Metallurgical and Materials Engineering

Course Structure and Detailed Syllabus

IV YEAR I SEMESTER

| SL. | SUBJECT | CODE | SUBJECT | L-T-P | CREDITS |
|-------|---------------|--------|--|-------|---------|
| No. | TYPE | | | | |
| 1. | Elective-I | MM4403 | Fracture mechanics | 3-1-0 | 3 |
| 2. | Elective-II | MM4405 | X-Ray Powder Diffraction | 3-1-0 | 3 |
| 3. | Open Elective | XXXXX | Open Elective-I** | 4-0-0 | 3 |
| 4. | Compulsory | BM4001 | Managerial Economics and Financial Analysis | 4-0-0 | 3 |
| 5. | Compulsory | MM4700 | Project | 0-0-4 | 4 |
| Total | | | | | 16 |

List of Free-elective:

| SL. No. | CODE | SUBJECT | L-T-P | CREDITS |
|---------|-----------|---------------------------------------|-------|---------|
| 1. | BSBE 4401 | BIOINFORMATICS | 3-0-0 | 3 |
| 2. | BM4401 | OPERATIONS RESEARCH | 4-0-0 | 3 |
| 3. | BM4402 | Production and Operations Research | 4-0-0 | 3 |
| 4. | BM4403 | Production and Project Management | 4-0-0 | 3 |

L - Lectures, T - Tutorials, P - Practicals, C - Credits

**Under Open Elective, a student has to choose any subject offered by other departments

MM4403 Externals: 60Marks Internals: 40Marks

FRACTURE MECHANICS

L-T-P-C* 3-1-0-3

Objectives:

* To provide an overview of the problems of fracture in structural materials and understand the basics of fracture mechanics.

- * To understand the concept of plastic zone size
- * To analyze the effect of energy supplied on fracture
- * To study different fracture tests.
- * To know the method of fractographic analyses.

Unit 1: Introduction

Introduction, overview of the basic problems of fracture in structural materials, theoretical cohesive strength, stress-concentration factor and external variables effecting fracture, types of fracture, Griffith crack theory, stress analysis of cracks.

Part 2: Concept of plastic zone and effect on fracture toughness

Elastic stress field and linear elastic fracture mechanics, crack-tip plastic zone and the elastic plastic fracture mechanics, design philosophy, the role of microstructure on fracture toughness and the fracture toughness approach for toughening of structural materials, plane stress and plane strain fracture modes.

Part 3: Energy and fracture relations

Transition temperature phenomenon, impact fracture test methods, impact energy-fracture toughness correlations, limitations, concepts of subcritical crack growth in cyclic loading, in environmental assisted cracking and at elevated temperature applications of structural materials.

Part 4: Testing

LEFM, EPFM and GYFM approach, plane strain fracture toughness measurement (E-399), indentation fracture toughness, plane stress fracture toughness measurement, J-integral approach, COD measurement.

Part 5: Fractograpy:

Mechanisms of failure associated with varied fractographic features, approach for failure analysis, problems and case studies.

Suggested References:

- 1. Dieter, G, E., Mechanical metallurgy (SI metric edition), McGraw-Hill book company, 1988.
- 2. Hertzberg, R, W., Deformation and fracture mechanics of engineering materials (3rd edition), John Wiley & sons, 1997

- 3. Broek, D., Elementary engineering fracture mechanics (3rd edition), Martinus Nijhoff publications, 1982.
- 4. Knott, J. F., Fundamentals of fracture mechanics, Butterworth publications, 1973.

*L-T-P-C stands for number of lectures, tutorials, practices and credits

MM4405 Externals: 60Marks Internals: 40Marks

X-Ray powder Diffraction

L-T-P-C* 3-1-0-3

Objectives:

- To study and understand crystalline states of materials by XRD.
- To study and understand X-ray production, Scattering and diffraction.
- To study and understand different diffractometers and experimental techniques.
- To process and analyse the diffracted data.

