# DEPARTMENT OF FUTURES STUDIES

## SCHOOL OF TECHNOLOGY

## UNIVERSITY OF KERALA

**M.Tech PROGRAMME IN TECHNOLOGY MANAGEMENT**
**SYLLABUS**

(Under Credit and Semester System w.e.f. 2017 Admissions

# DEPARTMENT OF FUTURES STUDIES

## SCHOOL OF TECHNOLOGY

### UNIVERSITY OF KERALA

**M.Tech PROGRAMME IN TECHNOLOGY MANAGEMENT**

**AIM:** Technology management is a set of management disciplines that allows organizations to manage their technological fundamentals to create competitive advantage.

**PROGRAMME OBJECTIVES**

To introduce the graduate engineers the basic concepts of:

- technology strategy,
- futuring technology through technology forecasting and modeling ( both quantitative and qualitative),
- operations management,
- technology roadmap,
- technology product portfolio.

## STRUCTURE OF THE PROGRAMME

| Sem No. | Course Code | Name of the Course | Number of Credits |
|---|---|---|---|
| I | Core Courses | | |
| | FUS-C-611 | Foresight and Futures Research | 2 |
| | FUS-C-612 | Technology Forecasting and Assessment | 2 |
| | FUS-C-613 | Systems Analysis and Design | 2 |
| | FUS-C-614 | Computer Applications | 2 |
| | FUS-C-615 | Systems Engineering | 2 |
| | FUS-C-616 | Financial Management and Managerial Decisions | 2 |
| | FUS-C-617 | Management of Innovation | 2 |
| | FUS-C-618 | Operations Research and Decision Theory | 2 |
| | FUS-C-619 | High Level Programming Language Lab | 2 |
| **Total Credits for Semester I** | | | **18** |
| II | Core Courses | | |
| | FUS-C-621 | Combinatorial Optimization | 2 |
| | FUS-C-622 | Modelling and Simulation | 2 |
| | FUS-C-623 | Principles of Technology Management | 3 |
| | FUS-C-624 | IT and its Management | 2 |
| | FUS-C-625 | IPR and Patents: Law, Practice and Consultancy | 2 |
| | FUS-C-626 | Data Analytics Lab | 3 |
| | Internal Electives | | |
| | FUS-E-6211 | Econometrics and Economic Forecasting | 3 |
| | FUS-E-6212 | Total Quality Management | 3 |
| | FUS-E-6213 | Computer Aided Design | 3 |
| | FUS-E-6214 | Environmental Engineering | 3 |
| | FUS-E-6215 | Energy, Ecology & Environment | 3 |
| | FUS-E-6216 | Strategic Management | 3 |
| | FUS-E-6217 | Knowledge Management | 3 |

| | | | |
|---|---|---|---|
| | FUS-E-6218 | Computer Aided Decision Support Systems | 3 |
| | FUS-E-6219 | Intelligent Manufacturing Systems | 3 |
| **Total Credits for Semester II** | | | **17** |
| **III** | Core Courses<br>FUS-C-631 | Research Methodology and Negotiated Studies | 2 |
| | FUS-P-632 | Industrial Project | 3 |
| | FUS-D-633 | Dissertation (Stage I ) | 7 |
| | Internal Electives<br>FUS-E-634 | Intelligent and Knowledge Based systems | 2 |
| | FUS-E-635 | Systems Dynamics Modelling and Applications | 2 |
| | FUS-E-636 | Planning and Management of Human Resources | 2 |
| | FUS-E-637 | IT in Health Care | 2 |
| | FUS-E-638 | Structure and Analysis of Complex Networks | 2 |
| | FUS-E-639 | Introduction to Data Analysis | 2 |
| | FUS-E-6310 | Management Information Systems | 2 |
| | FUS-E-6311 | Bio-Medical Engineering | 2 |
| | FUS-E-6312 | Software Projects Management | 2 |
| | FUS-E-6313 | Parallel Programming with MPI | 2 |
| **Total Credits for Semester III** | | | **14** |
| **IV** | FUS-D-641 | Dissertation (Stage II ) | 16 |
| **Extra Departmental Elective Courses** | | | |
| **I** | FUS-X-611 | Foresight and Futures Research | 2 |
| | FUS-X-612 | Management Information Systems | 2 |
| | FUS-X-613 | Econometrics and Economic Forecasting | 2 |
| | FUS-X-614 | Knowledge Management | 2 |
| **II** | FUS-X-621 | Software Projects Management | 2 |
| | FUS-X-622 | Introduction to Data Analysis | 2 |
| | FUS-X-623 | Parallel Programming with MPI | 2 |

**Codes:** C = Core; E = Elective; P = Project; D = Dissertation; X=Extra Departmental Elective.

**Semester: I**
**Course Code: FUS-C-611**
**Course Title: FORESIGHT AND FUTURES RESEARCH**
**Credits: 2**

**AIM:** This course aims for an exploration of the field of futures studies, with an overview of the futures discipline and giving a base and context for critical thinking about the future.

**OBJECTIVES**

- become familiar with the critical concepts in futures studies
- be capable of greater foresight about emerging issues, trends, impacts, and their implications
- develop communication skills to engage in effective dialogs on the future with the goal of influencing the future
- be familiar with other futures tools and with exploring the implications of change.
- become excited about the field of futures

**COURSE CONTENT**

**MODULE I:** Review futures basics- Become acquainted with key concepts, terms, and perspectives of the futures field.- Introduce some of the publications and organizations in the field and discuss futures skills- Identify the major events and founders in the history of future studies - Discuss what it means to be a futurist- Role of a futurist

**MODULE II:** Six Basic Concepts and six Basic Pillars of Futures Studies- Prominent Futures Schools

**MODULE III:** Environmental Monitoring, Scanning-Identify and monitor key quantities and conditions that indicate whether or not the baseline is occurring -Environmental scanning as the means to keep current on change within a specific domain- Practice environmental scanning and assess how well each scanning hit fits the ideal criteria -Use scanning hits as the empirical support for alternative plausible futures

**MODULE IV:** Creativity- Scenarios -The key concepts, terms, and approaches to creativity- A standard approach to creative problem solving and a variety of other Approaches - Scenario Theory- Key concepts, terms, and criteria of good scenarios-The use of scenarios in professional practice -A review of different ways that people can build scenarios Strengths and weaknesses of various scenario approaches

**MODULE V:** Implications and Opportunity Analysis - Drawing out the implications of scenarios using futures wheels- Identify challenges of specific scenarios for specific domains- Use those challenges to prioritize strategic issues that should be addressed- See change as resulting from trends, events, issues and images- Pick up the weak signals of coming change through environmental scanning - Setting up a good scanning system- Progress/Decline: That social change is generally an improvement of the human condition; or alternatively, that societies have descended from a better period to today. Development:

That social change moves in a definite direction, but that the direction is neutral—not necessarily any better or any worse than the past, just different.

**MODULE VI:** Case Studies on Scenarios and other Futures Techniques

**REFERENCES**


- Bill Ralston & Ian Wilson, *The Scenario Planning Handbook*
- Jerry Glenn & Ted Gordon (eds.), *Futures Research Methodology V3.0*, CD, Washington DC, Millennium Project, 2012.
- Pero Micic, *The Five Futures Glasses,* 2010
- Thomas Chermack, *Scenario Planning in Organizations: How to Create, Use, and Assess Scenarios*, 2011
- Trevor Noble (2000), *Social Theory and Social Change*, New York: St Martin's Press**.**


**ADDITIONAL REFERENCES**


- https://en.wikiversity.org/wiki/Introduction_to_Futures_Studies
- http://www.csudh.edu/global_options/IntroFS.HTML
- https://cals.arizona.edu/futures/

**Semester: I**
**Course Code: FUS-C-612**
**Course Title: TECHNOLOGY FORECASTING AND ASSESSMENT**
**Credits: 2**

**AIM:** The aim the course is to familiarise the students with various methodologies adopted for technology forecasting and assessment and make the students capable of implement them.

**OBJECTIVES**

1. To develop an understanding of the framework and importance of technology forecasting.
2. To gain exposure to concepts and tools used for technology forecasting.
3. To learn how to develop a technology forecasting program for a typical organization.

**COURSE CONTENT**

**MODULE 1:** Introduction to technology forecasting: What Is Technology Forecasting? - Models of Technology Growth and Diffusion - Technology Forecasting in Context - What Makes a Forecast Good? - Common Errors in Forecasting Technology - Why Forecast Technology? Methods of Forecasting

**MODULE II:** Delphi Introduction - Advantages of Committees - Disadvantages of Committees - The Delphi Procédure - Conducting a Delphi Sequence - Variations on Delphi - Guidelines for Conducting a Delphi Sequence - Selecting Delphi Panel Members - Constructing Delphi Event Statements -Forecasting by Analogy: introduction - Problems with Analogies - Dimensions of Analogies - Selecting Analogous Technologies - Measures of Technology: Scoring Models - Constrained Scoring Models

**MODULE III:** Growth Curves: The Pearl Curve - The Gompertz Curve - Comparison of the Pearl end Gompertz Curves - linear – Exponential – Fisher-Pry – Bas Lead-Lag Correlation models - Trend Extrapolation: Introduction - Exponential Trends - Examples- Model for Exponential Growth

**MODULE IV:** Features of technology assessment - Objectives of technology assessment - Distinction between technology assessment and environment impact analysis - Types of technology assessment / environment impact analysis - technology assessment as a map for alternate futures - components of technology assessment - the technology delivery systems - social impact analysis - Limitations of technology forecasts and assessment

**MODULE V:** Simulation: Monte Carlo simulation – system dynamics - cross-impact analysis

**MODULE VI:** Case Studies on Technology Forecasting

## REFERENCES


- Alan Thomas Roper , Scott W. Cunningham, Alan L. Porter, Thomas W. Mason, Frederick A. Rossini, Jerry Banks, *Forecasting And Management Of Technology, John Wiley & Sons, Inc., 2011*
- Ernest Braun: Technology in Context: Technology Assessment for Managers (Management of Technology and Innovation) , Routledge
- Martino, J.P., Technological Forecasting for Decision Making (third edition), MeGraw-Hill, 1993.
- Porter, A.L., A.T. Roper, T. Mason, R. Rossini, T. Roper, J. Banks, Forecasting and Management of Technology, John Wiley & Sons, NY, 1991.
- Sherry R. Arnstein, Alexander N. Christakis Perspectives on technology assessment-, Science and Technology Publishers
- Sullivan, W.G. and W.W. Claycombe, Fundamentals of Forecasting, Prentice-Hall, Reston, VA, 1977.
- Vanston, J.H., Technology Forecasting: An Aid to Effective Technology Management, Technology Futures Inc., Austin, TX, 1998.

**Semester: I**
**Course Code: FUS-C-613**
**Course Title: SYSTEMS ANALYSIS AND DESIGN**
**Credits: 2**

**AIM:** To introduce students to systems analysis and design by making familiarizing them with the different methods and tools to analyze, design and developing information system for an organization that meets the needs of the users.

**OBJECTIVES**
To provide the students with the necessary skills to identify business problems, determine requirements for information systems solutions, and develop designs which form the basis for implementing systems, as well as a foundation in systems analysis and design concepts, methodologies, techniques, and tools.

**COURSE CONTENT**

**MODULE I:** Introduction to Systems Analysis and Design, Information Systems- Building Blocks, Information Systems Development, Roles of systems analyst, Attributes of a Systems Analyst

**MODULE II:** System Development Life Cycle, Structured System Analysis, Project Management, Feasibility Analysis and the System Proposal, Project Scheduling Tools

**MODULE III:** Systems Analysis Design Approaches, Requirements Elicitation Methods, Managing Analysis and Design Activities

**MODULE IV:** Process Modeling: Data Flow Diagrams (DFD), DFD conventions, Leveling of DFDs, Leveling Rules, Logical and Physical DFDs

**MODULE V:** Logic Modeling: Procedure Specifications in Structured English, Decision Tables and Decision Trees for Complex Logical Specifications

**MODULE VI:** Data Modeling: Entity relationship model, E-R diagrams, Relationships cardinality, Normalizing relations, Various normal forms, Database Design - Prototyping, User Interface Design, Systems Construction and Implementation, Systems Operations and Support, Security, Case Studies

**REFERENCES**


- Dennis, Alan, Barbara Wixom, and Roberta Roth. *Systems Analysis and Design-2012, John Wiley & Sons, Inc*., 2012.
- Kendall, K., & Kendall, J., *Systems analysis and design* (9th ed.). Prentice Hall, 2014.
- Satzinger, J. W. R. B. Jackson and S. D. Burd. *Systems Analysis and Design in a Changing World,* 6th ed. Boston, USA: Thomson Course Technology, 2012.
- Whitten, Jeffrey L., and Lonnie D. Bentley. *Introduction to systems analysis and design*. McGraw Hill Irwin, 2008.

**Semester: I**
**Course Code: FUS-C-614**
**Course Title: COMPUTER APPLICATIONS**
**Credits: 2**

**AIM:** The aim of the course is to provide necessary computational skill required for technology management.

**OBJECTIVES**

- Overview of computer organization
- Understanding on networking
- Conceptualize sound programming principles
- Broad understanding on databases and its applications
- Execute a case study in a state-of-the-art programming language

**COURSE CONTENT**

**MODULE I:** Introduction - Overview of computer organization - Data representation: Number systems, character representation codes, Binary, hex, and their inter conversions. Data Storage - Hardware - Software - Operating Systems, Single user, multi user.

**MODULE II:** Concept of Networking – topologies – protocols - Overview of Internet – IP addresses – Domain names - Web Browsers - Search Engines - Principles of Web Design

**MODULE III:** Linux installation and package management

**MODULE IV:** Introduction to Programming - Concept of algorithms - Flow charts – Programming using C (Refer Lab syllabus)

**MODULE V:** Introduction to Python programming

**MODULEVI**: Introduction to R Programming

**REFERENCES**


- Brian Kernighan and Dennis Ritchie,The C Programming Language, second edition
- Byron Gottfried: Schaum's Outline of Programming with C
- Donald E. Knuth Art of Computer Programming, Volume 1,2,3 (3rd Edition)
- Paul Cobbaut: Linux Fundamentals by - http://linux-training.be/linuxfun.pdf
- R Project An Introduction to R - - https://cran.r-project.org/doc/manuals/R-intro.pdf
- Rajaraman Computer Fundamentals –
- Stephen C. Kochan: Programming in C
- Swaroop C. H A Byte of Python by. - https://python.swaroopch.com/

**Semester: I**
**Course Code: FUS-C-615**
**Course Title: SYSTEMS ENGINEERING**
**Credits: 2**

**AIM:** To introduce the students to the real world systems and man-made systems and their functioning and the role they could play in the progress of mankind through the systems engineering framework. Proper understanding about the useful requirements and engineering considerations of systems, their interactions with expected environments, also tools and techniques will help to develop insights about the important aspects of systems in every stages of its life cycle.

