**ANNA UNIVERSITY, CHENNAI**

**UNIVERSITY DEPARTMENTS**

**B.TECH. FOOD TECHNOLOGY**

**REGULATIONS – 2015**

**CHOICE BASED CREDIT SYSTEM**

**Program Educational Objectives:**

Bachelor of Food Technology curriculum is designed to prepare the graduates having attitude and knowledge to

1. Have successful professional and technical career.
2. Have strong foundation in basic sciences, mathematics and computational platforms
3. Have knowledge on the theory and practices in the field of Food Technology and allied areas.
4. Practice and inspire high ethical values and technical standards

**Program Outcome:**

1. Knowledge gaining from the subject that will facilitate to start own company. (Entrepreneur)
2. Ability to apply knowledge of mathematics, sciences and engineering
3. Ability to develop new Food products.
4. Ability to design an industry
5. Ability to understand ethical and professional responsibilities
6. Ability to review, comprehend and report technological development

| Programme Educational Objectives | Programme Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
| I | ✓ | ✓ | ✓ | ✓ | | |
| II | | | | | ✓ | ✓ |
| III | ✓ | | ✓ | ✓ | ✓ | ✓ |
| IV | | | | | ✓ | ✓ |

| | | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|---|---|
| Year 1 | SEM 1 | Foundational English | ✓ | | | | | |
| | | Mathematics-1 | ✓ | ✓ | | | | |
| | | Engineering Physics | ✓ | ✓ | | | | |
| | | Engineering Chemistry | ✓ | ✓ | | | | |
| | | Computing Techniques | ✓ | ✓ | | | | |
| | | Engineering Graphics | | ✓ | | | | |



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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Basic Sciences Laboratory | | ✓ | | | | |
| | | Engineering Practices Laboratory | | ✓ | | | | |
| | SEM 2 | Technical English | ✓ | | | | | |
| | | Mathematics-2 | | ✓ | | | | |
| | | Physics of Materials | | ✓ | | | | |
| | | Microbiology | | ✓ | | | | |
| | | Engineering Mechanics | | ✓ | | ✓ | | |
| | | Biochemistry | | ✓ | | | | |
| | | Microbiology Lab | | ✓ | | | | |
| | | Biochemistry Lab | | ✓ | | | | |
| Year 2 | SEM 3 | Transform Techniques and Partial Differential Equations | | ✓ | | | | |
| | | Food Process Calculations | ✓ | | ✓ | | | |
| | | Food Microbiology | | ✓ | | | | |
| | | Food Chemistry and Nutrition | | ✓ | | | | |
| | | Basic Electrical and Electronics Engineering | | ✓ | | ✓ | | |
| | | Fluid Mechanics in Mechanical Operations | | ✓ | | | | |
| | | Food Chemistry and Nutrition Laboratory | ✓ | | ✓ | | | |
| | | Food Microbiology Laboratory | | ✓ | | | | |
| | SEM 4 | Probability and Statistics | ✓ | ✓ | | | ✓ | |
| | | Environmental Science and Engineering | ✓ | ✓ | | | | |
| | | Introduction to Food Processing | ✓ | | | ✓ | | |
| | | Unit Operations for Food Industries | ✓ | | ✓ | ✓ | | |
| | | Refrigeration and Cold Chain Management | | ✓ | | ✓ | | |
| | | Food Processing and Preservation Technology | | ✓ | | ✓ | | |
| | | Food Processing and Preservation lab | | ✓ | | | | |
| | | Unit operations in Food Industries Lab | | ✓ | | | | |
| Year 3 | SEM 5 | Fundamentals of Heat and Mass Transfer | | ✓ | | ✓ | | |
| | | Principles of Biochemical Engineering | | ✓ | | | | |
| | | Food Analysis | ✓ | | ✓ | | | |
| | | Professional Elective I | ✓ | | | | | |
| | | Professional Elective II | | | | | | |
| | | Professional Elective III | | | | | | |
| | | Biochemical Engineering Lab | | ✓ | | | | |



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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Food Analysis Lab | | ✓ | ✓ | | | |
| | SEM 6 | Total Quality Management | ✓ | | | ✓ | ✓ | |
| | | Food Process Engineering | ✓ | | ✓ | ✓ | | |
| | | Food Additives | ✓ | | ✓ | | | |
| | | Dairy Process Technology | ✓ | | ✓ | ✓ | | ✓ |
| | | Professional Elective IV | | | | | | |
| | | Professional Elective V | | | | | | |
| | | Employability Skills | ✓ | | | ✓ | ✓ | |
| | | Dairy process Technology Lab | | | ✓ | | | |
| Year 4 | SEM 7 | Food Packaging Technology | ✓ | | ✓ | | | |
| | | Food Safety, Quality and Regulation | ✓ | | ✓ | | ✓ | |
| | | Creativity, Innovation and New Food Product development | ✓ | | | ✓ | | |
| | | Baking and Confectionery Technology | | ✓ | | | | |
| | | Professional Elective VI | | | | | | |
| | | Professional Elective VII | | | | | | |
| | | Open Elective * 1 | | | | | | |
| | | Skills for Food Product Design and Development | | | ✓ | | | |
| | | Bakery and Confectionery Technology Lab | ✓ | | ✓ | ✓ | | ✓ |
| | SEM 8 | Project Work | | | ✓ | ✓ | ✓ | ✓ |

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**B. TECH. FOOD TECHNOLOGY**

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**CURRICULA AND SYLLABI I - VIII SEMESTERS**

## SEMESTER I

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | HS7151 | Foundational English | HS | 4 | 4 | 0 | 0 | 4 |
| 2. | MA7151 | Mathematics – I | BS | 4 | 4 | 0 | 0 | 4 |
| 3. | PH7151 | Engineering Physics | BS | 3 | 3 | 0 | 0 | 3 |
| 4. | CY7151 | Engineering Chemistry | BS | 3 | 3 | 0 | 0 | 3 |
| 5. | GE7151 | Computing Techniques | ES | 3 | 3 | 0 | 0 | 3 |
| 6. | GE7152 | Engineering Graphics | ES | 5 | 3 | 2 | 0 | 4 |
| **PRACTICAL** | | | | | | | | |
| 7. | BS7161 | Basic Sciences Laboratory | BS | 4 | 0 | 0 | 4 | 2 |
| 8. | GE7162 | Engineering Practices Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **30** | **20** | **2** | **8** | **25** |

## SEMESTER II

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | HS7251 | Technical English | HS | 4 | 4 | 0 | 0 | 4 |
| 2. | MA7251 | Mathematics - II | BS | 4 | 4 | 0 | 0 | 4 |
| 3. | PH7257 | Physics of Materials | BS | 3 | 3 | 0 | 0 | 3 |
| 4. | IB7252 | Microbiology | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | GE7153 | Engineering Mechanics | ES | 4 | 4 | 0 | 0 | 4 |
| 6. | IB7251 | Biochemistry | PC | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 7. | IB7262 | Microbiology Lab | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | IB7261 | Biochemistry Lab | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **29** | **21** | **0** | **8** | **25** |



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## SEMESTER III

| S.No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | EE7151 | Basic Electrical and Electronics Engineering | ES | 3 | 3 | 0 | 0 | 3 |
| 2. | FT7301 | Fluid Mechanics in Mechanical Operations | PC | 4 | 4 | 0 | 0 | 4 |
| 3. | FT7302 | Food Chemistry and Nutrition | BS | 3 | 3 | 0 | 0 | 3 |
| 4. | FT7303 | Food Microbiology | BS | 3 | 3 | 0 | 0 | 3 |
| 5. | FT7304 | Food Process Calculations | PC | 4 | 4 | 0 | 0 | 4 |
| 6. | MA7358 | Transform Techniques and Partial Differential Equations | BS | 4 | 4 | 0 | 0 | 4 |
| **PRACTICALS** | | | | | | | | |
| 7. | FT7311 | Food Chemistry and Nutrition Lab | BS | 4 | 0 | 0 | 4 | 2 |
| 8. | FT7312 | Food Microbiology Lab | BS | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **29** | **21** | **0** | **8** | **25** |