UNIT-1

Crystalline state :

Crystal lattices, symmetry operations, finite and infinite symmetry operations, Crystallographic groups, crystal systems, point groups, unit cells, Bravais lattices, Infinite symmetry elements, space groups, stereographic projection.

UNIT_II

X-ray productions, scattering and diffraction :

Nature and sources of x-rays, production of x rays, Collimation and characteristic x-ray spectra, Conventional sealed x-ray sources, Rotating anode x-ray sources, Collimation and monochromatization, Detection of x-rays, Point detectors, Line and area detector, x-ray scattering by electrons, atoms, and lattices, Laueequations and Bragg's law, Reciprocal and Ewald's sphere, Origin and representation of the powder diffraction pattern, Position of powder diffraction peaks, shapes of powder diffraction peaks, Peak shape functions, Intensity of powder diffraction peaks, Structure factor, Effect s of symmetry on the structure amplitude, Fourier transformation, Phase problem

UNIT-III

Diffractometers and experimental techniques :

Diffractometer optics, slits, absorbers, cradles, Debye-Scherror-Hull, Seeman-Bohlin, and BRAGG-Brentano diffractometers used in transmission and reflection mode, monochromators and their use, Divergence and receiver slit configurations, Resolution, parallel beam optics, theta-theta, theta-two theta configurations, vertical and horizontal goniometers.

UNIT-4

Processing the diffraction data: continuous and step scan ,Aberration ,factors affecting the intensity, line profile ,and resolution of diffraction pattern ,crystallographic maze, from raw diffraction data to working pattern , indexing th powder pattern of cubic and non cubic crystal structures, precise lattice pattern determination , line profile analysis, Fourier and Patterson maps.

UNIT-5

Analysis: Quantitative phase analysis by peak –search method .ICDD database and matching of experimental pattern. Determination of crystallite size and strain, Quantitative phase analysis methods, Calculation of diffraction patterns, Rietveld analysis

Reference Books:

1) B.D.Cullity and S.R.Stock, "Elements of X-Ray Diffraction" Third edition, Prentice Hall, NJ, 2001.

*L-T-P-C stands for number of lectures, tutorials, practices and credits

L-T-P-C* 3-1-0-3

Course Objectives:

- The course describes the Nature And Scope of Managerial Economics. It gives complete study on the demand and elasticity of demand and methods of demand forecasting.
- It provides a detailed structure on the pricing strategies and shows clear picture methods and sources of raising finance.
- It gives a clear cut information of preparing final accounts and capital Budgeting techniques.

UNIT I: Introduction to Managerial Economics:

Definition, Nature and Scope of Managerial Economics-Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting.

UNIT II: Theory of Production and Cost Analysis:

Production Function - Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs. Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale.

Cost Analysis: Cost concepts, Opportunity cost. Fixed vs. Variable costs, Explicit costs Vs. Implicit costs. Out of pocket costs vs. Imputed costs. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems)- Managerial Significance and limitations of BEA.

UNIT III: Markets & Pricing Policies:

Market structures: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly. Objectives and Policies of Pricing- Methods of Pricing: Cost Plus Pricing. Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing.

UNIT IV: Introduction to Financial Accounting: Introduction to Financial Accounting: Double entry Book Keeping, Journal, Ledger, Trail Balance and Final Accounts (Trading account, Profit and Loss Account and Balance sheet with simple adjustments).

UNIT V: Capital and Capital Budgeting:

Capital and Capital Budgeting: Capital and its significance. Types of Capital. Estimation of Fixed and Working capital requirements. Methods and sources of raising finance. Nature and scope of capital budgeting, features of capital budgeting proposals. Methods of Capital Budgeting: Payback Method. Accounting Rate of Return (ARR) and Net Present Value Method, Internal Rate of Return (IRR).