**OBJECTIVES**

Systems engineering course stands for introducing students to the real world systems and man-made systems and their functioning and the role they could play in the progress of mankind. Proper understanding about the useful requirements and engineering considerations of systems, their interactions with expected environments, also tools and techniques will help to develop insights about the important aspects of systems in every stages of its life cycle. Capabilities for analysis of existing systems, decision making capabilities about re-engineering and insights about recent research trends like concurrent engineering etc. should be developed.

**COURSE CONTENT**

**MODULE I:** Definition of a System-Characteristics of a System-Categories of System-System of Systems (SoS)-Need for Systems Engineering-Systems Engineering as a Management Technology-Framework for Systems Engineering- Hall's Morphological box-Steps, phases and activity levels in Systems Engineering-Systems Engineering based policy formulation process

**MODULE II:** Systems Engineering Knowledge- Methods, tools and technologies for Systems Engineering products- Methods, tools and technologies for Systems Engineering process supports-Requirements of System Engineering-Some major supporting Design disciplines- Reliability and Maintainability Engineering-Fault Tree Analysis.

**MODULE III:** System Life Cycle-System Acquisition or Production Life Cycles-Planning and Marketing life cycle-Software Acquisition Life Cycle-Different life cycle models for Systems Engineering

.

**MODULE IV:** Three gateway model for Innovation and Technology transfer through Systems Engineering-Concurrent Engineering-System of Systems (SoS) development Vs Conventional development-Reverse Engineering.

**MODULE V:** Large Scale Systems/Generic Systems-Systems- Graphic tools for Systems Engineering-Interaction Matrices and Graphs-Structural Interaction Matrices-Delta Charts and Gantt charts-Dimensions of SE-Two dimensional taxonomy of Engineering projects and systems.

**MODULE VI:** Model Exchange Isomorphism-Interpretive Structural Modelling-Structural concepts and Graph theory- Construction of Reachability Matrices- MICMAC Analysis-Reachability Matrix to ISM–Structural Property Identification-Cross-Impact Models-Deterministic Models-Kane Simulation and weighted Graph models-Monte Carlo Models-Input-Output Models.

**READING LIST**


- Blanchard, Benjamin S. *System engineering management*. John Wiley & Sons, 2004.
- Blanchard, Benjamin S., Wolter J. Fabrycky, and Walter J. Fabrycky. *Systems engineering and analysis*. Vol. 4. Englewood Cliffs, New Jersey: Prentice Hall, 1990.
- Cacuci, Dan G., MihaelaIonescu-Bujor, and Ionel Michael Navon. *Sensitivity and Uncertainty Analysis: Applications to large-scale systems*. Vol. 2. CRC Press, 2005.
- Kossiakoff, Alexander, et al. *Systems engineering principles and practice*. Vol. 83. John Wiley & Sons, 2011.
- Parnell, Gregory S., Patrick J. Driscoll, and Dale L. Henderson, eds. *Decision making in systems engineering and management*. Vol. 81. John Wiley & Sons, 2011.
- Sage, Andrew P. "Methodology for large-scale systems." (1977).
- Sage, Andrew P., and Christopher D. Cuppan. "On the systems engineering and management of systems of systems and federations of systems."*Information, Knowledge, Systems Management* 2.4 (2001): 325-345.
- Sage, Andrew P., and William B. Rouse, eds. *Handbook of systems engineering and management*. John Wiley & Sons, 2009.
- Warfield, John N. *Science of Generic Design: Managing Complexity through Systems Design*. Iowa State Press, 1994.


**ADDITIONAL REFERENCES**

- http://www.incose.org/
- http://seem.uncc.edu/
- http://cer.sagepub.com/cgi/collection/2013downloads

**Semester: I**
**Course Code: FUS-C-616**
**Course Title: FINANCIAL MANAGEMENT AND MANAGERIAL DECISIONS**
**Credits: 2**

**AIM:** The course aims to equip the students about accounting concepts, the accounting model, measurement processes, financial statements, financial analysis, the accounting cycle, monetary and fixed assets, inventory, current and long-term liabilities and equity structures of partnerships, proprietorships and corporations.

**OBJECTIVES**

1. To give an understanding of how to prepare and interpret the financial statements.
2. To develop the knowledge and skills expected of a finance manager, in relation to investment, financing, and dividend policy decisions.
3. To provide an in depth knowledge of the detailed procedures and documentation involved in cost ascertainment systems.
4. To acquire knowledge and skills for application of tools and techniques in financial management and accounting in decision making of a company.

**COURSE CONTENT**

**MODULE I:** Financial Accounting- Accounting concepts-GAAP-convergence to IFRS-journalizing, posting and preparation of Trial Balance

**MODULE II:** Financial Statements - Profit and Loss Account and Balance Sheet Interpretation of financial Statements - Techniques for interpretation - ratios to judge profitability, solvency, liquidity

**MODULE III:** Financial management function -The nature and purpose of financial management - Objectives of Financial management- wealth maximization vs profit maximization - scope of financial management

**MODULE IV:** Project appraisal using Pay Back method- discounted cash flow techniques NPV, IRR and profitability Index

**MODULE V:** Working capital Management - Sources of working capital- determining requirements – inventory control techniques - EOQ, ABC Inventory levels, zero inventory - cash management techniques

**MODULE VI:** Cost concepts- preparation of Cost Sheets- costing techniques- marginal costing- break even analysis PV ratio –managerial decisions- standard costing variance analysis managerial decisions- Budgeting- Master budget and functional Budgets

**REFERENCES**


- Arora M.N (2012), Cost Accounting: Principles &Practice, 12th Edition. Vikas Publishing House Pvt Ltd, New Delhi
  Gupta, R.L. 2014.Introductory Corporate Accounting. Sultan Chand & Sons. New Delhi.
- James C. VanHorne, John M. Wachowicz Harlow 2009.Fundamentals of Financial Management (13th edition) FT Prentice Hall,
- Khan, M.Y. and P.K.Jain 2008 Financial Management. Tata McGraw Hill Publishing Company Limited, New Delhi
- Maheshwari, S N Sharad K Maheshwari and Suneel K Maheshwari (2013) An Introduction to Accountancy, 11th edition.Vikas Publishing House Pvt Ltd, New Delhi
- Maheshwari, S. N.: Corporate Accounting (Vikas Publishing House Pvt. Lit. New Delhi)
- Jain and Narang : Advanced Accounts (Kalyani Publishers, Ludhiana)
- Nigam, B. M. Lall, Jain, I. C. (2004) Cost Accounting: Principles And Practice.PHI Learning, New Delhi.'
- Pandey, I.M. (2010) Financial Management. 10th edition Vikas Publishing House Pvt Ltd,
- New Delhi
- Robert Anthony, D. F. Hawkins & K. A. Merchant: Accounting Text & Cases (Tata McGraaw Hill) Shukla and Grewal - Advanced Accounts
- Tulsian,P. C. (2014) Tulsian's Cost Accounting For CA-IPCC (Group - 1)1st Edition. S Chand & Company-New Delhi
- Tulsian, P. C. Accountancy for CA-IPCC: A Self Study Textbook with Quick Revision Book (Group - 2) (English) 7th Edition.Chand & Company-New Delhi

**Semester: I**
**Course Code: FUS-C-617**
**Course Title: MANAGEMENT OF INNOVATION**
**Credits: 2**

**AIM:** The course intends to give an in depth idea on the relationship between technology, innovation and management to the students

**OBJECTIVES**

1. To make an understanding of innovation and technology are key drivers of competitive advantage in today's knowledge economy.
2. To give the students the skills to encourage innovation and harness the power of technology.
3. To provides an overview of various models of innovation which helps the students to understand the growth of knowledge in the field.

**COURSE CONTENT**

**MODULE I:** Innovation Management - Invention and Innovation - Technological innovations and creativity – Technological innovations and Strategy – Developing a firm's innovative capabilities – Enactment of Technology Strategy - Technology and innovation management

**MODULE II:** Schumpeterian Theory of Innovation – Modern Models of innovation: Static and Dynamic Models – Incremental – Radical dichotomy, Abernathy –Clark model, Henderson-Clark Model, Innovation value-added chain , Strategic Leadership View, Familiarity matrix, The Teece model, Utterback and Abernathy model, Tushman-Rosenkopf Technology Life Cycle Model, S- Curve

**MODULE III:** The business potential of an innovation - Innovation as a management process - Reducing uncertainty associated with innovation: Technological, Market, Business Uncertainties - the underpinnings of profits: competencies, endowments and knowledge – shortcomings of S curve- Sibling S Curves.

**MODULE IV:** Financing entrepreneurial activity – Debt, Equity, Venture Capital, Angel Investors – Actors in the field – NPV – Options - Role of government in innovation – Educator, Godfather, Babysitter -

**MODULE V:** Globalisation and innovations – Transnational, Global, International, Multidomestic – Strategic choices - Strategic innovation process.

**MODULE VI:** Case Studies on various aspects of innovation

**REFERENCES**


- Allan Afua (2002) Innovation Management: Strategies Implementation & Profits. Oxford University Press
- For Case Studies: (https://mitsloan.mit.edu/LearningEdge/Pages/Case-Studies.aspx)

- Paul Trott, Innovation management and new product development: 5th Edition Prentice Hall
- Robert A. Burgelman, Clayton M. Christensen,Steven C. And Wheelwright (2009) Strategic Management of Technology and Innovation (5th edition) McGraw-Hill Irwin, Boston.
- Scott Shane (2008) The Handbook of Technology and Innovation Management. Wiley-Blackwell

**Semester: I**
**Course Code: FUS-C-618**
**Course Title: OPERATIONS RESEARCH AND DECISION THEORY**
**Credits: 2**

**AIM:** To have a firsthand knowledge of Operations Research with emphasis on Linear programming, Game theory, Queuing and Inventory Models

**OBJECTIVES:** This course is for students new to the topics of Operations Research. The main objective of the course is to study how to obtain the best decisions (according to a well–defined objective) in allocating scarce resources such as capital, materials, equipment, manpower, energy, etc. among competing activities that produce goods and services. Rather than developing a specific solution method for each optimization problem, will build abstractions of these problems in the form of mathematical models and study a general method to solve these models. Throughout this course, students are expected to know and understand common and important business problems. Students will develop problem modelling, solving skills and analyzing the solution to learn how to make intelligent business decisions from the point of view of optimization.

**COURSE CONTENT**

**MODULE I:** Introduction to OR - History, nature, scope and phases - OR and decision theory, types of models in Operations Research: Linear, Integer Linear, Mixed Integer-Linear, Non-Linear etc.

**MODULE II:** Formulating linear programs: Graphical Solution, The simplex algorithm: Basic feasible solutions and standard form, Certificates of optimality, infeasibility and unboundedness, Duality and sensitivity analysis, The dual problem, Duality theorems, Complementary slackness, Changing the right hand side, Changing the objective function

**MODULE III:** Structure of decision strategies - Decision trees -Decision under competitive situation - Theory of games - pure and mixed strategies

**MODULE IV:** Introduction to Non-Linear programming and Convex programming, Goal Programming

**MODULE V:** Queuing/Waiting Line Models (basic models)

**MODULE VI:** Inventory Models (basic models)

**REFERENCES**


- Billy E. Gillett, Introduction to operations research: a computer-oriented algorithmic approach, Tata McGraw-Hill
- George Bernard Dantzig, Mukund Narain Thapa Linear programming: theory and extensions 1& 2 , , Springer
- Hamdy Taha Operations Research, , PHI

- Woolsey L.A and G .L Nemhauser Integer and Combinatorial Optimization — John Wiley


**ADDITIONAL REFERENCES**


- http://www.personal.psu.edu/cxg286/Math484_V1.pdf
- http://www.pondiuni.edu.in/storage/dde/downloads/mbaii_qt.pdf

**Semester: I**
**Course Code: FUS-C-619**
**Course Title: HIGH LEVEL PROGRAMMING LANGUAGE LAB**
**Credits: 2**

**AIM:** This course is meant to familiarize the students the concepts of programming skills using high level languages such as C and Python

**OBJECTIVES**

- Familiarize the students with concepts of computer programming using a high level language
- Build up sound logic and write error free programs professionally in C
- Create structured, modular and re-usable code

**COURSE CONTENT**

**MODULE I:** C data types, int, char, float - C expressions, arithmetic operations, relational and logic operations - C assignment statements - Input - output using getchar and putchar - exposure to the scanf and printf functions - C statements

**MODULE II:** Flow control - conditional executing using if, else. - Concepts of loops, example of loops in C using for, while and do-while

**MODULE III:** Arrays - Matrix - Functions – Pointers - relationship between arrays and pointers, Argument passing using pointers, Array of pointers, Passing arrays as arguments

**MODULE IV:** Files and Streams- Strings and C string library -Structures and Unions - Defining C structures, passing strings as arguments- File I/O, Use of fopen, fscanf and fprintf routines.

**MODULE V:** Python programming

**MODULEVI:** Case studies using JAVA – Python- MS-Office - LateX

**REFERENCES**


- Brian Kernighan and Dennis Ritchie The C Programming Language, PHI
- Byron Gottfried Schaum's Outline of Programming with C
- Frank Mittelbach The LaTeX Companion (Tools and Techniques for Computer Typesetting) , Addison Wesley
- Helmut Kopka Guide to LaTeX (4th Edition) , Addison Wesley
- Herbert SchildtJava: The Complete Reference, Seventh Edition (Osborne Complete Reference Series)
- Stephen G. Kochan Programming in C, , SAMS

**Semester: II**
**Course Code: FUS-C-621**
**Course Title: COMBINATORIAL OPTIMIZATION**
**Credits: 2**

**AIM:** The aim of the course is to make students acquainted with discrete models of Operations Research, formulations of the models and methods for their solving. Students will work with special software products for solving discrete optimization problems.

**OBJECTIVES**

- the basics of Combinatorial optimization techniques with the help of graph theory,matrix theory and integer programming
- the modelling of real world optimization problems in industry, organization etc.
- the basic algorithmic design techniques such as greedy, dynamic programming, divide and conquer , searching techniques etc.
- the basics of analysis of algorithms and algorithmic complexity

**COURSE CONTENT**

**MODULE I**: Integer Linear programming, Mixed-Integer Linear Programing Problems, Generic Combinatorial Optimization Problems, Formulation of standard models of integer and mixed-integer programming problems like Matching problem, Knapsack problem. Assignment problems. Set-covering problem, Set-packing problem and Set-partitioning problem, Travelling Salesman Problem (TSP), Sequencing problems and other combinatorial Optimization Problems .