## SEMESTER IV

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | FT7401 | Food Processing and Preservation Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | FT7402 | Introduction to Food Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | FT7403 | Refrigeration and Cold Chain Management | BS | 4 | 4 | 0 | 0 | 4 |
| 4. | FT7404 | Unit Operations for Food Industries | PC | 4 | 4 | 0 | 0 | 4 |
| 5. | GE7251 | Environmental Science and Engineering | ES | 3 | 3 | 0 | 0 | 3 |
| 6. | MA7357 | Probability and Statistics | BS | 4 | 4 | 0 | 0 | 4 |
| **PRACTICALS** | | | | | | | | |
| 7. | FT7411 | Food Processing and Preservation lab | PC | 4 | 0 | 0 | 4 | 2 |
| 8. | FT7412 | Unit operations in Food Industries Lab | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **29** | **21** | **0** | **8** | **25** |



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## SEMESTER V

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | FT7501 | Food Analysis | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | FT7502 | Fundamentals of Heat and Mass Transfer | PC | 4 | 4 | 0 | 0 | 4 |
| 3. | FT7503 | Principles of Biochemical Engineering | ES | 3 | 3 | 0 | 0 | 3 |
| 4. | | Professional Elective I | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | | Professional Elective II | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | | Open Elective I | OE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 7. | FT7511 | Biochemical Engineering Lab | ES | 4 | 0 | 0 | 4 | 2 |
| 8. | FT7512 | Food Analysis Lab | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **27** | **19** | **0** | **8** | **23** |

## SEMESTER VI

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | FT7601 | Dairy Process Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | FT7602 | Food Additives | BS | 3 | 3 | 0 | 0 | 3 |
| 3. | FT7603 | Food Process Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | GE7652 | Total Quality Management | HS | 3 | 3 | 0 | 0 | 3 |
| 5. | HS7551 | Employability Skills | HS | 3 | 3 | 0 | 0 | 3 |
| 6. | | Professional Elective III | PE | 3 | 3 | 0 | 0 | 3 |
| 7. | | Professional Elective IV | PE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 8. | FT7611 | Dairy process Technology Lab | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **25** | **21** | **0** | **4** | **23** |



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## SEMESTER VII

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | FT7651 | Creativity, Innovation and New Food Product development | EEC | 3 | 3 | 0 | 0 | 3 |
| 2. | FT7701 | Baking and Confectionery Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | FT7702 | Food Packaging Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 4. | FT7703 | Food Safety, Quality and Regulation | PC | 3 | 3 | 0 | 0 | 3 |
| 5. | | Professional Elective V | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | | Professional Elective VI | PE | 3 | 3 | 0 | 0 | 3 |
| 7. | | Open Elective II | OE | 3 | 3 | 0 | 0 | 3 |
| **PRACTICALS** | | | | | | | | |
| 8. | FT7711 | Bakery and Confectionery Technology Lab | PC | 4 | 0 | 0 | 4 | 2 |
| 9. | FT7712 | Skills for Food Product Design and Development | EEC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **29** | **21** | **0** | **8** | **25** |

## SEMESTER VIII

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **PRACTICALS** | | | | | | | | |
| 1. | FT7811 | Project Work | EEC | 20 | 0 | 0 | 20 | 10 |
| | | | **TOTAL** | **20** | **0** | **0** | **20** | **10** |

**TOTAL NO OF CREDITS : 181**



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## PROFESSIONAL ELECTIVES (PE)

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | FT7001 | Biothermodynamics | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | FT7002 | Cereal Technology | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | FT7003 | Food Allergy and Toxicology | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | FT7004 | Food Fermentation Technology | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | FT7005 | Food Flavours Technology | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | FT7006 | Food Plant Design and Layout | PE | 3 | 3 | 0 | 0 | 3 |
| 7. | FT7007 | Fruits and Vegetable Processing Technology | PE | 3 | 3 | 0 | 0 | 3 |
| 8. | FT7008 | Functional Foods and Nutraceuticals | PE | 3 | 3 | 0 | 0 | 3 |
| 9. | FT7009 | Genetic Engineering and Genetically Modified Foods | PE | 3 | 3 | 0 | 0 | 3 |
| 10. | FT7010 | Instrumentation and Process Control | PE | 3 | 3 | 0 | 0 | 3 |
| 11. | FT7011 | Management of Food Waste | PE | 3 | 3 | 0 | 0 | 3 |
| 12. | FT7012 | Meat, Fish and Poultry Process Technology | PE | 3 | 3 | 0 | 0 | 3 |
| 13. | FT7013 | Post Harvest Technology | PE | 3 | 3 | 0 | 0 | 3 |
| 14. | FT7014 | Process Economics and Industrial Management in Food Industries | PE | 3 | 3 | 0 | 0 | 3 |
| 15. | FT7015 | Pulse and Oil Seed Technology | PE | 3 | 3 | 0 | 0 | 3 |
| 16. | FT7016 | Specialty Foods | PE | 3 | 3 | 0 | 0 | 3 |
| 17. | FT7017 | Spices and Plantation Technology | PE | 3 | 3 | 0 | 0 | 3 |
| 18. | FT7018 | Traditional Foods | PE | 3 | 3 | 0 | 0 | 3 |
| 19. | GE7071 | Disaster Management | PE | 3 | 3 | 0 | 0 | 3 |
| 20. | GE7073 | Fundamentals of Nano Science | PE | 3 | 3 | 0 | 0 | 3 |
| 21. | GE7074 | Human Rights | PE | 3 | 3 | 0 | 0 | 3 |
| 22. | GE7351 | Engineering Ethics and Human Values | PE | 3 | 3 | 0 | 0 | 3 |
| 23. | IB7072 | Biological Spectroscopy | PE | 3 | 3 | 0 | 0 | 3 |
| 24. | IB7552 | Chemical Reaction Engineering | PE | 3 | 3 | 0 | 0 | 3 |
| 25. | IB7752 | Downstream Processing | PE | 3 | 3 | 0 | 0 | 4 |
| 26. | GE7072 | Foundation Skills in Integrated Product Development | PE | 3 | 3 | 0 | 0 | 3 |



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## HUMANITIES AND SOCIAL SCIENCES (HS)

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | HS7151 | Foundational English | HS | 4 | 4 | 0 | 0 | 4 |
| 2. | HS7251 | Technical English | HS | 4 | 4 | 0 | 0 | 4 |
| 3. | HS7551 | Employability skills | HS | 3 | 3 | 0 | 0 | 3 |
| 4. | GE7652 | Total Quality Management | HS | 3 | 3 | 0 | 0 | 3 |

## BASIC SCIENCES (BS)

| S.No. | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | MA7151 | Mathematics – I | BS | 4 | 4 | 0 | 0 | 4 |
| 2. | PH7151 | Engineering Physics | BS | 3 | 3 | 0 | 0 | 3 |
| 3. | CY7151 | Engineering Chemistry | BS | 3 | 3 | 0 | 0 | 3 |
| 4. | BS7161 | Basic Sciences Laboratory | BS | 4 | 0 | 0 | 4 | 2 |
| 5. | MA7251 | Mathematics - II | BS | 4 | 4 | 0 | 0 | 4 |
| 6. | PH7257 | Physics of Materials | BS | 3 | 3 | 0 | 0 | 3 |
| 7. | MA7358 | Transforms and Partial Differential Equations | BS | 4 | 3 | 1 | 0 | 4 |
| 8. | FT7303 | Food Microbiology | BS | 3 | 3 | 0 | 0 | 3 |
| 9. | FT7302 | Food Chemistry and Nutrition | BS | 3 | 3 | 0 | 0 | 3 |
| 10. | FT7312 | Food Microbiology Lab | BS | 4 | 0 | 0 | 4 | 2 |
| 11. | FT7311 | Food Chemistry and Nutrition Lab | BS | 4 | 0 | 0 | 4 | 2 |
| 12. | MA7357 | Probability And Statistics | BS | 4 | 4 | 0 | 0 | 4 |
| 13. | FT7403 | Refrigeration and Cold Chain Management | BS | 4 | 3 | 1 | 0 | 4 |
| 14. | FT7602 | Food Additives | BS | 3 | 3 | 0 | 0 | 3 |

## ENGINEERING SCIENCES (ES)

| S.No. | CODE NO | COURSE TITLE | Category | Contact hours | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | GE7151 | Computing Techniques | ES | 3 | 3 | 0 | 0 | 3 |
| 2. | GE7152 | Engineering Graphics | ES | 5 | 3 | 2 | 0 | 4 |
| 3. | GE7162 | Engineering Practices Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 4. | GE7153 | Engineering Mechanics | ES | 4 | 4 | 0 | 0 | 4 |
| 5. | EE7151 | Basic Electrical and Electronics Engineering | ES | 3 | 3 | 0 | 0 | 3 |
| 6. | GE7251 | Environmental Science And Engineering | ES | 3 | 3 | 0 | 0 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7. | FT7503 | Biochemical Engineering | ES | 3 | 3 | 0 | 0 | 3 |
| 8. | FT7511 | Biochemical Engineering Lab | ES | 4 | 0 | 0 | 4 | 2 |

