4. Engineering Mechanics: Statics by James L. Meriam and L. G. Kraige, 2014.
5. Engineering Mechanics: Dynamics by James L. Meriam and L. G. Kraige, 2015.

Probability and Statistics 3 (3, 0)

Prerequisites: Calculus

Objective:

To develop an understanding of the basic concepts of probability and statistics.

Contents:

Measures of central tendency and dispersion, Moments, Introduction to classical Probability theory, Bayes theorem, Random variables (discrete and continuous), Probability distributions (Normal, Binomial, Poisson etc.), Expectation, Conditional distribution and conditional expectations, Correlation and regression.

Recommended Books:

1. Probability & Statistics for Engineers & Scientists by Walpole, Myers, Myers & Ye, Prentice Hall
2. Engineering Statistics by D. C. Montgomery, John Wiley
3. Business Statistics by Mark L. Berenson and David