**MODULE II:** Complexity of algorithms, Class P problems - Class NP- NP-hard problems, Searching algorithms –BFS/DFS- Spanning tress, Minimal Spanning Tree Problem and Greedy Strategies, Data structure for combinatorial optimization problems. Analysis of Heuristics

**MODULE III:** Network Theory: Max flow/Min cut problem, Ford-Fulkersen's Augmenting Path Algorithms- Bipartite Matching, Applications of Max-Flow Problem to Transportation Problems and bipartite matching etc.- Minimum Cost-Flow Problems etc.

**MODULE IV:** Shortest PathorMinimum Weight Path problems and Solution Strategies: Dijkstras Algorithm, Bellman-Ford Algorithms and Floyd- Warshall Algorithms

**MODULE V:** Theory of valid inequalities. Methods for solving mixed-integer programing problems.Relaxations of discrete problems. Cutting-plane, Branch and bound and Branch and Cut Method.

**MODULE VI**: Approximate Algorithms for hard combinatorial optimization problems like TSP, Knapsack, Vertex Cover tec.

**REFERENCES**


- Alexander Schrijver: Theory of linear and integer programming. John Wiley
- Papadimitriou and Steiglitz: Combinatorial Optimization : Algorithms and Complexity, , Dower Publishers
- Woolsey L.A and G .L Nemhauser Integer and Combinatorial Optimization — John Wiley


**ADDITIONAL REFERENCES**


- http://www.imada.sdu.dk/~marco/Teaching/AY2014-2015/DM554/Notes/dm554-main.pdf
- https://ocw.mit.edu/courses/mathematics/18-433-combinatorial-optimization-fall-2003/lecture-notes/

**Semester: II**
**Course Code: FUS-C-622**
**Course Title: MODELLING AND SIMULATION**
**Credits: 2**

**AIM:** The aim of the course is to provide an overall view of model building and foundation to various types of computer simulations.

**OBJECTIVES**

- To provide the knowledge of simulation principles.
- To provide the ability to create simulation models of various types.
- To provide the basic knowledge of simulation systems principles.

**COURSE CONTENT**

**MODULE I:** Model classification: conceptual, abstract, and simulation models. Heterogeneous models. Methodology of model building.

**MODULEII:** Simulation systems and languages, means for model and experiment description. Principles of simulation system design. Checking model validity, verification of models. Analysis of simulation results.

**MODULE III:** Continuous systems modelling. Overview of numerical methods used for continuous simulation.

**MODULE IV:** Discrete simulation models. Model time, simulation experiment control. Models of queuing systems.

**MODULE V:** Generating, transformation, and testing of pseudorandom numbers. Stochastic models, Monte Carlo method.

**MODULE VI:** Agent based modeling, *NetLogo* multi-*agent* programmable *modeling* environment.

**REFERENCES**


- Fishwick P.: Simulation Model Design and Execution, PrenticeHall, 1995, ISBN 0-13-098609-7
- Geoffrey Gordon: System Simulation , PHI
- Law A., Kelton D.: Simulation Modelling and Analysis, McGraw-Hill, 1991, ISBN 0-07-100803-9
- Narsingh Deo: System Simulation with Digital Computer, PHI
- Rábová Z. a kol: Modelování a simulace, VUT Brno, 1992, ISBN 80-214-0480-9
- Ross, S.: Simulation, Academic Press, 2002, ISBN 0-12-598053-1

- Uri Wilensky and William R: An Introduction to Agent-Based Modeling Modeling Natural, Social, and Engineered Complex Systems with NetLogo. The MIT Press


**ADDITIONAL REFERENCES**


- https://ccl.northwestern.edu/netlogo/

**Semester: II**
**Course Code: FUS-C-623**
**Course Title: PRINCIPLES OF TECHNOLOGY MANAGEMENT**
**Credits: 3**

**AIM:** The course intends to encourage students to study, research and practice technology under the lens of management.

**OBJECTIVES**

This course aims to introduce students to the realm of technology management, which deals with effective utilization of technology fundamentals to create and sustain competitive advantage. They should be able to answer the questions related to technology and its importance, role of technology management in technological advancement, importance of technology management in organizational, national and international levels. The course will guide them through different technology development process and provide insights and skills to realize technological innovations or to establish technology start-ups or both, to manage hi-tech firms, to offer technology consultancy services which includes Intellectual Property Rights management.

**COURSE CONTENT**

**MODULE I:** Technology management: concepts, definitions and issues - implications of technological change – technology and competitive advantage-technological innovation processes- technology management process Framework.

**MODULE II:** Brief overview of technology forecasting and assessment methods for technology management

**MODULE III:** Knowledge mapping: a tool for management of technology – general planning versus technology planning-technology planning methods-technology audit-technology transfer - technology absorption and diffusion - technology information systems - technology marketing.

**MODULE IV:** Organizing technology at the enterprise level -technology strategy - management of R&D and innovation - human resource management issues in R&D and innovation –

**MODULE V:** Technology policies - Science and Technology policy in India and other countries

**MODULE VI:** Technology management -projects- case studies

**REFERENCES**


- BurgeSmani, Robert A., and Steven C. Wheelwright. "Strategic management of technology and innovation." *READING* 1.1 (2004).
- Dorf, Richard C. *The technology management handbook*. CRC Press, 1998.
- Gehani, R. Ray. *Management of technology and operations*. John Wiley & Sons, 1998.

- Kropsu-Vehkapera, Hanna, Harri Haapasalo, and Jukka-Pekka Rusanen. "Analysis of technology management functions in Finnish high tech companies." *The Open Management Journal* 2 (2009): 1-10.
- Pavitt, Keith. *What we know about the strategic management of technology*. California, 1990.
- Porter, Alan L. *Forecasting and management of technology*. Vol. 18. John Wiley & Sons, 1991.
- Schilling, Melissa A. *Strategic management of technological innovation*. Tata McGraw-Hill Education, 2005.
- Tesar, George, Sibdas Ghosh, Steven W. Anderson, and Tom Bramorski. *Strategic Technology Management: Building Bridges between Sciences, Engineering and Business Management*. Singapore: World Scientific, 2008. Internet resource.
- Zedtwitz, Maximilian . *Management of Technology: Growth Through Business Innovation and Entrepreneurship : Selected Papers from the Tenth International Conference on Management of Technology*. Amsterdam: Pergamon, 2003. Print.


**ADDITIONAL REFERENCES**


- http://www.ifm.eng.cam.ac.uk/research/ctm/
- http://www.tifac.org.in/

**Semester: II**
**Course Code: FUS-C-624**
**Course Title: IT AND ITS MANAGEMENT**
**Credits: 2**

**AIM:** The aim of this course is to provide knowledge regarding the entire gamut of activities in a typical IT organization. The generalities in IT and business environments are discussed emphasizing on practical issues faced by industry. Along with that policies of state and national governments are discussed along with its implications.

**OBJECTIVES**

- Impart practical skills and tools as required by industry so as to make them industry ready
- Understand the HR requirements of the IT industry
- Discuss IT policies – state, national and global level
- Role of certifications in enhancing IT careers

**COURSE CONTENT**

**Module I:** Fundamentals of information systems, solving business problems with information systems, Information systems for managerial decision support

**MODULE II:** A managerial overview of information technology - computer hardware, system software, application software, telecommunications, database management, internet and electronic commerce, internets and extranets

**MODULE III:** HR analytics– Recruitment, e-commerce, IT outsourcing models, Quality and process models for the IT industry

**MODULE VI:** Policies – National and Global, ICT in governance, e-governance initiatives - case studies, e-waste management

**MODULE V:** Planning and implementing business change with IT, Change management, Risk management Security and control issues in information systems

**MODULE VI:** Big Data Governance, Ethical and societal challenges of IT**,** Web security threats and their handling - Role of social media in business organizations and governance

**REFERENCES**


- Edward Yourdon: Death March (2nd edition). Prentice Hall
- Frederick P. Brooks The Mythical Man-Month (Anniversary Edition)
- Gerald M Weinberg: Perfect Software and Other Illusions about Testing by. Dorset House, 2008
- Gerald M. Weinberg The Psychology of Computer Programming by Dorset House Publishing
- Robert L. Glass Facts and Fallacies of Software Engineering. Addison Wesley

- Tom DeMarco and Timothy Lister Waltzing with Bears: Managing Risk on Software Projects.

**Semester: II**
**Course Code: FUS-C-625**
**Course Title: IPR AND PATENTS: LAW, PRACTICE AND CONSULTANCY**
**Credits: 2**

**AIM:** The course aims to give a basic understanding of the concept and philosophy of IPR and its implications on the country vis a vis global scenario. To highlight the benefits of good and innovative design leading to patents and the issues in patenting

**OBJECTIVES**

- To empower the students with knowledge on intellectual property rights
- To impart the importance of patents and its role in business
- To highlight the scope of consultancy

**COURSE CONTENT**

**MODULE I:** Fundamentals and general introduction to the concept and philosophy of IPR – Evolution and relevance of IPR in global and Indian scenario – Different types of IPR

**MODULE II:** Introduction to Intellectual Property Rights- Copyright, Neighboring Rights- Industrial designs and Copyrights as applicable to software industry -Trademarks and related topics- Geographical Indications-Industrial design-Layout designs of Integrated Circuits and Protection of Plant Varieties and Farmers' Rights.

**MODULE III:** Law of patents – Industrial designs – geographical indications – confidential information – right to secrecy – patent infringement – abuse of patent rights – duration of patents – compulsory licensing – monitoring of patent obligations and practice – remedies against patent infringement – national and international perspectives – conventions and tactics on patent – dispute resolution – patent organizations – Indian IP policy

**MODULE IV:** Innovation Management, Invention disclosure, Non disclosure agreements, Provisional applications - Prior art search , national and international applications rudimentary of drafting a patent application -drafting and filing patent-Registration of trademark, geographical indication, copy rights, enforcement of related rights, and copyrights in the digital world -Fair use, exceptions, role of copyright societies and their functions-Registration for Design, Topography of integrated circuits and trade secrets with its legal implications

**MODULE V:** Intellectual Property Management: Introduction and an Overview - Economic Perspectives on Intellectual Property Management- Intellectual Property Valuation and Finance - Intellectual Property and Commercialization-On line Intellectual Property Management -Strategy for Intellectual Property Management, policing and legal implications- Safeguarding against IP litigation, policy management, dispute resolution, technology management, manpower management, R & D management.

**MODULE VI:** Definition of Consultancy - Importance and scope of industrial consultancy - case studies

**REFERENCES**


- Ahuja V.K Law relating to intellectual property rights
- Cornish W.R. Intellectual property, cases and materials
- Ganguli Intellectual Property Rights : Unleashing the Knowledge Economy
- Rajesh Asrani Intellectual Property Management in Techno-Economic Paradigm
- Salil K. Roy Chaudhary Law of trademarks, copyrights, patents
- Subbaram N.R. Demystifying Intellectual Property Rights

**Semester: II**
**Course Code: FUS-C-626**
**Course Title: DATA ANALYTICS LAB**
**Credits: 3**

**AIM:** The course intends to give a hands on experience on the Data Analytics software packages of Matlab and SPSS. The first three modules deals with Matlab and the last three modules is on SPSS.

**OBJECTIVES (MATLAB & SPSS)**

- Understand the Matlab Desktop, Command window and the Graph Window
- Be able to do simple and complex calculation using Matlab
- Be able to carry out numerical computations and analyses
- Understand the mathematical concepts upon which numerical methods rely
- Ensure you can competently use the Matlab programming environment
- Understand the tools that are essential in solving engineering problems
- How interesting and fun statistics can be
- How and why statistics has developed as a tool of the scientific process
- How data are collected and how observations are quantified during the scientific and research process
- How observations are represented and stored in a data file

**COURSE CONTENT**

**MODULE I:** Introduction to Matlab - Matlab Interactive Sessions, Menus and the toolbar, Computing with Matlab, Script files and the Editor Debugger, Matlab Help System, Programming in Matlab, Arrays, Multidimensional Arrays, Element by Element Operations, Polynomial Operations Using Arrays, Cell Arrays , Structure Arrays, Functions & Files, Elementary Mathematical Functions, User Defined Functions, Advanced Function Programming, Working with Data Files

**MODULE II:** Programming Techniques - Program Design and Development , Relational Operators and Logical Variables, Logical Operators and Functions, Conditional Statements, Loops, The Switch Structure, Debugging Mat Lab Programs, Plotting

**MODULE III:** SIMULINK - Simulation and Model-Based Design

**MODULE IV:** Starting an SPSS Session - frequently –used dialog boxes - Editing output - Printing results - Creating and editing a data file, Entering and manipulating data - Listing cases, replacing missing values, computing new variables, recording variables, exploring data, selecting cases, sorting cases, merging files; Importing and Exporting Data; Printing Datasets. - Data Presentation, Data exploration & Computing Statistical Measures- Frequency tables, Graphs, Diagrams - Creating and editing, Normality check, identification of outliers, transformations - Frequencies, bar charts, histograms, percentiles

**MODULE V:** Descriptive Statistics - measures of central tendency, variability, deviation from normality, size and stability - skewness and kurtosis - Cross Tabulation and chi-square analyses - Correlation – Bivariate Correlation, Partial Correlations and the correlation matrix

**MODULE VI:** Univariate Analysis: Testing of hypothesis, parametric and nonparametric tests - The T-test procedure: Independent –samples, paired samples, and one sample tests - The one way ANOVA procedure - General Linear model: Two –way analysis of variance, three –way analysis of variance and the influence of covariates - Simple Linear Regression - curve fitting - Multiple regression analysis - Multidimensional scaling - Factor analysis - Cluster analysis - Time Series models- ARMA – ARIMA

**REFERENCES**


- Andy Field: Discovering statistics using SPSS for Windows, SAGE publications Ltd. London.
- Johnson, R.A D.W. Wichern Applied Multivariate Statistical Analysis, PHI, New Delhi
- Matthew Zagumny (2001)The SPSS® Book: A Student Guide to the Statistical Package for the Social Sciences®
- Rudra Pratap: Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, Oxford University Press
- Stormy Attaway: A Practical Introduction to Programming and Problem Solving matlab a practical intro to programming and problem solving, , Elsevier Science
- Susan B. Gerber, Kristin Voelkl Finn ( 2005) Using SPSS for Windows – data analysis and graphics -– Springer 2nd ed.
- Timothy A. Davis and Kermit Sigmon MATLAB Primer, 7th Edition, Chapman & Hall/CRC, 2005. 1-58488-523-8
- William J. Palm III Introduction to Matlab 7 for Engineers, McGraw Hill 2005.