## PROFESSIONAL CORE (PC)

| S.No. | CODE NO | COURSE TITLE | Category | Contact hours | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| 1. | IB7252 | Microbiology | PC | 3 | 3 | 0 | 0 | 3 |
| 2. | IB7251 | Biochemistry | PC | 3 | 3 | 0 | 0 | 3 |
| 3. | IB7262 | Microbiology Lab | PC | 4 | 0 | 0 | 4 | 2 |
| 4. | IB7261 | Biochemistry Lab | PC | 4 | 0 | 0 | 4 | 2 |
| 5. | FT7304 | Food Process Calculations | PC | 4 | 4 | 0 | 0 | 4 |
| 6. | FT7301 | Fluid Mechanics in Mechanical Operations | PC | 4 | 3 | 1 | 0 | 4 |
| 7. | FT7402 | Introduction to Food Processing | PC | 3 | 3 | 0 | 0 | 3 |
| 8. | FT7404 | Unit Operations for food Industries | PC | 4 | 3 | 1 | 0 | 4 |
| 9. | FT7401 | Food Processing and Preservation Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 10. | FT7411 | Food Processing and Preservation lab | PC | 4 | 0 | 0 | 4 | 2 |
| 11. | FT7412 | Unit Operations Lab | PC | 4 | 0 | 0 | 4 | 2 |
| 12. | FT7502 | Fundamentals of Heat and Mass Transfer | PC | 4 | 3 | 1 | 0 | 4 |
| 13. | FT7501 | Food Analysis | PC | 3 | 3 | 0 | 0 | 3 |
| 14. | FT7512 | Food Analysis Lab | PC | 4 | 0 | 0 | 4 | 2 |
| 15. | FT7603 | Food Process Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 16. | FT7601 | Dairy Process Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 17. | FT7611 | Dairy Process Technology Lab | PC | 4 | 0 | 0 | 4 | 2 |
| 18. | FT7702 | Food Packaging Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 19. | FT7703 | Food Safety, Quality and Regulation | PC | 3 | 3 | 0 | 0 | 3 |
| 20. | FT7701 | Baking and Confectionery Technology | PC | 3 | 3 | 0 | 0 | 3 |
| 21. | FT7711 | Bakery and ConfectioneryTechnology Lab | PC | 4 | 0 | 0 | 4 | 2 |



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## SUMMARY

| S.No | Subject Area | Credits per Semester | | | | | | | | Credits Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | |
| 1 | HS | 4 | 4 | - | - | - | 3 | - | - | 11 |
| 2 | BS | 12 | 7 | 14 | 8 | - | 3 | - | - | 44 |
| 3 | ES | 9 | 4 | 3 | 3 | 5 | 3 | - | - | 27 |
| 4 | PC | - | 10 | 8 | 14 | 9 | 8 | 11 | - | 60 |
| 5 | PE | - | - | - | - | 6 | 6 | 6 | - | 18 |
| 6 | OE | - | - | - | - | 3 | - | 3 | - | 6 |
| 7 | EEC | | | | | | | 5 | 10 | 15 |
| | Total | 25 | 25 | 25 | 25 | 23 | 23 | 25 | 10 | 181 |

**HS7151 FOUNDATIONAL ENGLISH L T P C**
**4 0 0 4**

**COURSE DESCRIPTION:**

This course aims at developing the language skills necessary for the first year students of Engineering and Technology.

**OBJECTIVES:**

- To develop the four language skills – Listening, Speaking, Reading and Writing.
- To improve the students' communicative competence in English.
- To teach students the various aspects of English language usage.

**CONTENTS**

**UNIT I GREETING AND INTRODUCING ONESELF 12**

**Listening**- Types of listening – Listening to short talks, conversations; **Speaking** – Speaking about one's place, important festivals etc. – Introducing oneself, one's family/ friend;**Reading** – Skimming a passage– Scanning for specific information;**Writing**- Guided writing - Free writing on any given topic ( My favourite place/ Hobbies/ School life, writing about one's leisure time activities, hometown, etc.); **Grammar** – Tenses (present and present continuous) -Question types - Regular and irregular verbs; **Vocabulary** – Synonyms and Antonyms.

**UNIT II GIVING INSTRUCTIONS AND DIRECTIONS 12**

**Listening** – Listening and responding to instructions; **Speaking** – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; **Reading** – Reading and finding key information in a given text - Critical reading - **Writing –**Process description( non-technical)- **Grammar** – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; - **Vocabulary** – Compound words – Word formation – Word expansion ( root words).

**UNIT III READING AND UNDERSTANDING VISUAL MATERIAL 12**

**Listening**- Listening to lectures/ talks and completing a task; **Speaking** –Role play/ Simulation – Group interaction; **Reading** – Reading and interpreting visual material;**Writing**- Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/ narrative);**Grammar** – Tenses (perfect), Conditional clauses –Modal verbs; **Vocabulary** –Cause and effect words; Phrasal verbs in context.

**UNIT IV CRITICAL READING AND WRITING 12**

**Listening**- Watching videos/ documentaries and responding to questions based on them; **Speaking**Informal and formal conversation;**Reading** –Critical reading (prediction & inference);**Writing**–Essay writing ( compare & contrast/ analytical) – Interpretation of visual materials;**Grammar** – Tenses (future time reference);**Vocabulary** – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

**UNIT V LETTER WRITING AND SENDING E-MAILS 12**

**Listening**- Listening to programmes/broadcast/ telecast/ podcast;**Speaking** – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation;**Reading** – Extensive reading;**Writing**- Poster making – Letter writing (Formal and E-mail) ;**Grammar** – Direct and Indirect speech – Combining sentences using connectives;**Vocabulary** –Collocation;

**TEACHING METHODS:**
Interactive sessions for the speaking module.
Use of audio – visual aids for the various listening activities.
Contextual Grammar Teaching.

**EVALUATION PATTERN:**
Internals – 50%
End Semester – 50%

**TOTAL:60 PERIODS**

**LEARNING OUTCOMES:**
- Students will improve their reading and writing skills
- Students will become fluent and proficient in communicative English
- Students will be able to improve their interpersonal communication

**TEXTBOOK:**
1. Richards, Jack.C with Jonathan Hull and Susan Proctor **New Interchange : English for International Communication. (level2, Student's Book)** Cambridge University Press,New Delhi: 2010.

**REFERENCES:**
1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge,2011.
2. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering**. London: Garnet Publishing Limited, 2008.
3. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skillsfor Business English.** Cambridge University Press, Cambridge: Reprint 2011.

| MA7151 | MATHEMATICS – I | L | T | P | C |
|---|---|---|---|---|---|
| | | 4 | 0 | 0 | 4 |

**(Common to all branches of B.E. /B.Tech. Programmes in I Semester)**

**COURSE OBJECTIVES**
- The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

**UNIT I DIFFERENTIAL CALCULUS 12**

Representation of functions - New functions from old functions - Limit of a function - Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system - Differentiation in polar coordinates - Maxima and Minima of functions of one variable.

**UNIT II FUNCTIONS OF SEVERAL VARIABLES 12**

Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Errors and approximations – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

**UNIT III INTEGRAL CALCULUS 12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.

**UNIT IV MULTIPLE INTEGRALS 12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

**UNIT V DIFFERENTIAL EQUATIONS 12**

Method of variation of parameters – Method of undetermined coefficients – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients.

**TOTAL : 60 PERIODS**

**COURSE OUTCOMES**

- Understanding of the ideas of limits and continuity and an ability to calculate with them and apply them.
- Improved facility in algebraic manipulation.
- Fluency in differentiation.
- Fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
- Understanding the ideas of differential equations and facility in solving simple standard examples.

**TEXT BOOKS**


1. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi, 2008.
2. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
4. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.


**REFERENCE BOOKS**


1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.


Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

**PH7151** **ENGINEERING PHYSICS** **L T P C**

(Common to all branches of B.E / B.Tech programmes) **3 0 0 3**

**OBJECTIVE:**

- To introduce the concept and different ways to determine moduli of elasticity and applications.
- To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation, detection and applications
- To inculcate an idea of thermal properties of materials, heat flow through materials and quantum physics
- To promote the basic understanding of interferometers, principles and applications of lasers, optical fibers and sensors
- To establish a sound grasp of knowledge on the basics, significance and growth of single crystals

**UNIT I PROPERTIES OF MATTER 9**

Elasticity – Poisson's ratio and relationship between moduli (qualitative) - stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength - bending of beams - cantilever - bending moment - Young's modulus determination - theory and experiment - uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

**UNIT II ACOUSTICS AND ULTRASONICS 9**

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - calculation of reverberation time for different types of buildings – sound absorbing materials - factors affecting acoustics of buildings : focussing, interference, echo, echelon effect, resonance - noise and their remedies. Ultrasonics: production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating – ultrasonic interferometer - industrial applications – Non-destructive testing - ultrasonic method: scan modes and practice.

**UNIT III THERMAL AND MODERN PHYSICS 9**

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity- heat conductions in solids – flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment- Black body radiation – Planck's theory (derivation) – Compton effect – wave model of radiation and matter – Schrödinger's wave equation – time dependent and independent equations – Physical significance of wave function – particle in a one dimensional box.

**UNIT IV APPLIED OPTICS 9**

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its applications - Lasers – principle and applications – Einstein's coefficients – $CO_2$ and Nd:YAG laser - semiconductor lasers: homo junction and hetro junction - construction and working – applications. Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

**UNIT V CRYSTAL PHYSICS 9**

Single crystalline, polycrystalline and amorphous materials – Single crystals: unit cell, crystal systems, Bravais lattices, ditections and planes in a crystal, Miller indices - interplanar distance for a cubic crystal - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite - crystal imperfections: point defects, line defects – Burger vectors, dislocations and stacking faults – Growth of single crystals: Bridgman and Czochralski methods.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- The students will understand different moduli of elasticity, their determination and applications.
- The students will gain knowledge on the properties of sound, noise cancellation, and production, detection and applications of ultrasonics
- The students will acquire sound knowledge on thermal expansion and thermal conductivity of materials. Further they will gain an idea of quantum physics.
- The students will gain knowledge on interferometers, lasers and fiber optics
- The students will secure knowledge on the basics of crystal structures and their significance. Further they gain basic ideas of growing single crystals.

**TEXTBOOKS:**


1. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publications (2013)
2. Palanisamy P.K., "Engineering Physics", Scitech Publications (P) Ltd. (2006).
2. Arumugam M., "Engineering Physics", Anuradha Publications (2000)


**REFERENCES:**


1. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co. (2010).
2. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, (2007).
3. Markert J.T.,Ohanian, H. and Ohanian, M. "Physics for Engineers and Scientists". W.W.Norton & Co. (2007).


**CY7151 ENGINEERING CHEMISTRY**

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

**COURSE OBJECTIVES**

- To develop an understanding about fundamentals of polymer chemistry.
- Brief elucidation on surface chemistry and catalysis.
- To develop sound knowledge photochemistry and spectroscopy.
- To impart basic knowledge on chemical thermodynamics.
- To understand the basic concepts of nano chemistry.

**UNIT I POLYMER CHEMISTRY 9**

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

**UNIT II SURFACE CHEMISTRYAND CATALYSIS 9**

Adsorption-Types of adsorption-adsorption of gases on solids- adsorption from solutions-

Types of isotherms–Frendlich adsorption isotherm,Langmuir adsorption isotherm.Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis -factors affecting enzyme catalysis, Michaelis-Menton equation.Industrial applications of catalysts.

**UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9**

Photochemistry: Laws of photochemistry-Grotthuss-Draper law, Stark-Einstein law and Lambert-Beer Law. Photo processes-internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo-sensitization. Spectroscopy: Electromagnetic spectrum-absorption of radiation-electronic, vibrational and rotational transitions. Width and intensities of spectral lines.Spectrophotometric estimation of iron.UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

**UNIT IV CHEMICAL THERMODYNAMICS 9**

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtzand Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius Clapeyron equation; Maxwell relations-Van't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation- variation of chemical potential with temperature and pressure.

**UNIT V NANOCHEMISTRY 9**

Basics-distinction between molecules, nanoparticles and bulk materials; size-dependent properties.Preparation of nanoparticles – sol-gel and solvothermal.Preparation of carbon nanotube by chemical vapour deposition and laser ablation.Preparation of nanowires by VLS growth, electrochemical deposition and electro spinning.Properties and uses of nanoparticles, nanoclusters, nanorods, nanotubes and nanowires.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES**

- Will be familiar with polymer chemistry, surface chemistry and catalysis.
- Will know the photochemistry, spectroscopy and chemical thermodynamics.
- Will know the fundamentals of nano chemistry.

**TEXT BOOKS**


1. Jain P. C. & Monica Jain., "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd, New Delhi, 2014.
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014


**REFERENCE BOOKS**


1. Pahari A., Chauhan B., "Engineering Chemistry", Firewall Media, New Delhi, 2012.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. AshimaSrivastava. Janhavi N N, Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
4. Vairam S., Kalyani P., Suba Ramesh., "Engineering Chemistry", Wiley India Pvt Ltd., New Delhi., 2011.


**GE7151 COMPUTING TECHNIQUES L T P C**
**(Common to all branches of Engineering and Technology) 3 0 0 3**

**OBJECTIVES:**

- To learn programming using a structured programming language.
- To provide C programming exposure.
- To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

**UNIT I INTRODUCTION 9**

Introduction to Computers – Computer Software – Computer Networks and Internet - Need for logical thinking – Problem formulation and development of simple programs - Pseudo code - Flow Chart and Algorithms.

**UNIT II C PROGRAMMING BASICS 9**

Introduction to C programming – Fundamentals – Structure of a C program – Compilation and linking processes - Constants, Variables – Data Types – Expressions - Operators –Decision Making and Branching – Looping statements – Solving Simple Scientific and Statistical Problems.

**UNIT III ARRAYS AND STRINGS 9**

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays - Strings- String operations – String Arrays - simple programs- sorting- searching – matrix operations.

**UNIT IV POINTERS 9**

Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems - Basic file operations

**UNIT V FUNCTIONS AND USER DEFINED DATA TYPES 9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion –Enumerators – Structures - Unions

**TOTAL : 45 PERIODS**

**OUTCOMES**

**At the end of the course, the student should be able to:**

- Write C program for simple applications
- Formulate algorithm for simple problems
- Analyze different data types and arrays
- Perform simple search and sort**.**
- Use programming language to solve problems.

**TEXTBOOKS:**


1. Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Second Edition, Oxford University Press, 2013
2. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.
3. Yashavant P. Kanetkar. “Let Us C”, BPB Publications, 2011.


**REFERENCES:**


1. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006
2. Byron S Gottfried, “Programming with C”, Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, “How to Solve it by Computer”, Pearson Education, Fourth Reprint, 2007


**GE7152 ENGINEERING GRAPHICS L T P C**

**3 2 0 4**

**OBJECTIVES**

• To develop in students, graphic skills for communication of concepts, ideas and design of engineering products and expose them to existing national standards related to technical drawings.

**CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION) 1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

**UNIT I PLANE CURVES ANDFREE HANDSKETCHING 14**

Basic Geometrical constructions, Curves used in engineering practices-Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles – Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

**14**

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES**

Orthographic projection- principles-Principal planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes-Determination of true lengths and true inclinations by rotating line method and trapezoidal method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS 14**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to both the principal planes by rotating object method and auxiliary plane method.

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 14**

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.

**15**

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems.

Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

**COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) 3**

Introduction to drafting packages and demonstration of their use.

**L=45+T=30, TOTAL: 75 PERIODS**

**OUTCOMES:**

On Completion of the course the student will be able to

- Perform free hand sketching of basic geometrical shapes and multiple views of objects.
- Draw orthographic projections of lines, Planes and Solids

- Obtain development of surfaces.
- Prepare isometric and perspective views of simple solids.

**TEXT BOOK:**

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.