Reference Books:

- 1. Aryasri: Managerial Economics and Financial Analysis, TMH,2009.
- 2. Varshney & Maheswari : Managerial Economics, Sulthan Chand, 2009.
- 3. Raghunatha Reddy & Narasimhachary: Managerial Economics& Financial Analysis, Scitech. 2009.
- 4. V.Rajasekarn & R.Lalitha. Financial Accounting, Pearson Education. New Delhi. 2010
- 5. Suma Damodaran, Managerial Economics, Oxford University Press. 2009.

BSBE 4401

BIOINFORMATICS

Externals: 60 Marks Internals: 40 Marks

L-T-P-C 3-0-0-3

Learning objectives: To give an overview of the existing methodologies adopted in computational analysis of biological data. The main objective of the course is to stress the need for algorithm and data processing technologies for analysis and decoding the information processing of biological systems.

Learning outcome: This course improves the critical intellectual faculty required for handling and analyzing large data sets. It also stresses the need for integrating information to solve problems. The gap in resolving biological problems with the aid of core domain knowledge of different disciplines can be curtailed with the help of this course since it embarks the student with the skills to gather and integrate the required biological information. Students interested in developing algorithms and data processing technologies for analyzing biological information have huge demands since the applications of this branch play a vital role in alleviating bottlenecks in drug development.

UNIT-1: Biological Data Bases

1. Introduction to Bioinformatics -History of Bioinformatics- Internet and Bioinformatics

2. Introduction – Data base definition, data, Biological databases- Types of databases- conventions for databases indexing and specification of search terms

3. Contents and formats of database entries – retrieval of data using text based search tools – sources of data (Ex. Sequencing projects, Patent office's etc.), Method for deposition of data to databases.

4. Nucleic acid sequence databases - Genbank, EMBL, DDBJ

5. Protein sequence database – Primary sequence database. Introduction to protein information Resource (PIR)- Martinsried institute of Protein Sequence (MIPS), SWISS- PROT , Structure of SWISS- PROT Entries, Translated EMBL (TrEMBL)

6. Secondary sequence Database- Introduction to PROSITE, PROFILE, PRINTS, BLOCK, pfam and IDENTITY databases.

7. Genome Databases at NCBI, EBI, TIGR, SANGER.

8. Structural and Related Databases – PDB, NDB, CCSD, Prosite, PRODOM, Pfam, CATH, SCOP, DSSP, FSSP, DALI

UNIT-2: Sequence Analysis

9. Various file formats for Bio – molecular sequences – Genbank, FASTA, GCG, MSF, NBRF-PIR. Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, Paralogues

10. Scoring matrices- Basic concept of a scoring matrix- matrices for nucleic acid and protein sequences – PAM and BLOSUM matrices – Principles based on which these matrices are derived

11. Sequence – based Database searches- What are Sequence based database searches, BLAST and FASTA algorithms. Various versions of Basic BLAST and FASTA. Use of these methods for sequence analysis

12. Pairwise sequence Alignments- Basic concepts of sequence alignment, Needleman & Wuncsh, Smith & Waterman algorithms for Pair wise alignments – use of pair wise alignments for analysis of nucleic acid and protein sequences

13. Sequence Patterns and profiles – Basic concept and definition of sequence patterns, motifs and profiles, various types of pattern representations- namely consensus, regular expression and profiles.

14. Profile based database searches using PSI- BLAST, analysis and interpretation of profile – based searches

UNIT-3: Phylogenetic Analysis

15. Introduction – Evolution, definition of phylogenetic tree – nodes, internodes, root, tree, styles, cladogram, Phenogram, curvogram

16. Steps involved in construction of Phylogenetic tree

17. Methods of Phylogenetic analysis – Distance method, character based method

18. Tree Evaluation – Jumbling sequence addition order, Boot strap method.

19. Problems in Phylogenetic analysis- Phylogenetic analysis tool (Phylip, Clustalw, Tree view)

20. Chemiinformatics in Biology- conventions for representing molecules – Chemiinformatics, resources

21. Bioinformatics in Pharmaceutical industries and Medical Sciences, Immunology, Agriculture, Forestry, Geo Informatics, Bio sensing.