**ADDITIONAL REFERENCES**


- http://www.mathworks.in
- http://www.mathworks.in/products/simulink/
- SPSS Statistics Base 17.0 User's Guide, http://www.spss.com

**Semester: II**
**Course Code: FUS-E-6211**
**Course Title: ECONOMETRICS AND ECONOMIC FORECASTING**
**Credits: 3**

**AIM:** The course intends to provide a comprehensive introduction to econometric concepts and techniques.

**OBJECTIVES**
This course introduces students to simple and multiple regression methods for analyzing data in economics and related disciplines. The objective of the course is for the student to learn how to conduct and to critique empirical studies in economics and related fields. Although the emphasis of the course is on empirical applications, a treatment of traditional econometrics will also be made.

**COURSE CONTENT**

**MODULE I:**Nature and Scope of Econometrics, Statistical Concepts: Normal distribution; chi-sq, t- and F-distributions; estimation of parameters; properties of estimators; testing of hypotheses, Simple Linear Regression Model: Two Variable Case - Estimation of model by method of ordinary least squares; properties of estimators; goodness of fit; tests of hypotheses; scaling and units of measurement; confidence intervals; Gauss-Markov theorem; forecasting.

**MODULE II:** Multiple Linear Regression Model Estimation of parameters; properties of OLS estimators; goodness of fit - $R^2$ and adjusted $R^2$ - partial regression coefficients; testing hypotheses - Violations of Classical Assumptions: Consequences, Detection and Remedies Multicollinearity; heteroscedasticity; serial correlation,

**MODULE III:** Specification Analysis - Omission of a relevant variable; inclusion of irrelevant variable; tests of specification errors.

**MODULE IV:** Dummy variable technique – Use of dummy variables, regression with dummy variables – ANOVA models, ANCOVA models, interaction effects, piecewise regression, deseasonalisation, Logit, probit and Tobit models.

**MODULE V:** Forecasting using Time series models: Smoothing and Extrapolation of Time series – Simple extrapolation models, Smoothing and seasonal adjustment. Properties of stochastic Time series: Introduction to stochastic time series models. Stationary and Non stationary Time series, Linear Timer Series Models. Moving average models, ARIMA Models and Specification of ARIMA models.

**MODULE VI:** Application of Statistical Packages

**REFERENCES**


- Christian Gourieroux, Econometric of Qualitative Dependent Variables, Cambridge University Press, 2000.
- Christopher Dougherty, Introduction to Econometrics, Oxford University Press, 3rd

edition, Indian Edition, 2007.

- Goldberger, A., A Course in Econometrics, Harvard University Press.
- Greene, W. H., Econometric Analysis, Prentice Hall.
- Gujarati, D. N. and D.C. Porter, Essentials of Econometrics, McGraw Hill, 4th edition, International Edition, 2009.
- Jan Kmenta, Elements of Econometrics, Indian Reprint, Khosla Publishing House, 2nd edition, 2008
- Kerry Patterson, An Introduction to Applied Econometrics: A time series Approach, Macmillan Press, London 2000.
- Krishna, K.L. Econometric Applications in India, OUP, New Delhi 1999.
- Robert. S.Pindiyck& Daniel Rubinfield, Econometric Models and Economic Forecasts, MacGraw Hill, 1998.
- Ruud, P., An Introduction to Classical Econometric Theory, Oxford University Press.
- Stock, J.H. and M.W. Watson, *Introduction to Econometrics* (first edition), Addison-Wesley, 2003 (available at the COOP
- Walter Enders, Applied Econometric Time Series, 2nd Edn., Wiley, 2008.
- Wooldridge, J.M., *Introductory Econometrics*, South-Western College Publishing.

**Semester: II**
**Course Code: FUS-E-6212**
**Course Title: TOTAL QUALITY MANAGEMENT**
**Credits: 3**

**AIM:** To understand the basics of Total quality management (TQM), its philosophy, methodology and system of tools to create and maintain mechanism of organization's continuous improvement.

**OBJECTIVES**
The objectives of this course is to introduce the main principles of business and social excellence, to generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector.

**COURSE CONTENT**

**MODULE I:** Quality System and Foundations of Total Quality Management **-** Components of quality-The total quality management approach-Innovation, design and improvement-Product quality characteristics and service quality characteristics-Quality parameters and specific dimensions of quality- Planning for quality-Flowcharting-Detailed flow process charts and flow diagrams-Planning for just-in-time (JIT) management-System design and contents-System documentation, implementation and assessment

**MODULE II:** TQM Tools and the Improvement Cycle - Measurement of quality- Costs of quality-Tools and techniques for quality improvement-Statistical process control-Quality improvement techniques in service industries-Specific techniques for design, reliability, maintenance and process improvement

**MODULE III:** Conformance and Non-conformance to Quality Standards - Quality of design-Quality of conformance to design-Control of non-conforming products - identifying and classifying non-conformance-documenting non-conforming products- reinspection of repaired and reworked products-Corrective and preventive action

**MODULE IV:** The Quality Organisation within an Organisation - People and the organizational structure-Responsibilities and performance management-The relationship between the quality organization and top management-Culture change through teamwork for quality improvement-Implementing teamwork for quality improvement: the DRIVE model.

**MODULE V**: Quality and Business Process Re-engineering **-** Beyond tools to total quality management-Stages in the development of quality and related activities:. Inspection-. quality assurance-company-wide quality control- total quality management-Quality circles-Stages in the evolution of a company's improvement capability - traditional approach- structured continuous improvement-goal-oriented continuous improvement- proactive/empowered continuous improvement-full continuous improvement capability (the learning organization)

**MODULE VI:** TQM-projects- case studies

**REFERENCES**


- Brown, S. Strategic Operations Management 2nd Edition Elsevier Butterworth-Heinemann 2005
- De Toro I.J. Addison –Wesley Publishing Company 1992
- Hoyle, D.ISO 9000 Quality Systems Handbook : 2nd Edition. Butterworth/Heinemann 1997
- Oakland, J.S. Total Quality Management : the route to improving performance Butterworth/Heinemann (1993)
- Tenner, A.R. Total Quality Management: Three Steps to Continuous Improvement

**Semester: II**
**Course Code: FUS-E-6213 (Elective)**
**Course Title: COMPUTER AIDED DESIGN**
**Credits: 3**

**AIM:** To introduce the students with the computer aided design philosophy which helps them to appreciate the advantage of computer aided design and how important a role it is playing in the realization of system with optimum performance. Awareness about the systems, system components and their specifications and software requirement specifications etc. are to be provided through suitable case examples, illustrative sessions etc.

**OBJECTIVES**
The Principal objective of this course is to provide necessary skills in detailed design of system components to ensure optimum system design which leads to optimum system performance. Students have to be familiar with methods and tools for analysis of machine components for the stresses and other factors which will be incurred during its operational, standby conditions. Insights about the role of numerical consideration in graphics and optimization methods in system design are also intended to be created among students.

**COURSE CONTENT**

**MODULE I:** Computer aided design philosophy - Systems definition – Introduction to manufacturing- Brief history of CAD-Principles of Computer aided design and manufacturing. Computer aided design basics- Advantages of CAD- Engineering Product Specification-Design modelling requirements-Paradigms of Design - Architecture of CAD

**MODULE II:** Application of computers in Design-Engineering design-Design Drafting-CAD, Geometric modeling - Surface Modelling - Solid modeling

**MODULE III:** Basic elements of Computer Graphics- co-ordinate systems- 2D and 2D transformations- Homogeneous coordinates – Line drawing – Clipping – Viewing transformation

**MODULE IV:** Software requirements specification - Product functions - Design Requirements - Interface requirements - Specific requirement s- design constraints - standards compliance – Graphical Kernal System – OpenGL – Data exchange standards

**MODULE V**: Computer method of linear and non-linear systems analysis - Sensitivity models for computer aided design - optimization methods in systems design - Automated system design - Computer aided probabilistic design.

**MODULE VI:** Data structures and data base management – Numerical consideration – Graphics -Introduction to finite element modelling and analysis – General procedure for FEM, Finite element modeling, General structure of a FEM procedure

## REFERENCES


- Farin, Gerald E. *Curves and surfaces for computer-aided geometric design: a practical code*. Academic Press, Inc., 1996.
- Kalay, Yehuda E. *Architecture's new media: principles, theories, and methods of computer-aided design*. MIT Press, 2004.
- Lofberg, Johan. "YALMIP: A toolbox for modeling and optimization in MATLAB."*Computer Aided Control Systems Design, 2004 IEEE International Symposium on*. IEEE, 2004.
- Micheli, Giovanni De. *Synthesis and optimization of digital circuits*. McGraw-Hill Higher Education, 1994.
- Mrozek, Zbigniew. "Computer aided design of mechatronic systems."*International Journal of Applied Mathematics and Computer Science* 13 (2003): 255-267.
- Prasad, Biren. *Concurrent engineering fundamentals*. Vol. 1. Prentice-Hall PTR, 1997.
- Renner, Gábor, and AnikóEkárt. "Genetic algorithms in computer aided design." *Computer-Aided Design* 35.8 (2003): 709-726.
- Tien-Chien, Chang. *Computer-aided manufacturing*. Pearson Education India, 2008.
- Upadhyay, Parag R., and K. R. Rajagopal. "FE analysis and computer-aided design of a Sandwiched axial-flux permanent magnet brushless DC motor."*Magnetics, IEEE Transactions on* 42.10 (2006): 3401-3403.


## ADDITIONAL REFERENCES


- http://nptel.ac.in/courses/112102101/
- http://nptel.ac.in/courses/Webcourse-contents/II
- Delhi/Computer%20Aided%20Design%20&%20ManufacturingI/
- http://fosscad.org/fc/
- http://www.design-skills.org/about_cad.html

**Semester: II**
**Course Code: FUS-E-6214**
**Course Title: ENRIVONMENTAL ENGINEERING**
**Credits: 3**

**AIM:** To provide an opportunity to understand the environmental systems and their balance through mathematical modeling, environmental problem solving and the importance of environmental engineering in sustainable development.

**OBJECTIVES**

This course intends to introduce students to the environmental systems and their balance, impacts of technology and other aspects of industrial activities on the environment. A conscience development for environmental protection, through systematic approach of environmental engineering problem solving is the concern of this subject. Advanced analytical skills for the design and development of environmentally sound technologies, assessment and adoption of green policies are expected to be developed.

**COURSE CONTENT**

**MODULE I:** Man and environment: scales of interaction - environmental systems - environmental legislation and regulation – a materials Balance approach to environmental engineering problem solving - Hydrology - rainfall analysis surface and ground water analysis - water resource management - water quality management

**MODULE II :** Pollution - abatement methods of air pollution. Noise pollution, forecasting and its abatement - Environmental Impact Assessment (EIA) - different methods of EIA –

**MODULE III:** Mathematical Modeling of environmental engineering problems - System Dynamic Modelling

**MODULE IV:** Environmentally sound technology for Sustainable Development - technological options that minimize the loss of biological diversity –

**MODULE V:** Environmental policy (taxation/subsidy ) as instruments for diffusion of green technology - transfer of green technology to developing countries - policy options for environmentally sound technology in India

**MODULE VI: C**ase studies for EIA and environmental engineering problems

**REFERENCES**


- Allen, David T., and David R. Shonnard. *Green engineering: environmentally conscious design of chemical processes*. Pearson Education, 2001.
- Allenby, Braden R., and T. E. Graedel. *Industrial ecology*. Prentice-Hall, Englewood Cliffs, NJ, 1993.

- Anastas, Paul T., and Julie B. Zimmerman. "Peer reviewed: design through the 12 principles of green engineering." *Environmental science & technology* 37.5 (2003): 94A-101A.
- Billatos, Samir. *Green technology and design for the environment*. CRC Press, 1997.
- Corbitt, Robert A. *Standard handbook of environmental engineering*. New York, 1990.
- Dincer, Ibrahim, and Marc A. Rosen. *Exergy: energy, environment and sustainable development*. Newnes, 2012.
- Elzen, Boelie, Frank W. Geels, and Kenneth Green, eds. *System innovation and the transition to sustainability: theory, evidence and policy*. Edward Elgar Publishing, 2004.
- Hoffert, Martin I., et al. "Advanced technology paths to global climate stability: energy for a greenhouse planet." *science* 298.5595 (2002): 981-987.


**ADDITIONAL REFERENCES**

- http://www.aaees.org/
- http://www.iema.net/
- http://www.asce.org/Leadership-and-Management/Ethics/Code-of-Ethics/

**Semester: II**
**Course Code: FUS-E-6215**
**Course Title: ENERGY, ECOLOGY & ENVIRONMENT**
**Credits: 3**

**AIM:** The course aims to understand Energy Systems Technology, Methods for the Analysis of Energy Systems and Energy Economics and Policy.

**OBJECTIVES**

- To study the scope of energy for the sustainable development, with special emphasis on renewable energy resources, eco-friendly technologies, models for sustainable energy production.
- To understand the environmental and social challenges of energy sector both at global and national levels, in the context of ongoing environmental changes including pollution.
- To develop the critical evaluation skills, research techniques and quantitative analytical methodologies essential for assessing real-world energy systems.

**COURSE CONTENT**

**MODULE I:** Origins of earth - Earth's temperature and atmosphere - sun as a source of energy, nature of its radiation - Biological processes, photosynthesis, Food Chains, Marine ecosystem, Ecosystem theories, Archaeology.

**MODULE II:** Sources of energy, classification of energy sources, quality and concentration of energy sources, characteristics temperature - Fossil fuels - coal, oil, gas, geothermal, tidal and nuclear energy - Solar, Wind, hydropower, biomass - Resources of energy and energy use pattern in different regions of the world.

**MODULE III:** Environmental degradation, primary and secondary pollutants - Thermal and radioactive pollution, air and water pollution from stationary and mobile sources, Biological effects of radiation, heat and radioactivity disposal - Pollution abatement methods.

**MODULE IV:** Fundamentals of modern/future energy systems in terms of their technical properties and economic and environmental impacts: Solar photovoltaic electricity generation, fuel cells and hydrogen for stationary and transport electricity generation and wind power. Estimation of energy resources and demands along with the main sources of data and methods for analysis.

**MODULE V:** Energy demand, supply markets and competition. Energy policy principles and local, national and regional examples-National and international regulatory and legal environments. Energy-economics-environmental models of global impact. Cost/Benefit analysis. Private investment decision making-Evaluating future technologies-Policy instruments and market mechanisms for carbon mitigation.