**REFERENCES:**

1. K.R.Gopalakrishna., "Engineering Drawing" (Vol I&II combined) SubhasStores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,'' Fundamentals of Engineering Drawingwith an introduction to Interactive Computer Graphics for Design and Production",Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P)Limited ,2008.
5. K. V.Natarajan, "A text book of Engineering Graphics", 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, " Engineering Drawing", Oxford University Press, 2015

**Publication of Bureau of Indian Standards:**

1. IS 10711 – 2001: Technical products Documentation – Size and lay out ofdrawing sheets
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

**Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.



**BS7161 BASIC SCIENCES LABORATORY L T P C**

(Common to all branches of B.E. / B.Tech Programmes) **0 0 4 2**

**PHYSICS LABORATORY: (Any Seven Experiments)**

**OBJECTIVE:**

- To inculcate experimental skills to test basic understanding of physics of materials including properties of matter, thermal and optical properties.
- To induce the students to familiarize with experimental determination of velocity of ultrasonic waves, band gap determination and viscosity of liquids.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus

3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor
5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille's flow

**TOTAL: 30 PERIODS**

**OUTCOME:**

Upon completion of the course, the students will be able

- To determine various moduli of elasticity and also various thermal and optical properties of materials.
- To determine the velocity of ultrasonic waves, band gap determination and viscosity of liquids.

**CHEMISTRY LABORATORY:**

**(Minimum of 8 experiments to be conducted)**

1. Estimation of HCl using $Na_2CO_3$ as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline/thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of poly vinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.

**TOTAL: 30 PERIODS**

**TEXTBOOKS**

1. Vogel's Textbook of Quantitative Chemical Analysis ($8^{TH}$ edition, 2014)
2. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).

**GE7162 ENGINEERING PRACTICES LABORATORY L T P C**

**(Common to all Branches of B.E. / B.Tech. Programmes) 0 0 4 2**

**COURSE OBJECTIVES**



Attested

DIRECTOR
Centre For Academic Courses
Anna University, Chennai-600 025.

• To provide exposure to the students with hands-on experience on various Basic Engineering Practices in Civil, Mechanical, Electrical and Electronics Engineering.

**GROUP – A (CIVIL & ELECTRICAL)**

**1. CIVIL ENGINEERING PRACTICES** 15

**PLUMBING**

- Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.
- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in householdappliances.

**WOOD WORK**

- Sawing, planing and making joints like T-Joint, Mortise and Tenon joint and Dovetail joint.

**STUDY**

- Study of joints in door panels and wooden furniture
- Study of common industrial trusses using models.

2. **ELECTRICAL ENGINEERING PRACTICES** 15

- Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,
- Stair case light wiring
- Tube – light wiring
- Preparation of wiring diagrams for a given situation.
  Study of Iron-Box, Fan Regulator andEmergency Lamp

**GROUP – B (MECHANICAL AND ELECTRONICS)**

3. **MECHANICAL ENGINEERING PRACTICES** 15

**WELDING**

- Arc welding of Butt Joints, Lap Joints, and Tee Joints
- Gas welding Practice.
- Basic Machining - Simple turning, drilling and tapping operations..
- Study and assembling of the following:
  a. Centrifugal pump
  b. Mixie
  c. Air Conditioner.

**DEMONSTRATION ON FOUNDRY OPERATIONS.**

4. **ELECTRONIC ENGINEERING PRACTICES** 15

- Soldering simple electronic circuits and checking continuity.
- Assembling electronic components on a small PCB and Testing.
- Study of Telephone, FM radio andLow Voltage Power supplies.

**TOTAL : 60 PERIODS**

**COURSE OUTCOMES**

- Ability to fabricate carpentry components and to lay pipe connections including plumbing works.
- Ability to use welding equipments to join the structures

- Ability to do wiring for electrical connections and to fabricate electronics circuits.

**HS7251 TECHNICAL ENGLISH L T P C**
**4 0 0 4**

**OBJECTIVES**

- To enable students acquire proficiency in technical communication.
- To enhance their reading and writing skills in a technical context.
- To teach various language learning strategies needed in aprofessional environment.

**CONTENTS**

**UNIT I ANALYTICAL READING 12**

**Listening**- Listening to informal and formal conversations; **Speaking** – Conversation Skills(opening, turn taking, closing )-explaining how something works-describing technical functions and applications;**Reading** –Analytical reading, Deductive and inductive reasoning; **Writing**- vision statement–structuring paragraphs.

**UNIT II SUMMARISING 12**

**Listening**- Listening to lectures/ talks on Science & Technology;**Speaking** –Summarizing/ Oral Reporting, **Reading** – Reading Scientific and Technical articles; **Writing**- Extended definition – Lab Reports – Summary writing.

**UNIT III DESCRIBING VISUAL MATERIAL 12**

**Listening**- Listening to a panel discussion; **Speaking** – Speaking at formal situations; **Reading** –Reading journal articles - Speed reading;**Writing**-data commentary-describing visual material-writing problem-process- solution-the structure of problem-solution texts- writing critiques

**UNIT IV WRITING/ E-MAILING THE JOB APPLICATION 12**

**Listening**- Listening to/ Viewing model interviews; **Speaking** –Speaking at different types of interviews – Role play practice ( mock interview); **Reading** – Reading job advertisements and profile of the company concerned;**Writing**- job application – cover letter –Résumé preparation.

**UNIT V REPORT WRITING 12**

**Listening**- Viewing a model group discussion;**Speaking** –Participating in a discussion - Presentation;**Reading** – Case study - analyse -evaluate – arrive at a solution;**Writing**– Recommendations- Types of reports (feasibility report)- designing and reporting surveys- – Report format.- writing discursive essays.

**TEACHING METHODS:**

Practice writing
Conduct model and mock interview and group discussion.
Use of audio – visual aids to facilitate understanding of various forms of technical communication.
Interactive sessions.

**EVALUATION PATTERN:**

Internals – 50%
End Semester – 50%

**TOTAL:60 PERIODS**

**LEARNING OUTCOMES**

- Students will learn the structure and organization of various forms of technical communication.
- Students will be able to listen and respond to technical content.
- Students will be able to use different forms of communication in their respective fields.

**TEXTBOOK:**

1. Craig,Thaine**. Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012

**REFERENCES:**

1. Laws, Anne. **Presentations.** Hyderabad: Orient Blackswan, 2011.
2. Ibbotson, Mark. **Cambridge English for Engieering**. Cambridge University Press, Cambridge,New Delhi: 2008
3. Naterop, Jean B. and Rod Revell. **Telephoning in English**. Cambridge: Cambridge University Press, 2004.
4. Rutherford, Andrea J. **Basic Communication Skills for Technology**. New Delhi: Pearson Education, 2001.
5. Bailey, Stephen. **Academic Writing A practical Guide for Students**. Routledge, London: 2004
6. Hewings, Martin**. Cambridge Academic English: An integrated skills course for EAP(Student's Book)Level: Intermediate** Cambridge University Press, New Delhi: 2012.

| MA7251 | MATHEMATICS – II | L | T | P | C |
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**(Common to all branches of B.E. /B.Tech. Programmes in II Semester)**

**COURSE OBJECTIVES**

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To acquaint the student with the concepts of vector calculus, needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.
- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

**UNIT I MATRICES 12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

**UNIT II VECTOR CALCULUS 12**

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

**UNIT III ANALYTIC FUNCTION 12**

Analytic functions – Necessary and sufficient conditions for analyticity - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c$, $az$, $\frac{1}{z}$, $z^2$ - Bilinear transformation.

**UNIT IV COMPLEX INTEGRATION 12**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

**UNIT V LAPLACE TRANSFORMS 12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

**TOTAL : 60 PERIODS**

**COURSE OUTCOMES**

Upon successful completion of the course, students should be able to:

- Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem
- Appreciate how complex methods can be used to prove some important theoretical results.
- Evaluate line, surface and volume integrals in simple coordinate systems
- Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities
- Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

**TEXT BOOKS**


1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.


**REFERENCE BOOKS**


1. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
4. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
5. Peter V. O'Neil , "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.


**PH7257 PHYSICS OF MATERIALS L T P C** 3 0 0 3

(Common to Chemical, Ceramic, Food, Leather, Textile, Apparel, Industrial Biotechnology, Pharmaceutical and PET) **3 0 0 3**

**OBJECTIVE:**

- To make the students to understand the basics of phase diagrams and various materials preparation techniques
- To equip the students to have a knowledge on different types of electron theory, basics of quantum mechanics and about superconductors
- To introduce the physics of semiconducting materials and applications of semiconductors in device fabrication
- To familiarize the students with the theory and applications of magnetic and dielectric materials
- To provide the students a sound platform towards learning about advanced materials and their applications.

**UNIT I PREPARATION OF MATERIALS 9**

Phases - phase rule – binary systems – tie line rule – lever rule – phase diagram – invariant reactions - nucleation – homogeneous and heterogeneous nucleation – free energy of formation of a critical nucleus – Thin films – preparation: PVD, CVD method – Nanomaterials Preparation: wet chemical, solvothermal, sol-gel method.