22. Legal, Ethical and commercial ramifications of bioinformatics

REFERENCES

- 1. David E. Mount. Textbook of Bioinformatics. Cold Spring Harbor (CSH) publication.
- 2. D. Baxavenis, and B. F. F. Ouellette, Bio informatics- A Practical guide to the analysis of Genes and Proteins, 2nd ed., John Wiley and Sons Inc., 2001.
- 3. A.R Leach, Molecular Modeling: Principles and Applications, Addisons-Wesley Pub Co. 1997.
- 4. P.E.Bourne and H.Weissig, Structural Bioinformatics, WILEY, 2003.
- 5. T.Lenguer, Bioinformatics-From Genome to Drug, Vols 1 and 2, Wiley-VCH, 2002.
- 6. B.Brayn, Bioinformatics computing: the comlete practical guide to bioinformatics for life scientists, Prentice Hall, 2000.
- 7. Misner and S.A. Krawetz, Bioinformatics: methods and protocols, Hanuma Press, 2000.
- 8. S.A. krawetz and D.D. Womble, Introduction to Bioinformatics: a theoretical and practical approach, Hanuma Press, 2003.
- 9. D.Higgins and W.Taylor (ed), Bioinformatics: sequence ,structure and databanks-a practical approach, Oxford, 2000.
- 10. Prof. P.B. Kavi Kishor and L.N. Chavali, Principles of Biological Databases, Himalaya Publishers, 2013.

BM4401

OPERATIONS RESEARCH

Externals: 60Marks

L-T-P-C*

Internals: 40Marks

4-0-0-3

Course Objective:

- The objective of this course is to provide the exposure to the major tools and techniques of Operations Research.
- Create awareness and appreciation about the applications of Operations Research in the functional areas of management.

Course Contents:

- 1. **Introduction:** Learning objectives, Decision making, Development of OR, Application of OR. (4 Modules)
- 2. Linear of Programming: Formulation of LP Models, Graphical solution, Simplex Method, Artificial Variables, Big-M Method, Two phase method, degeneracy and unbound solutions, Duality theory and application. (8 modules)
- 3. **Transportation and Assignment Models:** Formulation, Solution, Unbalanced transportation problem, finding basic feasible solutions- North West corner Rule, Least cost method and Vogel's Approximation method and optimality test: the stepping stone method and MODI method. Assignment problem: Formulation, Hungarian Method, Solving unbalanced problem. Travelling salesman and assignment problem. (10 modules)
- 4. Waiting Line Models: Elements of queuing models, Poisson arrival and exponential service time distributions, M/M/1 Queue; Finite population models. Queuing cost models, Applications. (8 modules)
- 5. **Inventory Control:** Introduction, Costs, and Deterministic and Stochastic models, Buffer stocks. (6 modules)

Suggested Reference Books:

- 1. Ravindran, Phillips & Solberg, Operations research, John Wiley, Singapore, (2007)
- 2. Richard Levin & David Rubin, *Quantitative approaches to Management*, Mc GrawHill International, (1992).
- 3. Taha H.A., Operation Research- An Introduction, PHI, (2008)
- 4. Hillier & Lieberman, Operation Research, Addison Wesley, (1974)
- 5. Hadley G., Linear Programming, Addison-Wesley, (1962).

BM4402 PRODUCTION AND OPERATIONS MANGEMENT

Externals: 60Marks

L-T-P-C*

Internals: 40Marks

4-0-0-3

Course Objective:

- This course aims at helping the students to learn operations management systems and analyze issues pertaining to management of productivity, technology and facilities.
- This course focuses on concepts relating to planning and control of management of materials and resources.