**MODULE VI: C**ase studies for Energy, ecology and environment management problems

**REFERENCES**


- BalaBhaskar (2013). Energy Security and Economic Development in India: a holistic approach.TERI Press, New Delhi.
- Brown, L.R. PLAN B 4.0. (2013). Mobilizing to Save Civilization. The Earth Policy Institute, WW Norton and Co., New York, 362pp.
- Brown, L.R., Larsen, J. & B. Fischlowitz-Roberts 2002.The Earth Policy Reader. Orient Longman, Hyderabad, 303 pp.
- Cunningham, W.P & M.A. Cunningham 2004.Principles of Environmental Science.Inquiry and Applications. McGraw Hill Higher Education, New York, 424 pp.
- Herbert Girardet and Miguel Mendonça. A Renewable World: Energy, Ecology, Equality Green Books
- IUCN, UNEP & WWF 1991.Caring for the Earth, International Union for the Conservation of Nature, Gland.
- Kishore V V N (2009). Renewable Energy Engineering And Technology Principles and Practice. TERI Press, New Delhi.
- Mendonça, M., Jacobs, D., Sovacool, B. (2009).Powering the Green Economy: The Feed-in TariffHandbook, Earthscan.
- Moef (2011). Sustainable Development in India: Stocktaking in the run up to Rio+20Ministry of Environment and Forests, Government of India.
- Pahwa, P K and G K Pahwa (2014) Hydrogen Economy. TERI Press, New Delhi.
- Ringwald, A. (2008). India: Renewable energy trends. Centre for Social Markets, Kolkata.
- TERI-NCSC-CUFE-ZU-UNDP. 2014. Low Carbon Development in China and India: Issues and Strategies (Advance Publication). To be published by TERI Press (http://www.teriin.org/pdf/TERI-NCSC-CUFE-ZU_China-India-LCD-book-new.pdf)
- WWF (2012).Living Planet Report 2012. WWF International, Gland.
- WWF (2013).The energy report- India.WWF-India and The Energy and Resources Institute, 2013


**ADDITIONAL REFERENCES**

- www.ceeindia.org (Centre for Environment Education)
- www.cseindia.org (Centre for Science and Environment)
- www.desd.org/ (Education for Sustainable Development)
- www.earthcharterinaction.org/education/UNDESD.html
- www.earthday.net/footprint/info.asp
- www.indiaenvironmentportal.org.in) (India Environment Portal)
- www.ipcc.ch/ (for all climate change reports)
- *www.mnre.gov.in/*
- www.sustainable-development.gov.uk
- www.teriin.org/
- www.un.org/esa/sustdev/

- www.unep.org/
- www.worldfuturecouncil.org/a_renewable_world.html
- www:portal.unesco.org/education/en/

**Semester: II**
**Course Code: FUS-E-6216**
**Course Title: STRATEGIC MANAGEMENT**
**Credits: 3**

**AIM:** The course introduces the subject of strategic management to the students and makes them understand its processes and levels.

**OBJECTIVES**

This course will help the students to analyse a company's business environment, select a strategy, and construct the organisation necessary to put it into action and to identify the link between strategy formulation and implementation with environmental analysis. This course intends to provide information pertaining to business, corporate and global reforms which are taking place globally and familiarizing the students to new formats of the market. This will also help to acquaint the students with knowledge of disaster management to handle critical situations through practical application of strategies of control and prevention. The mission of the course is to explore why good strategic management leads to good business performance, to present the basic concepts and tools of strategic analysis, and to drill you in the methods of crafting a well-conceived strategy and executing it competently. The course on strategic management would help to develop learning and analytical skill of the students to solve business cases and provide strategic solutions. In short, the center of attention of the present course is the total enterprise–-the industry and competitive environment in which it operates, its long-term direction and strategy, its resources and competitive capabilities, and its prospects for success.

**COURSE CONTENT**

**MODULE I:** Organisational Decisions - characteristics of successful strategy - Strategic Business Unit - - Strategic Management Process - Levels of Strategies- Corporate, Business and Operational level, Types of Strategies-Functional Strategies, H. R Strategy, Marketing strategy, Financial Strategy, Operational Strategy Benefits and Risks of Strategic Management - Formulation of Strategy and Strategic Implementation.

**MODULE II:** Models for Strategic Management - The product Life Cycle and Strategic Management - Evaluation of Strategic Alternatives, Types of Strategic Alternatives like Portfolio Analysis and its techniques, SWOT Analysis, Profit Impact of Market Strategy (PIMS) - Strategic Change, Corporate Renewal, Internal and External causes of Organizational failures -Culture of Organization, Management of Strategies and Cultures

**MODULE III:** Growth strategies: Concentric expansion strategy - Vertical integration strategy - Diversification strategy - Merger strategy - Takeover strategy - Joint venture strategy - Strategic alliance - Organizational change - innovation generation and innovation diffusion - strategic leadership - - corporate governance in behavioural implementation

**MODULE IV:** Environmental analysis in Strategic Management - Business Environment, Components of Environment, Environmental Scanning - forecasting techniques available for environmental analysis - ETOP - Strategy Implementation,

**MODULE V:** Evaluation and Control Strategic control - Premise control, Implementation control, Financial performance control, Budgetary control, Social performance control, - Softwares for Strategic Management **-** Analysis of Strategies and Choice of Strategy - Business, Corporate and Global Strategies: Practices and Issues

**MODULE VI:** Case studies on various aspects of Strategic Management

**REFERENCES**


- David hunger,J. and Thomas L. Wheelen(2011) Essentials of Strategic Management, custom edition, Prentice Hall.
- Hill, Charles W. L. and Gareth R. Jones (2012), Strategic Management: An Integrated Approach,
- JauchLawrance R, Business Policy and strategic Management, MacGraw Hill Co;
- Mathur, U.C. Text book of strategic management, Macmillain India limited.

**Semester: II**
**Course Code: FUS-E-6217**
**Course Title: KNOWLEDGE MANAGEMENT**
**Credits: 3**

**AIM:** The course intends to provide the theory and practice of Knowledge Management (KM), with an integrated interdisciplinary presentation.

**OBJECTIVES**
The present course tries to give an overall understanding of the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management. It also looks into what is role and use of knowledge in organizations and institutions, and the obstacles that KM aims to overcome. The students will come into acquaintance with the core concepts, methods, techniques, and tools for computer support of knowledge management and helps to understand how to apply and integrate appropriate components and functions of various knowledge management systems. It also helps the students to further their study in knowledge generation, organization, and exchange of knowledge. It also tries t critically evaluate current trends in knowledge management and their manifestation in business and industry.

**COURSE CONTENT**

**MODULE I:** The Nature of Knowledge -Knowledge Management (KM) - concept and its conceptualization - Knowledge Management Solutions - basic KM discipline, emerging trends, practices, institutionalizing best practices for KM, process orientation: different types of knowledge. Overview of Knowledge Management-Organizational Impacts of Knowledge Management-Factors Influencing Knowledge Management

**MODULE II:** IT in KM; social capital, intellectual capital (measurement- key performance indicators and evaluation) and critical success factors, customer value management; networked knowledge economy

**MODULE III:** Technologies to Manage Knowledge: Artificial Intelligence, Digital Libraries, Repositories, etc. - Preserving and Applying Human Expertise: Knowledge-Based Systems - Past History Explicitly as Knowledge: Case-Based Systems - Knowledge Elicitation: Converting Tacit Knowledge to Explicit- Discovering New Knowledge: Data Mining Text - KM & Text Mining

**MODULE IV:** Tools kit for KM: knowledge networker's tools kit, knowledge teams tools kit, knowledge based enterprise tools kit, enterprise tools kit - Knowledge Capture Systems: Systems that Preserve and Formalize Knowledge; Concept Maps, Process Modeling, RSS, Wikis, Delphi Method, etc. - knowledge Sharing Systems: Systems that Organize and Distribute Knowledge; Ontology Development Systems, Categorization and Classification Tools, XML-Based Tools, etc. - Knowledge Application Systems: Systems that Utilize Knowledge

**MODULE V:** Knowledge futures: knowledge markets, knowledge ethics and governance, knowledge scenario KM matrix; learning and knowledge (differences in learning styles, corporate memory and learning) – KM Audit -

**MODULEVI:** Case Studies on various aspects of Knowledge Management

**REFERENCES**


- AmritTiwana (2002). *The Knowledge Management Toolkit: Orchestrating IT, Strategy, and Knowledge Platforms* (2nd Edition). Prentice Hall.
- Elias M. Awad, Hassan M. Ghaziri (2004). *Knowledge Management*.Prentice Hall.
- Irma Becerra-Fernandez, Avelino Gonzalez, Rajiv Sabherwal (2004). *Knowledge Management Challenges, Solutions, and Technologies* (edition with accompanying CD).Prentice Hall. ISBN: 0-13-109931-0.
- Madanmohan Rao (2004). *Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions*. Butterworth-Heinemann.
- Stuart Barnes (ed) (2002). *Knowledge Management Systems Theory and Practice*. Thomson Learning

**Semester: II**
**Course Code: FUS-E-6218**
**Course Title: COMPUTER AIDED DECISION SUPPORT SYSTEMS**
**Credits: 3**

**AIM:** To provide the students with a working knowledge of topics related to Decision Support Systems design and implementation. Upon completion of the class, students should be able to develop their own decision support system applications that integrate databases and models with an intuitive user interface. Additionally, the course also aims at exploring recent trends and advancements in decision support systems, especially the MRP and ERP systems with knowledge bases.
.

**OBJECTIVES**

- to provide students with a working knowledge of topics related to Decision Support Systems design and implementation.
- to develop their own decision support system applications that integrate databases and models with an intuitive user interface.
- to explore recent trends and advancements in decision support systems, especially the MRP and ERP systems with knowledge bases.

**COURSE CONTENT**

**MODULE I:** Introduction to information system analysis and design, decision support systems, database management systems, query languages, user interfaces. User interface languages, usability designs and considerations, model-based management systems

**MODULE II:** Development of decision support models, basic simulation models, mathematical and empirical models. Model validation and verification, algorithms for decision support, alternative analysis, and knowledge based systems, implementing EOQ models

**MODULE III:** Enterprise resource planning systems, manufacturing resource planning systems -Introduction to decision support systems, decision theory, rational decisions, applicability.

**MODULE IV:** Database management systems, MySQL in Linux platform, Relational database concept -relationships, normal forms, database design for complex systems - Database queries, query languages and query optimization for decision support systems, Implementing SQL through server side scripting.

**MODULE V**: User interfaces, HTML+PHP as user interface (UI) designing tools- Server side programming, interfacing with MySQL etc.

**MODULE VI:** Usability considerations of UI, information gathering and presentation for decision support, manipulation of query results. Application of decision support system in manufacturing systems.

**REFERENCES**


- Caisson M. Vickery, The Use of Computer-Aided Decision Support Systems for Complex Source Selection Decisions, PN Publications
- Frada Burstein, Clyde Holsapple, Handbook on Decision Support Systems 1: Basic Themes, Volume 1, Springer

**Semester: II**
**Course Code: FUS-E-6219**
**Course Title: INTELLIGENT MANUFACTURING SYSTEMS**
**Credits: 3**

**AIM:** The course intends to understand the use of computers and associated equipment to integrate the flow of information across the various activities performed in manufacturing organizations.

**OBJECTIVES**

The course is designed to provide students with the knowledge, skills, and abilities to successfully meet the most difficult challenges of modern manufacturing industries on a global scale. The option provides engineers with detailed state-of-the-art knowledge of both traditional and advanced manufacturing technologies, systems integration techniques, economic analysis methods, and operations management practices and principles. Based upon this knowledge, students develop the ability to perform analysis, evaluation, and synthesis for a broad range of problems related to the design, implementation, and efficient operation of manufacturing systems.

**COURSE CONTENT**

**MODULE I:** Introduction to Expert system - Introduction to Artificial Intelligence, Expert Systems Overview; Development of Expert Systems; Problem Presentation, Expert System Structure, Knowledge Bases and Representation, Inference Mechanism, Probability and Fuzzy Logic, User Interface, Development Cycle, Expert System Development tools.

**MODULE II:** Introduction to PROLOG; Syntax and operations, Data Structures, Backtracking and Cut, Input-Output, Predicates, Logic; Classes and Expert System Approaches

**MODULE III:** Analysis, Design Planning and Object-Oriented Systems in Manufacturing; Systems in System Design; Equipment Selection, Layout Design

**MODULE IV:** Materials Handling, Capacity Planning; Systems in Product Design and Development; Product Design, Feature Extraction and Recognition, Bar Codes and Coding of Components

**MODULEV:** System in Manufacturing Planning, Scheduling and Control; Group Technology, NC Part Programming, Process Planning - Generative and Variant, Production Planning, Resource Scheduling, Automatic Storage and Retrieval, Robot Trajectory Planning, Inspection; Applications Exercises; Exposure to Expert System Shells and Packages, Manufacturability Evaluation.

**MODULE VI:** Case studies

**REFERENCES**


- Andrew Kusiak, Intelligent Manufacturing Systems, Prentice Hall (1990)

- Mohammed Jamshidi and Hamid R. Parsaei, Design and Implementation of Intelligent Manufacturing Systems: From Expert Systems, Neural Networks, to Fuzzy Logic (Prentice-Hall, 1995)

**Semester: III**
**Course Code: FUS-C-631**
**Course Title: RESEARCH METHODOLOGY AND NEGOTIATED STUDIES**
**Credits: 2**

**AIM:** The aim of the course is to give students the tools to conceptualize their thesis in terms of research questions and design, methodology, data collection and qualitative/quantitative analysis etc.

**OBJECTIVES**

- To understand the fundamental aspects of the epistemology, ontology and methodology of scientific and technological researchas well as the methods/tools/ methodology in general.
- To address the issues, problems, and strategies related to a student research problem.
- To understand and learn entirely by the student itself on a negotiated module

**COURSE CONTENT**

**MODULE I:** Science in distinction to technology; Technologies to manage the world outside and oneself; Methodology, method and technique

**MODULE II:** Commonsense and Science; Popular Knowledge and Scientific Knowledge-Objectivity and Subjectivity; Value Neutrality; Law and Truth; Universality-Methodology-Method –Technique- Epistemology; Ontology; Historical Ontology (overcoming essentialism)-Deterministic and Non-deterministic Sciences-Human Reason and Modern Scientific Knowledge

**MODULE III:** Survey of Research Methodologies: Rationalism, Idealism, Positivism, Post Positivism. Introduction to major binaries of modern science, Subjectivity vs Objectivity, Realism vs Anti –realism, True vs False, Scientific evolution vs Scientific Revolutions, Continuity vs Discontinuity, Deterministic vs Probabilistic, Linearity vs Non –Linearity;

**MODULE IV:** Beyond the binaries and deterministic science - Methods: Deduction, Induction, Hypothetical Deductive -method, Explanation and Prediction, General and Particular, Cause and Effect. Scientific revolutions, Paradigms, Against Method, Epistemic shift; Frontiers of technology management research.

**MODULE V:** Arrow of Time: Linearity and non-linearity; Irreversible Time- Postmodern Condition; Post-structuralism; Deconstruction -From Methodology to Methodologies

**MODULE VI:** Negotiated Studies. The students can select a review research paper in a standard journal and critically review the contents and make a report on how to approach a research problem.