**UNIT II ELECTRICAL AND SUPERCONDUCTING MATERIALS 9**

Classical free electron theory - expression for electrical conductivity – thermal conductivity, - Wiedemann-Franz law - Quantum free electron theory – applications of Schrodinger wave equation: particle in a finite potential well – particle in a three-dimensional box- degenerate states – Fermi-Dirac statistics – density of energy states – electron in periodic potential – electron effective mass – concept of hole. Superconducting phenomena, properties of superconductors – Meissner effect and isotope effect. Type I and Type II superconductors, High $T_c$ superconductors – Magnetic levitation and SQUIDS.

**UNIT III SEMICONDUCTING MATERIALS 9**

Elemental Semiconductors - Compound semiconductors - Origin of band gap in solids (qualitative) - carrier concentration in metals - carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – variation of Fermi level with temperature – electrical conductivity – band gap determination – carrier concentration in n-type and p-type semiconductors (derivation) – variation of Fermi level with temperature and impurity concentration – Hall effect – determination of Hall coefficient – LED - Solar cells.

**UNIT IV DIELECTRIC AND MAGNETIC MATERIALS 9**

Dielectric, Paraelectric and ferroelectric materials - Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – dielectric loss – different types of dielectric breakdown – classification of insulating materials and their applications - Ferroelectric materials - Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials.

**UNIT V NEW MATERIALS AND APPLICATIONS 9**

Ceramics – types and applications – Composites: classification, role of matrix and reinforcement – processing of fibre reinforced plastics and fibre reinforced metals – Metallic glasses – Shape memory alloys – Copper, Nickel and Titanium based alloys – grapheme and its properties – Relaxor ferroelectrics - Bio materials – hydroxyapatite – PMMA – Silicone - Sensors: Chemical Sensors - Bio-sensors – Polymer semiconductors – Photoconducting polymers.

**TOTAL: 45 PERIODS**

**OUTCOME:**

On completion of the course, the students will be able to

- acquire knowledge of phase diagram, and thin film and nanomaterial preparation techniques
- familiarize with conducting materials, basic quantum mechanics, and properties and applications of superconductors.
- gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
- realize with theories and applications of dielectric and ferromagnetic materials
- familiarize with ceramics, composites, metallic glasses, shape memory alloys, biomaterials and their important applications.

.

**REFERENCES:**


1. Callister W. D. and Rethwisch, D. G., "Materials Science and Engineering", 9th Edition, Wiley (2014).
2. Raghavan V., "Materials Science and Engineering", Prentice Hall of India (2004).
3. Askeland D.R. and Wright, W.J., "Essentials of Materials Science and Engineering", 3rd Edition, Cengage Learning (2014).
4. Pillai, S.O., "Solid State Physics", New Age International, 7th Edition (2015).
5. Viswanathan, B., "Nanomaterials", Narosa Book Distributors Pvt Ltd. (2011).


**IB7252 MICROBIOLOGY L T P C**

**3 0 0 3**

**AIM**

To introduce students to the principles of Microbiology ,to emphasize the structure and biochemical aspects of various microbes.

**OBJECTIVE**

• To provide to the students the fundamentals of Microbiology , the scope of microbiology and solve the problems in microbial infection and their control,

**UNIT I INTRODUCTION TO MICROBIOLOGY 9**

History (scientists and discoveries) and scope of microbiology (Primary and secondary metabolites), classification and nomenclature of microorganisms, microscopic examination of microorganisms: light, fluorescent, dark field, phase contrast, and electron microscopy. Stains and staining techniques – Definition of auxochrome, chromophores, dyes, Classification of stains, Theories of staining, Mechanism of gram staining, acid fast staining, negative staining, capsule staining, flagella staining, endospore staining.

**UNIT II MICROBES- STRUCTURE AND REPRODUCTION 9**

Structural organization and multiplication of bacteria, viruses (TMV, Hepatitis B), algae (cyanophyta, rhodophyta) and fungi (Neurospora), life history of actinomycetes (Streptomyces), yeast (Sacharomyces), mycoplasma (M. pneumoniae) and bacteriophages ( T4 phage, λ phage)

**UNIT III MICROBIAL NUTRITION, GROWTH AND METABOLISM 9**

Nutritional classification of microorganisms based on carbon, energy and electron sources Definition of growth, balanced and unbalanced growth, growth curve and different methods to quantify bacterial growth:(counting chamber, viable count method, counting without equipment, different media used for bacterial culture (defined, complex, selective, differential, enriched) the mathematics of growth-generation time, specific growth rate.

**UNIT IV CONTROL OF MICROORGANISMS 9**

Physical and chemical control of microorganisms Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Disinfection sanitization, antiseptics sterilants and fumigation. Determination of phenol coefficient of disinfectant. Host-microbe interactions; anti-bacterial, anti-fungal and anti-viral agents; mode of action and resistance to antibiotics; clinically important microorganisms

**UNIT V INDUSTRIAL MICROBIOLOGY AND MICROBIAL ECOLOGY 9**

Microbes involved in preservation (Lactobacillus,bacteriocins), spoilage of food and food borne pathogens *(E.coli, S.aureus, Bacillus, Clostridium*). Industrial use of microbes (production of penicillin, alcohol, vitamin B-12); biogas; bioremediation(oil spillage leaching of ores by microorganisms ,pollution control); biofertilizers, biopesticides. Biosensors.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**


1. Pelczar, M.J. "Microbiology", 5th Edition, Tata McGraw-Hill, 1993.
2. Prescot. Harley, Klein. " Microbiology ": McGraw-Hill Higher Education, 2008
3. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. "General Microbiology." 5th edition, McMillan Press. 1986
4. Ananthanarayanan, R. and C.K. JayaramPaniker, "Textbook of Microbiology",4th Edition, Orient Longman, 1990.
5. Casida, L.E. "Industrial Microbiology", New Age International, 1968.
6. Schlegel, H.G. "General Microbiology", 7th Edition, Cambridge University Press, 1993.


**GE7153 ENGINEERING MECHANICS**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**OBJECTIVE :**

The objective of this course is to inculcate in the student the ability to analyze any problem in a simple and logical manner and to predict the physical phenomena and thus lay the foundation for engineering applications.

**UNIT I STATICS OF PARTICLES 12**

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors.

Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

**UNIT II EQUILIBRIUM OF RIGID BODIES 12**

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point ,Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

**UNIT III DISTRIBUTED FORCES 16**

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Center of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration.

Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel-Axis Theorem ,

Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

**UNIT IV FRICTION 8**

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance , Ladder friction.

**UNIT V DYNAMICS OF PARTICLES 12**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles.

Kinetics- Newton's Second Law of Motion -Equations of Motions , Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force , Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

**L – 45 + T – 15 TOTAL: 60 PERIODS**

**OUTCOMES:**

- Upon completion of this course, students will be able to construct meaningful mathematical models of physical problems and solve them.

**TEXT BOOK**

1. Beer,F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers", McGraw-Hill Education (India) Pvt. Ltd. 10th Edition, 2013.

**REFERENCES**

1. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.
2. J.L. Meriam & L.G. Karige, Engineering Mechanics: Statics (Volume I) and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
3. P. Boresi & J. Schmidt, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
4. Irving H. Shames, G. Krishna Mohana Rao, Engineering Mechanics - Statics and Dynamics, Fourth Edition – PHI / Pearson Education Asia Pvt. Ltd., 2006.
5. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

**IB7251 BIOCHEMISTRY L T P C**

**3 0 0 3**

**AIM**

To enable students learn the fundamentals of Biochemical Processes and Biomolecules.

**OBJECTIVES**

- To ensure students have a strong foundation in the structure and reactions of Biomolecules.
- To introduce them to metabolic pathways of the major biomolecules and relevance to clinical conditions.
- To correlate Biochemical processes with Biotechnology applications.

**UNIT I INTRODUCTION TO BIOMOLECULES 5**

Basic principles of organic chemistry, role of carbon, types of functional groups, biomolecules,

chemical nature of water, pH and biological buffers.

**UNIT II STRUCTURE AND PROPERTIES OF IMPORTANT BIOMOLECULES 15**

Carbohydrates (mono, di, oligo & polysaccharides) mutarotation, glycosidic bond, reactions of monosaccharides and reducing sugars Starch, glycogen, cellulose and chitin. Proteoglycans, glycosaminoglycans. hyaluronic acid, chondroitin sulfate.