Course Contents:

1. **Introduction to POM:** Learning objectives, Production and Operations function and its relations to other management functions of an organization. Work System Design: Product and Process design, Methods study, Facilities layout, Line Balancing, Work Measurement (10 Modules)

2. **Manufacturing Planning and Control:** Aggregate production planning, Master Production Scheduling, Shop Scheduling and Shop Floor Control. DRP and Demand Management. Project management: PERT/CPM, resource leveling, project scheduling, Gantt Charts. (11 Modules)

3. Materials Flow Control: Raw Materials and WIP inventory control, MRP, MRP-II, JIT purchasing, Lead-time control. (7 Modules)

4. Maintenance Planning and Management: Corrective, Preventive and Predictive maintenance, Replacement analysis, RCM and TPM. Manpower Scheduling: Techniques of manpower scheduling, (8 Modules).

5. Introduction to Project management: an overview, Project Selection: Project Identification and Screening, Project Appraisal and Project Selection. (6 modules)

Suggested Reference Books:

1. Operations Management- Strategy and Analyses (6th Edition) New Delhi: Pearson Education, (2000).

2. Production and Operations Management. New Delhi: Prentice Hall of India, (2005).

3. Production and Operations Management - An applied Modern Approach. New Delhi: John Wiley, (2002).

4. Chary, Production and Operations Management. New Delhi: Tata Mc Graw Hill, (1995).

5. Schroeder, Operations Management. New Delhi: Tata Mc Graw Hill, (2009).

6. Hand Book of Materials Management. New Delhi: PHI, (1997).

7. Project Management. New Delhi: John Wiley & Sons, (2000).

BM4403 PROJECT AND PRODUCTION MANAGEMENT

Externals: 60Marks

L-T-P-C*

Internals: 40Marks

4-0-0-3

Course Objective:

- This course aims at helping the students to learn operations management systems and analyze issues pertaining to management of productivity, technology and facilities.
- The objective of the course is to impart the concepts, tools & techniques in formulation and analysis of projects as well as in planning, scheduling & controlling of projects.

Unit I:

Introduction: Project management: an overview, Project Selection: Project Identification and Screening, Project Appraisal: Part I, Project Appraisal: Part II, Project Selection. (6 modules)

Unit II:

Project Planning and Implementation: Development of Project Network, Project Representation, Consistency and Redundancy in Project Networks, **Project Scheduling:** Basic Scheduling with A-O-A Networks, Basic Scheduling with A-O-N Networks, Project Scheduling with Probabilistic Activity Times. Project Implementation: Project Monitoring and Control with PERT /Cost, Project Completion, Review and Future Directions. (8 Modules)

Unit III:

Production Management: Introduction to Production Systems and a Generalized Model of Production, Life cycle of a Production System and Major managerial Decisions, **financial evaluation of production related decisions**, Performance Measures of a Production System, Financial Evaluation of Capital Decisions, Decision Trees and evaluation of risk. (6 Modules)

Unit IV:

Product Design, Facility Location and Layout: Introducing New Products and Services, Product Mix Decisions, **Facility location and layout:** Plant Location, Process Layouts, Product Layouts and Assembly Line Balancing, Cellular Layouts, Layouts for Advanced Manufacturing Systems. (8 Modules)

Unit V:

Production Planning: Production Planning over medium term: Demand Forecasting, Aggregate Production Planning. Operational Decisions over Short term: .Inventory related Decisions, Material Requirements Planning and Scheduling of Job Shops. (8 Modules)

REFERENCE BOOKS:

1. Elements of Production Planning and Control / Samuel Eilon.

2. Modern Production/ operation managements / Baffa & Rakesh Sarin

4. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller.

5. Reliability Engineering & Quality Engineering by Dr. C. Nadha Muni Reddy and Dr. K. Vijaya Kumar Reddy, Galgotia Publications, Pvt., Limited.

6. Operations Management / Joseph Monks.

7. Project Management, Prasanna Chandra.

MM4700 Externals: 60Marks Internals: 40Marks Project - I

L-T-P-C* 0-0-4-4

Student has to do literature review on the chosen/allotted area of project work and must submit a report.