**REFERENCES**


- Abraham Kaplan, 1964, *Conduct of Inquiry*, Chander Publishing Company, California.

- Ann Majchrzak, 1984, *Methods for Policy Research*, Sage London
- Carl G Hempel *"The Covering Law Analysis of Scientific Explanation"* in Leonard I Krimerman (ed)
- Catheriner Marsh, 1988, *Exploring Data*, Polity Press, Cambridge
- Cohen and Ernest Nagel (ed) 1978, An Introduction to Logic and Scientific Method, Allied, New Delhi
- Jean-Francois Lyotard, The Post Modern Condition: A Report on Knowledge, The Manchester University Press, Manchester
- John Brewer and Albewrt Hunter, *Multimethod Research*: *A synthesis of Styles*, Sage Publications, London
- Karl R Popper, "*The Hypothetical – Deductive Method and the Unity of Social and Natural Science",* in Leonard I Krimerman (ed)
- Peter Clough and Cathy Nutbrown, A Students Guide to Methodology, Sage Publications, London
- Thomas S Khun, The Structure of Scientific Revolution, University of Chicago Press, Chicago

**Semester: III**
**Course Code: FUS-P-632**
**Course Title: INDUSTRIAL PROJECT**
**Credits: 3**

**AIM:** The aim of this course is to address a problem of practical relevance in an industry or an organization of similar type.

**OBJECTIVES**

- to identify an existing/new problem in an industry/organization and approach the problem from a research point of view.
- to study and analyze some existing problem in the industry/organization and suggest possible improvements/strategies and prepare the details under the supervision and guidance from the concerned officer/executive of the industrial concern.

**REFERENCES**

All literature relevant to the chosen Industrial Problem as suggested by the advisor of the industry and required for the student.

**Semester: III**
**Course Code: FUS-D-633**
**Course Title: DISSERTATION (STAGE I)**
**Credits: 7**

**AIM:** The aim of the first stage of dissertation is to identify the topic and problem for the dissertation. To develop (with the advisor's guidance) a research plan at the beginning of the semester that will state a research problem/question/hypothesis, its background, outline a research strategy and experimental approach, method of data collection, interpretation and validation, and method of communication of the project results to others.

## OBJECTIVES

- To discover and pursue a unique topic of research in order to construct new knowledge
- To design and conduct an original research project
- To develop skills in designing a discipline specific research methodology.
- To develop a working knowledge of relevant literature in the discipline
- To practice scientific writing and learn how to participate in the peer review process
- To be able to discuss research and other topics with academics in your field

## COURSE CONTENT

Assign the student to develop a research plan and schedule for the semester/session and use this plan as the basis for assignments and assessment of the student's performance.

An exhaustive review of literature is to be done and place the problem suitably in the overall realm of research arena so that the exact gap identified. The student should have a clear idea of the objectives, tools and methodology for the problem at hand.

## READING LIST

All literature relevant to the chosen Research Problem as suggested by the advisor and required for the student.

**Semester: III**
**Course Code: FUS-E-634**
**Course Title: INTELLIGENT AND KNOWLEDGE BASED SYSTEM**
**Credits: 2**

**AIM:** The course aims to provide an overview of the Artificial Intelligence (AI) field with particular emphasis on knowledge representation.

**OBJECTIVES**

- Gain a thorough knowledge of the field of Artificial Intelligence
- Understand the emerging approaches in AI and their implications for Information Engineering
- Demonstrate understanding of the applications of AI in business and industry

**COURSE CONTENT**

**MODULE I:** Overview of the Artificial Intelligence - Basic concepts; Definition of AI; Background and past achievements; Aims -Overview of application areas; Problems and problem solving: State space search; Production rules; Logic; Heuristic search techniques; Generate and test; Hill climbing; Search reduction strategies

**MODULE II:** Knowledge Representation -Representation models; Predicate logic; rules; Semantic nets; Frames; Conceptual graphs; -Scripts; Fuzziness and uncertainty; Fuzzy logic; Statistical techniques for determining probability

**MODULE III:** Methodologies - Methodologies for developing knowledge based systems; The KBS Development Life Cycle; Knowledge acquisition/elicitation; Management of KBS projects; Prototyping; Implementation; Development environments

**MODULE IV:** Adaptive Approaches-Neural Networks; Architectures; Hopfield network; Multi-layer perception; Feed forward; Back propagation; Genetic algorithms: Basic concepts; Population; Chromosomes; Operators; Schemata; Coding, Rule induction; Basic concepts; Decision trees/rule sets

**MODULE V:** Major Application Areas-Expert systems; Natural language processing; Machine vision and robotics; Data mining and intelligent business support; Internet based application

**MODULE VI:** Softwares and Packages for AI based Knowledge management

**REFERENCES**


- Damiani, E., Howlett, R.J., Jain, L.C., Ichalkaranje, N., Knowledge-based Intelligent Information Engineering Systems and Allied Technologies, edited (STM Publishing House, 2002)

- Maria Virvou, L. C. Jain Intelligent Interactive Systems in Knowledge-Based Environments. ( Springer, 2008)

**Semester: III**
**Course Code: FUS-E-635**
**Course Title: SYSTEMS DYNAMICS MODELLING AND APPLICATIONS**
**Credits: 2**

**AIM:** The overall goal of this course is to provide students with a gentle introduction to the area of system dynamics and how system dynamics modelling is applied socioeconomic and business situations.

**OBJECTIVES**

This course aims to guide individuals to acquire knowledge and skills necessary to conceptualize dynamic policy problems, develop appropriate simulation models, and use models for decision making and policy analysis. The core of this course is to understand the significance and usefulness of information feedback and circular causality in comprehending the behavior of social systems. The course is appropriate and beneficial for both people who wish to equip themselves with capabilities of understanding studies that employ computer simulation approach, and for people who wish themselves to become skilled simulation modelers.

**COURSE CONTENT**

**MODULEI:** Introduction: Purpose and concepts of system dynamics - Building a model

**MODULE II:** Problem definition and model purpose; building theory with causal loop diagrams

**MODULE III:** Mapping the stock and flow structure of systems Dynamics of stocks and flows; linking feedback with stock and flow structure-Understanding the Dynamics of Simple Systems

**MODULE IV:** Analyzing Systems and Creating Robust Policies

**MODULE V:** Industry dynamics and diffusion models

**MODULE VI:** Growth Strategies- Network externalities- complementarities, and path dependence

**REFERENCES**


- Coyle, Robert Geoffrey. *System dynamics modelling: a practical approach*. Vol. 1. CRC Press, 1996.
- Sterman, J. (2000). Business Dynamics: Systems Thinking and Modeling for a Complex World, Irwin/McGraw Hill. ISBN 0-07-238915X.
- Sushil. *System dynamics: a practical approach for managerial problems*. Wiley Eastern Limited, 1993.

## ADDITIONAL REFERENCES

- iThink: See the isee Systems web site at <www.iseesystems.com>.
- Powersim: See the Powersim web site at <www.powersim.com>.
  Vensim: See the Ventana Systems web site at <www.vensim.com>.

**Semester: III**
**Course Code: FUS-E-636**
**Course Title: PLANNING AND MANAGEMENT OF HUMAN RESOURCES**
**Credits: 2**

**AIM:** The course aims to familiarize the students the human resource management processes and to sensitize them to the training process and techniques.

**OBJECTIVES**
The basic Objective of the course is to provide a sound understanding of the basic principles of Human Resource Management and their applications in the business and industry The course aims at developing a basic understanding in the students of the issues relating to procurement, development, appraisal, compensation, integration etc. of human resource for its optimum utilization and productivity in the organisation in the context of dynamic business environment.

**COURSE CONTENT**

**MODULE I:** The approach to human resources management: Concept , objectives , scope, functions , importance - Human Resource Planning - Meaning , Objectives, process, limitations, importance , responsibility for human resource planning .

**MODULE II:** Recruitment and Selection - Meaning, sources of recruitment, selection process, induction - Social aspects - Problems of selection,

**MODULE III:** Training and placement in diverse organisations - Meaning , identification of training and development needs , methods of training and development, evaluation of training and development programmes, significance of training and development , career development - Planning of human resources - Manpower planning - Manpower Development - Utilisation of human resources - Performance appraisal : Meaning , process , methods, limitations, importance, internal mobility , separation -

**MODULE IV:** Wage and Salary Administration : Concept, objectives, factors influencing wage and salary administration . Job evaluation : meaning , principles, methods, limitations, importance , Systems of payment : Time rate system ,piece rate system , Incentive payments .Fringe benefits, Executive compensation .

**MODULE V:** Industrial relations and personnel management functions, legal aspects, factories acts- Training needs and planned refresher programmes at various levels for updating sills - Evaluation of training.

**MODULE VI:** Case Studies of various aspects of Human resource management.

**REFERENCES**


- Dale Yoder & Paul Staudohar : Personnel Management & Industrial Relations Prentice-Hall, Inc New York :

- David A. De Cenze(2009) Fundamentals of Human Resource Management, Tenth Edition, Wiley, John & Sons
- Subba Rao P. (2013) Essentials of Human Resource Management & Industrial Relations.Himalaya Publishing House.

**Semester: III**
**Course Code: FUS-E-637**
**Course Title: IT IN HEALTH CARE**
**Credits: 2**

**AIM:** This course will prepare students with a basic understanding of major IT applications in Healthcare and essential skills of managing them, how information systems and technology can improve the quality of service provided to consumers and the clinical quality of health care is examined, as well as the technology selection, acquisition and implementation processes.

**OBJECTIVES**

This course will help students develop familiarity with major IT applications in healthcare. This course equips the students to develop essential skills of acquiring, implementing, managing, and evaluating information technology applications in healthcare.

**COURSE CONTENT**

**MODULE I:** Introduction to Information Technology in Health Care, Essential Concepts of Health Care Information Systems

**MODULE II:** Healthcare Data Management, Patient Care Applications, E-Health Applications.

**MODULE III:** Internet Medical Consultancy Centres, Cyberspace in Medicines, Digital Internet library,

**MODULE IV:** IT in Hospital Management, Video Conferencing, IT in Pharmacy, Internet in Diagnostics Health Records Management, Medical Transcription Technologies

**MODULE V:** Expert Systems in Medicine, Spinoffs of Internet Technologies in Organ Transplantation, Picture Archival and Communication Systems, Medical Image Processing Techniques.

**MODULE VI: C**ase studies

**REFERENCES**


- Davis, Nadinia, and Melissa LaCour. *Introduction to health information technology*. Saunders WB Co, 2001.
- Glandon, Gerald L., Donna J. Slovensky, and Detlev H. Smaltz. *Information systems for healthcare management*. Health Administration Press, 2013.
- Johns, Merida L. *Health information management technology: An applied approach*. Chicago, IL: American Health Information Management Association, 2002.
- Kropf, Roger, and Guy Scalzi. *Making Information Technology Work: Maximizing the Benefits for Health Care Organizations*. AHA Press, 2007.

- Shortliffe, Edward H., and James J. Cimino. *Biomedical informatics*. Springer Science+ Business Media, LLC, 2006.3rd ed. New York City, NY: Springer; 2006. ISBN 0387289860.

**Semester: III**
**Course Code: FUS-E-638**
**Course Title: STRUCTURE AND ANALYSIS OF COMPLEX NETWORKS**
**Credits: 2**

**AIM:** This course aims to give a basic understanding on the emerging science of complex networks and their applications, through an introduction to techniques and models for understanding and predicting their behaviour.

## OBJECTIVES

1. Explain the main concepts of complex network analysis
2. Be familiar with its models to explain emergent features of complex networks
3. Explain and use methodologies and softwares for analyzing networks;

## COURSE CONTENT

**MODULE I:** Quick review of graph theory concepts, Random networks, Scale-free networks, Small world, Preferential attachment, fitness, resilience against random attacks

**MODULE II:** Network metrics and properties: degree, clustering coefficient, diameter, density, shortest paths, centralities, communities, influence detection techniques and measures of user influence

**MODULE III:** Network visualization: graph formats; graph drawing; graph layout methods and algorithms

**MODULE IV:** Graph models: Erdos-Renyi random models (for comparison); small-world model; models of scale free networks, preferential attachment, and Barabasi-Alberto model (other models as science advances).

**MODULE V**: Citation Networks-Detailed analysis of citation networks

**MODULE VI:** Softwares and packages for complex networks analysis

## REFERENCES


- Maarten van Steen:, Graph Theory and Complex Networks: an Introduction, 2010
- Mark Newman: Networks an Introduction, OUP Oxford, 2010
- Networks". Princeton University Press, 2006.
- Newman, M., Barabasi, A. and Watts, D. “The Structure and Dynamics of


## ADDITIONAL REFERENCES

- http://www.cs.cornell.edu/~lwang/Wang10TAMC.pdf?attredirects=0
- http://www.cs.usyd.edu.au/~visual/valacon/

**Semester: III**
**Course Code: FUS-E-639**
**Course Title: INTRODUCTION TO DATA ANALYSIS**
**Credits: 2**

**AIM:** The overall goal of this course is to provide students with a gentle introduction to the world of statistical data analyses and, familiarize them with various methods and software packages.

**OBJECTIVES**

By the end of the course, students should be able to enter tabular data, plot data, and carry out exploratory data analysis in R. Upon completion of this course, students should be able to think critically about data and apply standard statistical inference procedures to draw conclusions from such analyses.

**COURSE CONTENT**

**MODULE I:** An Introduction to R: A Programming Environment for Data Analysis and Graphics

**MODULE II:** Numerical and graphical summaries of data Module

**MODULE III:** Hypothesis Testing, Confidence Intervals, Counts And Tables,

**MODULE IV:** Analysis Of Variance, Regression,

**MODULE V:** Principal components, and Linear discriminant analysis

**MODULE VI:** *Factor analysis and cluster analysis*

**REFERENCES**


- Chatterjee, Samprit, and Ali S. Hadi. *Regression analysis by example*. John Wiley & Sons
- De Veaux, Richard D., Paul F. Velleman, and David E. Bock. *Stats: data and models*. Boston: Pearson/Addison Wesley, 2005.
- Gonick, Larry, and Woollcott Smith. *The cartoon guide to statistics*. New York: HarperPerennial
- Ramsey, Fred, and Daniel Schafer. *The statistical sleuth: a course in methods of data analysis*. Cengage Learning, 2012.
- Weisberg, Sanford. *Applied linear regression*. John Wiley & Sons, 2014.