Lipids**:** Fatty acids, glycerol, triacylglycerol, saponification, iodination, hydrogenation, phospholipids, glycolipids, sphingolipids. Inherited metabolic disorders of Lipid-metabolism-Tay-Saach's disease, Niemann-Pick's disease and Gaucher's disease. Cholesterol, steroids, Bile acids and salts, Gluco-and Mineralo-corticosteroids. Aldosterone, cortisone and synthetic derivative-prednisolone. Androgens-testosterone, Estrogens- estrone, estradiol and progesterone. Prostaglandins and their functions. LDL, HDL and VLDL. Cardiovascular disease and correlation with circulating lipid and lipoprotein concentration

Amino Acids, Peptides, and Proteins.Classification based on side-chain properties. Structures, hierarchy of organization primary, secondary, tertiary and quaternary structures, glycoproteins, lipoproteins. Determination of primary structure.

Nucleic acids: Purines, pyrimidines, nucleosides, nucleotides, Chargaff's Rules. Base pairing, A-T and G-C, mRNA, rRNA and tRNA., Watson-Crick structure of DNA. reactions, properties, Tm and hypochromicity, Measurement of DNA and RNA. Nucleoprotein complexes

**UNIT III METABOLISM CONCEPTS 5**

Functions of Proteins, Enzymes, introduction to biocatalysts, metabolic pathways, primary and secondary metabolites. Interconnection of pathways and metabolic regulation.

**UNIT IV INTERMEDIARY METABOLISM AND REGULATION 15**

Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt, glyoxalate shunt, fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination and decarboxylation, urea cycle, Bioenergetics - High energy compounds, electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

**UNIT V CASE STUDIES 5**

Case study on overproduction of primary and secondary metabolites - glutamic acid, threonine , lysine, methionine, isoleucine, propionic acid and ethanol.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**


1. Lehninger Principles of Biochemistry 6th Edition by David L. Nelson, Michael M. Cox
2. Satyanarayana, U. and U. Chakerapani, "Biochemistry" 3rd Rev. Edition, Books & Allied (P) Ltd., 2006.
3. Rastogi, S.C. "Biochemistry" 2nd Edition, Tata McGraw-Hill, 2003.
4. Conn, E.E., etal., "Outlines of Biochemistry" 5th Edition, John Wiley & Sons, 1987.
5. **Outlines of biochemistry**, **5th** Edition: By E E Conn, P K Stumpf, G Bruening and R Y Doi. pp 693. John Wiley and Sons, New York. 1987.


**REFERENCES**


1. Berg, Jeremy M. et al. "Biochemsitry", 6th Edition, W.H. Freeman & Co., 2006.
2. Voet, D. and Voet, J.G., "Biochemistry", 3rd Edition, John Wiley & Sons Inc.,2004.
3. Murray, R.K., etal "Harper's Illustrated Biochemistry", 27th Edition, McGraw-Hill, 2006.


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**IB7262 MICROBIOLOGY LABORATORY L T P C**
**0 0 4 2**

**Experiments**

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques
2. Culture Media-Types and Use; Preparation of Nutrient broth and agar
3. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid:Pour plates, streak plates, slants, stabs
4. Microscopy – Working and care of Microscope
5. Microscopic Methods in the Study of Microorganisms., Microscopic identification of yeast/mould
6. Staining Techniques Simple, Differential- Gram's Staining, spore /capsule staining
7. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in Soil – TVC
8. Effect of Disinfectants- Phenol Coefficient
9. Antibiotic Sensitivity Assay
10. Growth Curve in Bacteria and Yeast
11. Effect of pH, Temperature, UV radiation on Growth Bacteria

**TOTAL : 60 PERIODS**

**Equipment Needed for 20 Students**

Autoclave 1
Hot Air Oven 1
Incubators 2
Light Microscopes 4
Incubator Shaker 1
Colorimeter 2
Lamina Flow Chamber 2
Glassware, Chemicals, Media as required

**TEXT BOOKS**


1. Cappuccino, J.G. and N. Sherman "Microbiology : A Laboratory Manual", 4th Edition, Addison-Wesley, 1999.
2. Collee, J.G. etal., "Mackie & McCartney Practical Medical Microbiology" 4th Edition, Churchill Livingstone, 1996.


**IB7261 BIOCHEMISTRY LABORATORY L T P C**
**0 0 4 2**

**AIM**

To learn and understand the principles behind the qualitative and quantitative estimation of biomolecules (proteins, carbohydrates, lipids, metabolites etc.,) and laboratory analysis of the same in the body fluids.

**EXPERIMENTS**

1. General guidelines for working in biochemistry lab (theory)
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
3. Accuracy, precision, sensitivity and specificity (theory)
4. Preparation of buffer –titration of a weak acid and a weak base.
5. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.

6. Quantitative method for amino acid estimation using ninhydrin – distinguishing amino from imino acid.
7. Protein estimation by Biuret and Lowry's methods.
8. Protein estimation by Bradford and spectroscopic methods.
9. Extraction of lipids and analysis by TLC.
10. Estimation of nucleic acids by absorbance at 260 nm and hyperchromic effect (demo).
11. Enzymatic assay: phosphatase from potato.
12. Enzymatic assay: estimation of glucose by GOD-POD method after hydrolysis of starch with acid and specificity of the enzymatic method.

Equipment Needed for 20 Students

| | |
|---|---|
| Autocalve | 1 |
| Hot Air Oven | 1 |
| Incubators | 2 |
| Light Microscopes | 4 |
| Incubator Shaker | 1 |
| Colorimeter | 2 |
| Laminar Flow Chamber | 2 |

Glassware, Chemicals, Media as required

**TOTAL: 60 PERIODS**

**TEXT BOOKS**

1. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
2. Introduction of Practical Biochemistry by David T. Phummer. (II Edition)

**REFERENCES**

1. Harpers Biochemistry Ed. R.K. Murray , D.K. Granner, P.A. Mayes and V.W.Rodwell, Appleton and Lange ,Stanford ,Conneticut.
2. Textbook of Biochemistry with clinical correlations. Ed. Thomas M. Devlin. Wiley Liss Publishers

## MA7358 TRANSFORM TECHNIQUES AND PARTIAL DIFFERENTIAL EQUATIONS

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**OBJECTIVES:**

- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes;
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems;
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic;
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems.

**OUTCOMES :**

The students can able to solve the partial differential equations , find the Fourier series analysis and solve the problems by using Fourier transform and Z transform techniques.

**UNIT I PARTIAL DIFFERENTIAL EQUATIONS** **12**

Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange's Linear equation – Integral surface passing through a given curve – Classification of partial differential equations - Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

**UNIT II FOURIER SERIES 12**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

**UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION 12**

Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

**UNIT IV FOURIER TRANSFORM 12**

Fourier integral theorem – Fourier transform pair - Sine and cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

**UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 12**

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and final value theorems – Formation of difference equation – Solution of difference equation using Z - transform.

**TOTAL : 60 PERIODS**

**TEXT BOOKS:**


1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Erwin kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 9th Edition, , New Delhi, 2014.


**REFERENCES:**


1. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
2. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 11th Reprint , 2010.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics",Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.


**FT7304 FOOD PROCESS CALCULATIONS L T P C**
**4 0 0 4**

**OBJECTIVES:**

To introduce students to basic principles of stoichiometry and its calculations.

**UNIT I 9+3**

Units and Dimensions: Basic and derived units, use of model units in calculations, Methods of expression, compositions of mixture and solutions. Ideal and real gas laws – Gas constant - calculations of pressure, volume and temperature using ideal gas law.

**UNIT II 9+3**

Fundamental Calculations and Humidity: Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

**UNIT III** **9+3**

Basic Principles of Stoichiometry - Importance of material balance and energy balance in a process Industry-Dimensions, Units, conversion factors and their use –Data sources, Humidity and applications. Material Balance: Stoichiometric principles, Application of material balance to unit operations like distillation, evaporation, crystallization, drying, extraction, Leaching.

**UNIT IV** **9+3**

Energy Balance: Heat capacity of solids, liquids, gases and solutions, use of mean heat capacity in heat calculations, problems involving sensible heat and latent heats, evaluation of enthalpy.

**UNIT V** **9+3**

Enthalpy Changes: Standard heat of reaction, heats of formation, combustion, solution, mixing etc., calculation of standard heat of reaction - Effect of pressure and temperature on heat of reaction - Energy balance for systems without chemical reaction.