**ADDITIONAL REFERENCES**


- Emmanuel Paradis, R for Beginners, (available at http://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf)

- Julian J. Faraway, Practical Regression and Anova using R (available at http://cran.r-project.org/doc/contrib/Faraway-PRA.pdf)
- Venables, W. N. D. M. Smith and the R Core Team, An Introduction to R - Notes on R: A Programming Environment for Data Analysis and Graphics (available at http://cran.r-project.org/doc/manuals/R-intro.pdf)

**Semester: III**
**Course Code: FUS-E-6310**
**Course Title: MANAGEMENT INFORMATION SYSTEMS**
**Credits: 2**

**AIM:** To help students to understand the meaning and concept of MIS, its role in decision making and the various models involved in the decision making process. The informational needs at various levels, the scope of databases in integrating various functional and activity subsystems and the applicability of MIS for enterprise wide solutions are discussed in detail. By closely following this course, the students will learn how to design and implement MIS for making organisations competitive in the dynamically changing IT environment

**OBJECTIVES**

- develop understanding on MIS in general
- generate insight on developing MIS for an industrial concern/business entity
- comprehend the role of MIS in decision making
- appreciate the inevitability of ICT in MIS

**COURSE CONTENT**

**MODULE I:** An overview of management - strategic management - Importance of information in managerial decision making – Business environment – MIS – concepts – Role and impact of MIS in organisations

**MODULE II:** Concepts in planning and control – concepts of information – organisational structure – system concepts – decision making process – behavioural models of organisational decision making and decision maker – decision making under stress – documenting and communicating decision rules.

**MODULE III:** Database management system – Logical and Physical view of data, Types of data bases,

**MODULE IV:** System Development - Determination of information needs and sources – selection of conceptual design options – detailed MIS design – forms and report design – physical systems design – physical data base design - procedure development – programme development – testing – quality assurance. organizational aspects of implementation – operation and maintenance – post audit.

**MODULE V:** Enterprise Resource Planning, Softwares in MIS

**MODULE VI:** MIS Case studies – Future scope of MIS

**REFERENCES**


- August W. Smith: Management Systems: Analysis and Applications: by (Dryden Press)

- Gordon B. Davis & Margrethe H. Olsen: Management Information Systems – Conceptual Foundations, Structure and Development (McGraw Hill)
- Robert Murdick & Joel Ross: Introduction to MIS : by (Prentice Hall)

**Semester: II**
**Course Code: FUS-E-6311**
**Course Title: BIO-MEDICAL ENGINEERING**
**Credits: 2**

**AIM:** The course aims to give an introduction into the biomedical engineering through discussion of its evolution as a discipline, highlighting the Physiological systems of the body.

**OBJECTIVES**

This course establishes a knowledge pathway into the all time important field- Biomedical Engineering. Its Primary focus is to create awareness about importance of biomedical engineering in treatment of diseases. Students should have clear understanding about recent developments in biomedical engineering by the end of this course. This will invoke research interest and make them industry ready.

**COURSE CONTENT**

**MODULEI:** Introduction to Biomedical Engineering –Basics of anatomy and physiology for engineers-Physiological systems of the body - Respiratory systems, Cardiovascular systems, Nervous systems –Membrane potentials and Action potentials

**MODULEII:** Skeletal muscles contraction, Neuro muscular transmission - electrodes used for the measurement of bio- electric potentials (biopotential electrodes) - Electrode theory - Macro electrodes - Micro electrodes - Biochemical transducers

**MODULE III:** Study of ECG, EMG, EEG - Therapeutic equipment

**MODULE IV:** Modern imaging systems like MRT, CT Scan-. Biomaterials - Materials used for hard / soft tissue replacement

**MODULE V:** LASER applications in biomedical engineering –Minimal Invasive Procedure and technologies- Artificial Internal Organs.

**MODULE VI:** Bio-Medical Engineering case studies

**REFERENCES**


- Bronzino, Joseph D. *Biomedical engineering handbook*. Vol. 2. CRC press, 1999.
- Enderle, John Denis, and Joseph D. Bronzino, eds. *Introduction to biomedical engineering*. Academic Press, 2012.
- Ferrara, Katherine, Rachel Pollard, and Mark Borden. "Ultrasound microbubble contrast agents: fundamentals and application to gene and drug delivery."*Biomedical Engineering* 9 (2007).
- Goyal, Megh R. *Biomechanics of Artificial Organs and Prostheses*. CRC Press, 2014.
- Kline, Jacob, ed. *Handbook of biomedical engineering*. Elsevier, 2012.

• Park, Joon B., and Joseph D. Bronzino, eds. *Biomaterials: principles and applications*. crc press, 2002.
• Rangayyan, Rangaraj M. *Biomedical signal analysis*. IEEE Standards Office, 2001.
• West, Jennifer L., and Naomi J. Halas. "Engineered nanomaterials for biophotonics applications: improving sensing, imaging, and therapeutics."*Annual Review of Biomedical Engineering* 5.1 (2003): 285-292.

**ADDITIONAL REFERENCES**

• http://www.embs.org/about-biomedical-engineering
• http://www.worldscientific.com/worldscinet/bme
• https://www.asaio.com/

**Semester: III**
**Course Code: FUS-E-6312**
**Course Title: SOFTWARE PROJECTS MANAGEMENT**
**Credits: 2**

**AIM:** This course aims to cover the techniques for managing software projects. It is intended to give the students both knowledge about, and practical experience in, the design and development of production of quality software.

**OBJECTIVES**

- Discuss the tasks under taken by a project manager
- To understand software project management as practiced in industry
    - Understand project planning and planning process

**COURSE DESCRIPTION:** This course will cover the techniques for managing software projects. It is intended to give the students both knowledge about, and practical experience in, the design and development of production quality software. The techniques taught in the class will be applied to a substantial team project.

**COURSE CONTENT**

**MODULE I:** Project Formation and Appraisal - Project Management – an overview – Feasibility – Technical – Market and Demand – Economic and Financial – Formulation of Detailed Project Reports

**MODULE II:** Project Definition – Contract Management – Activities covered By Software Project Management – Overview of Project Planning – Stepwise Project Planning

**MODULE III:** Objectives – Project Schedule – Sequencing and Scheduling Activities – Network Planning Models – Forward Pass – Backward Pass – Activity Float – Shortening Project Duration – Activity on Arrow Networks – Risk Management – Nature Of Risk – Types Of Risk – Managing Risk – Hazard Identification – Hazard Analysis – Risk Planning And Control.

**MODULE IV:** Creating Framework – Collecting The Data – Visualizing Progress – Cost Monitoring – Earned Value – Prioritizing Monitoring – Getting Project Back To Target – Change Control – Managing Contracts – Introduction – Types Of Contract – Stages In Contract Placement – Typical Terms Of A Contract – Contract Management – Acceptance.

**MODULE V:** Project Life cycle – Initiating – Planning – Executing – Controlling – Closing

**MODULE VI:** Risk Management and Control

**REFERENCES**


- Bob Hughes, Mikecotterell, “Software Project Management”, Third Edition, Tata McGraw Hill, 2004.

- Humphrey, Watts S. *Managing the Software Process (Hardcover)*. Addison-Wesley Professional, 1989.
- Jalote, “Software Project Management in Practice”, Pearson Education, 2002.
- Royce, Walker. *Software project management*. Pearson Education India, 1998.

**Semester: III**
**Course Code: FUS-E-6313**
**Course Title: PARALLEL PROGRAMMING WITH MPI**
**Credits: 2**

**AIM:** Large scale computer simulations require high performance computing facilities. The aim the course is to develop programming skill to develop parallel programs to run on cluster computers using message passing interface to reduce computing time.

**OBJECTIVES**
By the end of the course participants will be able to apply the concepts of Message Passing to the creation of a program that executes efficiently on a parallel computer architecture.

**COURSE CONTENT**

**MODULE I:** Introduction to Parallel Processing -What is Parallel Processing ?-The Goals of Parallel Processing -Pros and Cons of Parallel Processing -Sequential Limits -Why Parallel Processing -Simplified Examples -Applications -History of Supercomputing

**MODULE II:** Types of Parallel Systems-SISD - Single Instruction stream over a Single Data Stream Single Instruction stream over a Single Data Stream -MISD - Multiple Instruction stream over a Single Data stream -SIMD - Single Instruction, Multiple Data Stream MIMD - Multiple Instruction, Multiple Data Stream

**MODULE III:** What is MPI -Basic Idea of MPI -When Use MPI -Getting started with LAM -MPI Commands -MPI Environment -MPI Functions Specifications -MPI Datatypes

**MODULE IV:** Parallel Programming using MPI -Communication Strategies-Point to Point Communication –Collective Communication -Performance Evaluation

**MODULE V:** Demonstration and Writing of Simple MPI Programs

**MODULE VI:** Rewrite Sequential Program to Parallel Program, Strategies to rewrite Sequential Program

**REFERENCES**

- Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing. Second Edition. Addison-Wesley, 2003 (ISBN 0 201 64865 2).
- Gropp, William, Ewing Lusk, and Anthony Skjellum. *Using MPI: Portable Parallel Programming with the Message Passing Interface*. 2nd ed. Cambridge, MA: MIT Press, 1999. ISBN: 9780262571326.
- Gropp, William, Steven Huss-Lederman, Andrew Lumsdaine, Ewing Lusk, Bill Nitzberg, William Saphir, and Marc Snir. *MPI: The Complete Reference (Vol. 2) - The MPI-2 Extensions*. 2nd ed. Cambridge, MA: MIT Press, 1998. ISBN: 9780262571234.
- Selim G . Akl, The Design and Analysis of Parallel Algorithms, Prentice-Hall, Inc. 1989.
- Snir, Marc, and William Gropp. *MPI: The Complete Reference (2-volume set)*. 2nd ed. Cambridge, MA: MIT Press, 1998. ISBN: 9780262692168.

- Snir, Marc, and William Gropp. *Using MPI-2: Advanced Features of the Message Passing Interface*. Cambridge, MA: MIT Press, 1999. ISBN: 9780262571333.


**ADDITIONAL REFERENCES**


- http://openmp.org/wp/
- http://www.mpi-forum.org/
- https://computing.llnl.gov/tutorials/mpi/
- *https://computing.llnl.gov/tutorials/parallel_comp/*

**Semester: IV**
**Course Code: FUS-D-641**
**Course Title: DISSERTATION (STAGE II)**
**Credits: 16**

**AIM:** The student will continue the development (with the advisor's guidance) of the research problem selected in the **Dissertation (stage I )** and complete the work using appropriate tools and methods, algorithms, experiment etc.

**OBJECTIVES**
- To discover and pursue a unique topic of research in order to construct new knowledge
- To design and conduct an original research project
- To develop skills in designing a discipline specific research methodology.
- To develop a working knowledge of relevant literature in the discipline
- To practice scientific writing and learn how to participate in the peer review process
- To be able to discuss research and other topics with academics in your field

**COURSE CONTENT:** Assign the student to develop the research plan and question as a continuation of **Dissertation (stage I )** andschedule for the semester/session and use this plan as the basis for assignments and assessment of the student's performance.

The **Dissertation (Stage II)** must contain the detailed procedures for data collection/ survey/methods, theory and tools to be developed. The student should present the results/output and analysis of the study before finalizing the report. The final report is to be prepared by incorporating the suggestions after the presentations**.**

**REFERENCES**
All literature relevant to the chosen Research Problem as suggested by the advisor and required for the student

**Semester: I**
**Course Code: FUS-X-611**
**Course Title: FORESIGHT AND FUTURES RESEARCH**
**Credits: 2**

**AIM:** This course aims for an exploration of the field of futures studies, with an overview of the futures discipline and giving a base and context for critical thinking about the future.

**OBJECTIVES**

- become familiar with the critical concepts in futures studies
- be capable of greater foresight about emerging issues, trends, impacts, and their implications
- develop communication skills to engage in effective dialogs on the future with the goal of influencing the future
- be familiar with other futures tools and with exploring the implications of change.
- become excited about the field of futures

**COURSE CONTENT**

**MODULE I:** Review futures basics- Become acquainted with key concepts, terms, and perspectives of the futures field.- Introduce some of the publications and organizations in the field and discuss futures skills- Identify the major events and founders in the history of future studies - Discuss what it means to be a futurist- Role of a futurist

**MODULE II:** Six Basic Concepts and six Basic Pillars of Futures Studies- Prominent Futures Schools

**MODULE III:** Environmental Monitoring, Scanning-Identify and monitor key quantities and conditions that indicate whether or not the baseline is occurring -Environmental scanning as the means to keep current on change within a specific domain- Practice environmental scanning and assess how well each scanning hit fits the ideal criteria -Use scanning hits as the empirical support for alternative plausible futures

**MODULE IV:** Creativity- Scenarios -The key concepts, terms, and approaches to creativity- A standard approach to creative problem solving and a variety of other Approaches
Scenario Theory- Key concepts, terms, and criteria of good scenarios-The use of scenarios in professional practice -A review of different ways that people can build scenarios Strengths and weaknesses of various scenario approaches

**MODULE V:** Implications and Opportunity Analysis - Drawing out the implications of scenarios using futures wheels- Identify challenges of specific scenarios for specific domains- Use those challenges to prioritize strategic issues that should be addressed- See change as resulting from trends, events, issues and images- Pick up the weak signals of coming change through environmental scanning - Setting up a good scanning system- Progress/Decline: That social change is generally an improvement of the human condition; or alternatively, that societies have descended from a better period to today. Development: That social change moves in a definite direction, but that the direction is neutral—not necessarily any better or any worse than the past, just different.

**MODULE VI:** Case Studies on Scenarios and other Futures Techniques

**REFERENCES**


- Bill Ralston & Ian Wilson, *The Scenario Planning Handbook*
- Jerry Glenn & Ted Gordon (eds.), *Futures Research Methodology V3.0*, CD, Washington DC, Millennium Project, 2012.
- Pero Micic, *The Five Futures Glasses,* 2010
- Thomas Chermack, *Scenario Planning in Organizations: How to Create, Use, and Assess Scenarios*, 2011
- Trevor Noble (2000), *Social Theory and Social Change*, New York: St Martin's Press**.**


**ADDITIONAL REFERENCES**


- https://en.wikiversity.org/wiki/Introduction_to_Futures_Studies
- http://www.csudh.edu/global_options/IntroFS.HTML
- https://cals.arizona.edu/futures/

**Semester: I**
**Course Code: FUS-X-612**
**Course Title: MANAGEMENT INFORMATION SYSTEMS**
**Credits: 2**

**AIM:** To help students to understand the meaning and concept of MIS, its role in decision making and the various models involved in the decision making process. The informational needs at various levels, the scope of databases in integrating various functional and activity subsystems and the applicability of MIS for enterprise wide solutions are discussed in detail. By closely following this course, the students will learn how to design and implement MIS for making organisations competitive in the dynamically changing IT environment

**OBJECTIVES**

- develop understanding on MIS in general
- generate insight on developing MIS for an industrial concern/business entity
- comprehend the role of MIS in decision making
- appreciate the inevitability of ICT in MIS

**COURSE CONTENT**

**MODULE I:** An overview of management - strategic management - Importance of information in managerial decision making – Business environment – MIS – concepts – Role and impact of MIS in organisations

**MODULE II:** Concepts in planning and control – concepts of information – organisational structure – system concepts – decision making process – behavioural models of organisational decision making and decision maker – decision making under stress – documenting and communicating decision rules.

**MODULE III:** Database management system – Logical and Physical view of data, Types of data bases,

**MODULE IV:** System Development - Determination of information needs and sources – selection of conceptual design options – detailed MIS design – forms and report design – physical systems design – physical data base design - procedure development – programme development – testing – quality assurance. organizational aspects of implementation – operation and maintenance – post audit.

**MODULE V:** Enterprise Resource Planning, Softwares in MIS

**MODULE VI:** MIS Case studies – Future scope of MIS

**REFERENCES**


- Gordon B. Davis &Margrethe H. Olsen Management Information Systems – Conceptual Foundations, Structure and Development (McGraw Hill)

- Robert Murdick& Joel Ross Introduction to MIS (Prentice Hall)
- August W. Smith Management Systems: Analysis and Applications (Dryden Press)

**Semester: I**
**Course Code: FUS-X-613**
**Course Title: ECONOMETRICS AND ECONOMIC FORECASTING**
**Credits: 2**

**AIM:** The course intends to provide a comprehensive introduction to econometric concepts and techniques.

**OBJECTIVES**
This course introduces students to simple and multiple regression methods for analyzing data in economics and related disciplines. The objective of the course is for the student to learn how to conduct and to critique empirical studies in economics and related fields. Although the emphasis of the course is on empirical applications, a treatment of traditional econometrics will also be made.

**COURSE CONTENT**

**MODULE I:** Nature and Scope of Econometrics, Statistical Concepts: Normal distribution; chi-sq, t- and F-distributions; estimation of parameters; properties of estimators; testing of hypotheses, Simple Linear Regression Model: Two Variable Case - Estimation of model by method of ordinary least squares; properties of estimators; goodness of fit; tests of hypotheses; scaling and units of measurement; confidence intervals; Gauss-Markov theorem; forecasting.

**MODULE II:** Multiple Linear Regression Model Estimation of parameters; properties of OLS estimators; goodness of fit - $R^2$ and adjusted $R^2$ - partial regression coefficients; testing hypotheses - Violations of Classical Assumptions: Consequences, Detection and Remedies Multicollinearity; heteroscedasticity; serial correlation,

**MODULE III:** Specification Analysis - Omission of a relevant variable; inclusion of irrelevant variable; tests of specification errors.

**MODULE IV:** Dummy variable technique – Use of dummy variables, regression with dummy variables – ANOVA models, ANCOVA models, interaction effects, piecewise regression, deseasonalisation, Logit, probit and Tobit models.

**MODULE V:** Forecasting using Time series models: Smoothing and Extrapolation of Time series – Simple extrapolation models, Smoothing and seasonal adjustment. Properties of stochastic Time series: Introduction to stochastic time series models. Stationary and Non stationary Time series, Linear Timer Series Models. Moving average models, ARIMA Models and Specification of ARIMA models.

**MODULE VI:** Application of Statistical Packages

**REFERENCES**


- Christian Gourieroux, Econometric of Qualitative Dependent Variables, Cambridge University Press, 2000.

- Christopher Dougherty, Introduction to Econometrics, Oxford University Press, 3rd edition, Indian Edition, 2007.
- Goldberger, A., A Course in Econometrics, Harvard University Press.
- Greene, W. H., Econometric Analysis, Prentice Hall.
- Gujarati, D. N. and D.C. Porter, Essentials of Econometrics, McGraw Hill, 4th edition, International Edition, 2009.
- Jan Kmenta, Elements of Econometrics, Indian Reprint, Khosla Publishing House, 2nd edition, 2008
- Kerry Patterson, An Introduction to Applied Econometrics: A time series Approach, Macmillan Press, London 2000.
- Krishna, K.L. Econometric Applications in India, OUP, New Delhi 1999.
- Robert. S.Pindiyck& Daniel Rubinfield, Econometric Models and Economic Forecasts, MacGraw Hill, 1998.
- Ruud, P., An Introduction to Classical Econometric Theory, Oxford University Press.
- Stock, J.H. and M.W. Watson, *Introduction to Econometrics* (first edition), Addison-Wesley, 2003 (available at the COOP
- Walter Enders, Applied Econometric Time Series, 2nd Edn., Wiley, 2008.
- Wooldridge, J.M., *Introductory Econometrics*, South-Western College Publishing.

**Semester: I**
**Course Code: FUS-X-614**
**Course Title: KNOWLEDGE MANAGEMENT**
**Credits: 2**

**AIM:** The course intends to provide thetheory and practice of Knowledge Management (KM), with an integrated interdisciplinary presentation.

**OBJECTIVES**
The present course tries to give an overall understanding of the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management. It also looks into what is role and use of knowledge in organizations and institutions, and the obstacles that KM aims to overcome. The students will come into acquaintance with the core concepts, methods, techniques, and tools for computer support of knowledge management and helps to understand how to apply and integrate appropriate components and functions of various knowledge management systems. It also helps the students to further their study in knowledge generation, organization, and exchange of knowledge. It also tries t critically evaluate current trends in knowledge management and their manifestation in business and industry.

**COURSE CONTENT**

**MODULE I:** The Nature of Knowledge -Knowledge Management (KM) - concept and its conceptualization - Knowledge Management Solutions - basic KM discipline, emerging trends, practices, institutionalizing best practices for KM, process orientation: different types of knowledge. Overview of Knowledge Management-Organizational Impacts of Knowledge Management-Factors Influencing Knowledge Management

**MODULE II:** IT in KM; social capital, intellectual capital (measurement- key performance indicators and evaluation) and critical success factors, customer value management; networked knowledge economy

**MODULE III:** Technologies to Manage Knowledge: Artificial Intelligence, Digital Libraries, Repositories, etc. - Preserving and Applying Human Expertise: Knowledge-Based Systems - Past History Explicitly as Knowledge: Case-Based Systems - Knowledge Elicitation: Converting Tacit Knowledge to Explicit- Discovering New Knowledge: Data MiningText - KM & Text Mining

**MODULE IV:** Tools kit for KM: knowledge networker's tools kit, knowledge teams tools kit, knowledge based enterprise tools kit, enterprise tools kit - Knowledge Capture Systems: Systems that Preserve and Formalize Knowledge; Concept Maps, Process Modeling, RSS, Wikis, Delphi Method, etc. - knowledge Sharing Systems: Systems that Organize and Distribute Knowledge; Ontology Development Systems, Categorization and Classification Tools, XML-Based Tools, etc. - Knowledge Application Systems: Systems that Utilize Knowledge

**MODULE V:** Knowledge futures: knowledge markets, knowledge ethics and governance, knowledge scenario KM matrix; learning and knowledge (differences in learning styles, corporate memory and learning) – KM Audit

**MODULE VI:** Case Studies on various aspects of Knowledge Management

**REFERENCES**


- AmritTiwana (2002). *The Knowledge Management Toolkit: Orchestrating IT, Strategy, and Knowledge Platforms* (2nd Edition). Prentice Hall.
- Elias M. Awad, Hassan M. Ghaziri (2004). *Knowledge Management*.Prentice Hall.
- Irma Becerra-Fernandez, Avelino Gonzalez, Rajiv Sabherwal (2004). *Knowledge Management Challenges, Solutions, and Technologies* (edition with accompanying CD).Prentice Hall. ISBN: 0-13-109931-0.
- Madanmohan Rao (2004). *Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions*. Butterworth-Heinemann.
- Stuart Barnes (ed) (2002). *Knowledge Management Systems Theory and Practice*. Thomson Learning

**Semester: II**
**Course Code: FUS-X-621**
**Course Title: SOFTWARE PROJECT MANAGEMENT**
**Credits: 2**

**AIM:** This course aims to cover the techniques for managing software projects. It is intended to give the students both knowledge about, and practical experience in, the design and development of production of quality software.

**OBJECTIVES**

- Discuss the tasks under taken by a project manager
- To understand software project management as practiced in industry
- Understand project planning and planning process

**COURSE CONTENT**

**MODULE I:** Project Formation and Appraisal - Project Management – an overview – Feasibility – Technical – Market and Demand – Economic and Financial – Formulation of Detailed Project Reports

**MODULE II:** Project Definition – Contract Management – Activities covered By Software Project Management – Overview of Project Planning – Stepwise Project Planning

**MODULE III:** Objectives – Project Schedule – Sequencing and Scheduling Activities – Network Planning Models – Forward Pass – Backward Pass – Activity Float – Shortening Project Duration – Activity on Arrow Networks – Risk Management – Nature Of Risk – Types Of Risk – Managing Risk – Hazard Identification – Hazard Analysis – Risk Planning And Control.

**MODULE IV:** Creating Framework – Collecting The Data – Visualizing Progress – Cost Monitoring – Earned Value – Prioritizing Monitoring – Getting Project Back To Target – Change Control – Managing Contracts – Introduction – Types Of Contract – Stages In Contract Placement – Typical Terms Of A Contract – Contract Management – Acceptance.

**MODULE V:** Project Life cycle – Initiating – Planning – Executing – Controlling – Closing

**MODULEVI:** Risk Management and Control

**REFERENCES**


- Bob Hughes, Mikecotterell, "Software Project Management", Third Edition, Tata McGraw Hill, 2004.
- Humphrey, Watts S. *Managing the Software Process (Hardcover)*. Addison-Wesley Professional, 1989.
- Jalote, "Software Project Management in Practice", Pearson Education, 2002.
- Royce, Walker. *Software project management*. Pearson Education India, 1998.

**Semester: III**
**Course Code: FUS-X-622**
**Course Title: INTRODUCTION TO DATA ANALYSIS**
**Credits: 2**

**AIM:** The overall goal of this course is to provide students with a gentle introduction to the world of statistical data analyses and, familiarise them with various methods and software packages.

**OBJECTIVES**
By the end of the course, students should be able to enter tabular data, plot data, and carry out exploratory data analysis in R. Upon completion of this course, students should be able to think critically about data and apply standard statistical inference procedures to draw conclusions from such analyses.

**COURSE CONTENT**

**MODULE I:** An Introduction to R: A Programming Environment for Data Analysis and Graphics

**MODULE II:** Numerical and graphical summaries of data Module

**MODULEIII:**Hypothesis Testing, Confidence Intervals, Counts And Tables,

**MODULE IV:** Analysis Of Variance, Regression,

**MODULE V:** Principal components, and Linear discriminant analysis

**MODULE VI:** *Factor analysis and cluster analysis*

**REFERENCES**


- Chatterjee, Samprit, and Ali S. Hadi. *Regression analysis by example*. John Wiley & Sons
- De Veaux, Richard D., Paul F. Velleman, and David E. Bock. *Stats: data and models*. Boston: Pearson/Addison Wesley, 2005.
- Emmanuel Paradis, R for Beginners, (available at http://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf)
- Gonick, Larry, and Woollcott Smith. *The cartoon guide to statistics*. New York: HarperPerennial
- Julian J. Faraway, Practical Regression and Anova using R (available at http://cran.r-project.org/doc/contrib/Faraway-PRA.pdf)
- Ramsey, Fred, and Daniel Schafer. *The statistical sleuth: a course in methods of data analysis*. Cengage Learning, 2012.
- Venables, W. N. D. M. Smith and the R Core Team, An Introduction to R - Notes on R: A Programming Environment for Data Analysis and Graphics (available at http://cran.r-project.org/doc/manuals/R-intro.pdf)

- Weisberg, Sanford. *Applied linear regression*. John Wiley & Sons, 2014.

**Semester: II**
**Course Code: FUS-X-623**
**Course Title: PARALLEL PROGRAMMING WITH MPI**
**Credits: 2**

**AIM:** Large scale computer simulations require high performance computing facilities. The aim the course is to develop programming skill to develop parallel programs to run on cluster computers using message passing interface to reduce computing time.

**OBJECTIVES**
By the end of the course participants will be able to apply the concepts of Message Passing to the creation of a program that executes efficiently on a parallel computer architecture.

**COURSE CONTENT**

**MODULE I:** Introduction to Parallel Processing -What is Parallel Processing ?-The Goals of Parallel Processing -Pros and Cons of Parallel Processing -Sequential Limits -Why Parallel Processing -Simplified Examples -Applications -History of Supercomputing

**MODULE II:** Types of Parallel Systems-SISD - Single Instruction stream over a Single Data Stream Single Instruction stream over a Single Data Stream -MISD - Multiple Instruction stream over a Single Data stream -SIMD - Single Instruction, Multiple Data Stream MIMD - Multiple Instruction, Multiple Data Stream

**MODULE III:** What is MPI -Basic Idea of MPI -When Use MPI -Getting started with LAM -MPI Commands -MPI Environment -MPI Functions Specifications -MPI Datatypes

**MODULE IV:** Parallel Programming using MPI -Communication Strategies-Point to Point Communication –Collective Communication -Performance Evaluation

**MODULEV:** Demonstration and Writing of Simple MPI Programs

**MODULE VI:** Rewrite Sequential Program to Parallel Program, Strategies to rewrite Sequential Program

**REFERENCES**

- Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Introduction to Parallel Computing. Second Edition. Addison-Wesley, 2003 (ISBN 0 201 64865 2).
- Gropp, William, Ewing Lusk, and Anthony Skjellum. *Using MPI: Portable Parallel Programming with the Message Passing Interface*. 2nd ed. Cambridge, MA: MIT Press, 1999. ISBN: 9780262571326.
- Gropp, William, Steven Huss-Lederman, Andrew Lumsdaine, Ewing Lusk, Bill Nitzberg, William Saphir, and Marc Snir. *MPI: The Complete Reference (Vol. 2) - The MPI-2 Extensions*. 2nd ed. Cambridge, MA: MIT Press, 1998. ISBN: 9780262571234.
- Selim G . Akl, The Design and Analysis of Parallel Algorithms, Prentice-Hall, Inc. 1989.

- Snir, Marc, and William Gropp. *MPI: The Complete Reference (2-volume set)*. 2nd ed. Cambridge, MA: MIT Press, 1998. ISBN: 9780262692168.
- Snir, Marc, and William Gropp. *Using MPI-2: Advanced Features of the Message Passing Interface*. Cambridge, MA: MIT Press, 1999. ISBN: 9780262571333.


**ADDITIONAL REFERENCES**


- http://openmp.org/wp/
- http://www.mpi-forum.org/
- https://computing.llnl.gov/tutorials/mpi/
- https://computing.llnl.gov/tutorials/parallel_comp/