**TOTAL : 60 PERIODS**

(Use of Psychometric chart is permitted in the examination)

**OUTCOMES:**

To make them understand different types of laws of chemistry of materials and also prepare the students to accurately calculate the stoichiometric relations between the materials involved in the unit operation process

**TEXT BOOKS**

1. Bhatt, B.L and Vora, S.M., —Stoichiometry, Third Edition, McGraw-Hill, New York, 1996.
2. Gavhane, K.A —Introduction to Process Calculations (Stoichiometery) NiraliPrakashan Publications, Pune, 2006.

**REFERENCES**

1. Venkataramani, V. and Anantharaman, N., —Process Calculations , Prentice Hall of India, New Delhi, 2003.
2. Himmelblau, D.M., —Basic Principles and Calculations in Chemical Engineering, Sixth Edition, Prentice Hall India, New Delhi, 2003.

**FT7303 FOOD MICROBIOLOGY** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

- The course aims to develop the knowledge of students in the basic area of Food Microbiology.
- This is necessary for effective understanding of food processing and technology subjects as well as food safety.
- This course will enable students to appreciate the role of microbes in food spoilage, preservation of foods and food borne infections.

**UNIT I ROLE OF MICROBES IN SPOILAGE OF FOODS** **9**

Factors affecting spoilage of foods, Microbial flora associated with various food groups their spoilage potential. Microbiological spoilage problems associated with typical food products.

**UNIT II CONTROL OF MICROBES IN FOODS** **9**

Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, benzoates, sorbates / propionates naturally occurring antimicrobials; physical methods- low and high temperatures, drying, radiation and high pressure; tolerance of microbes to chemical and physical methods in various foods.

**UNIT III MICROBES IN FOOD FERMENTATIONS 9**

Microbes of importance in food fermentations, – homo & hetero-fermentative bacteria, yeasts & fungi; biochemistry of fermentations – pathways involved, lactic acid bacteria fermentation and starter cultures, alcoholic fermentations -yeast fermentations - characteristics and strain selection, fungal fermentations. microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idli, soy products, fermented vegetables and meats.

**UNIT IV MICROBIAL AGENTS OF FOOD BORNE ILLNESS 9**

Food borne infections and food poisoning, microbial toxins, Gram Negative and Gram positive food borne pathogens; toxigenic algae and fungi; Food borne viruses; helminths, nematodes and protozoa.

**UNIT V MICROBIAL EXAMINATION OF FOODS 9**

Detection & Enumeration of microbes in foods; Indicator organisms and microbiological criteria; Rapid and automated microbial methods - development and impact on the detection of food borne pathogens; Applications of immunological, techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. botulimum& Salmonella, Listeria monocytogenes Norwalk virus, Rotavirus, Hepatitis A virus from food samples.

**TOTAL : 45 PERIODS**

**OUTCOME:**

On completion of the course the students are expected to

- Be able to understand and identify the various microbes associated with foods and food groups.
- Be able to understand and identify the role of these microbes in food spoilage, food preservation.
- Understand the role of pathogens in food borne infections. • Understand the methods used to detect pathogens in foods.

**TEXT BOOKS**


1. Banwart, G.J. “Basic Food Microbiology” 2nd Edition. CBS Publishers, 1998.
2. Vijaya Ramesh. “ Food Microbiology”. MJP Publishers, Chennai, 2007.
3. Jay, J.M. “Modern Food Microbiology”. 4th Edition. CBS Publishers, 2003.
4. Adams, M.R. and M.O. Moss.” Food Microbiology”. New Age International, 2002
5. Khetarpaul, Neelam. “Food Microbiology” Daya Publishing House, 2006.


**REFERENCES**


1. Montville, Thomas J. and Karl R. Matthews “ Food Microbiology : An Introduction”. ASM Press, 2005.
2. Ray, Bibek and ArunBhunia. “Fundamental Food Microbiology” 4th Edition, CRC Press, 2008
3. Pawsey, R. K. “Case Studies in Food Microbiology for Food Safety and Quality”. The Royal Society of Chemistry, 2001.
4. Forsythe, S.J. “The Microbiology of Safe Food”. Blackwell Science, 2000.
5. Doyle, Michael P. “Food Microbiology : Fundamentals and Frontiers”. 2nd Edition, ASM Press, 2001.


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**FT7302 FOOD CHEMISTRYAND NUTRITION L T P C**
**3 0 0 3**

**OBJECTIVES:**

The course aims to develop the knowledge of students in the basic area of Food Chemistry. This is necessary for effective understanding of food processing and technology subjects. This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

**UNIT I AN OVERVIEW OF NUTRITION 9**

Definition, six classes of nutrients, calculating energy values from food, using the RDA, nutritional status, nutritional requirement, malnutrition, nutritional assessment of individuals and populations, dietary recommendations, Balanced diet planning: Diet planning principles, dietary guidelines; food groups, exchange lists, personal diet analysis; Digestion, Absorption and Transport: Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients.

**UNIT II CARBOHYDRATES 9**

Simple Sugars: mono and disaccharides, Properties, Caramelization, Maillard reaction;Sugar alcohols; Oligosaccharides: structure, nomenclature, occurrence, uses in foods. Polysaccharides: Starch- Structure, Properties, Functional role in food system, Modified starches, Resistant starch, Starch hydrolysates, Applications in food industry.Non-starch polysaccharides:Pectins, Gums &Hydrocolloid, Fiber - Cellulose & hemicellulose; Food sources, functional role and uses in foods.Digestion and absorption of carbohydrates, lactose intolerance; Glycemic and Non-glycemic carbohydrates, blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, Artificial sweeteners; Importance of blood sugar regulation, Dietary recommendations for NIDDM and IDDM

**UNIT III PROTEINS & LIPIDS 9**

Review of protein structure & conformation; Properties & reactions of proteins in food systems: Dissociation, optical activity, solubility, hydration, swelling, foam formation & stabilization, gel formation, emulsifying effect, thickening & binding, amino acids in Maillard reaction, denaturation; Food enzymes ; Texturized proteins; Food sources, functional role and uses in foods.Review of structure, composition & nomenclature of fats. Non-glyceride components in fats & oils; Properties of fats & oils: crystal formation, polymorphism, melting points, plasticity, 44 isomerisation, unsaturation; Modification of fats: hydrogenation- cis and trans isomers, interesterification, acetylation, winterization; Hydrolytic rancidity & oxidative rancidity; radiolysis Shortening power of fats, tenderization, emulsification, frying - smoke point, auto oxidation, polymerization; Fat replacements; Food sources, functional role and uses in foods. Lipid digestion, absorption and transport; Functions of the triglycerides; essential fatty acids- n-3 and n-6 fatty acids; trans fatty acids, Medium Chain Triglycerides, phospholipids and sterols; Health effects and recommended intakes of lipids. Digestion and absorption of proteins; Functions of proteins; amino acids, Recommended intakes of proteins, Deficiency- short term and long term effects.

**UNIT IV WATER AND MICRONUTRIENTS 9**

Chemistry, physical properties, free, bound & entrapped water, water activity. Drinking water, mineral water, water hardness, water quality for food processing.Mineral & vitamin content of foods- Food and Pharmaceutical grades; Recommended daily intake,toxicities, deficiencies, factors affecting bioavailability, Stability under food processing conditions.

**UNIT V METABOLISM, ENERGY BALANCE AND BODY COMPOSITION 9**

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Review of catabolic and anabolic pathways of glucose, fats and amino acids; Definition, units, calorific value of foods – bomb calorimeter; energy requirements – basal metabolism, specific dynamic action of foods, energy balance, direct and indirect calorimetry, physiological energy value of foods; Energy Balance and Body Composition: Energy balance; body weight and body composition; health implications; obesity, BMR and BMI calculations; Weight Control: Fat cell development; hunger, satiety and satiation; dangers of weight loss; how to identify unsafe weight loss schemes; treatment of obesity; attitudes and behaviors toward weight control.

**TOTAL : 45 PERIODS**

**OUTCOME:**

On completion of the course the students are expected to

- Be able to understand and identify the various food groups; the nutrient components (macro and micro), proximate composition.
- Be able to understand and identify the non-nutritive components in food, naturally present.
- Understand and use effectively, food composition tables and databases.
- Grasp the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition

**TEXT BOOKS:**


1. Chopra, H.K. and P.S. Panesar. " Food Chemistry". Narosa, 2010.
2. Meyer, Lillian Hoagland. " Food Chemistry". CBS Publishers, 1987.
3. Deman, John M. "Principles of Food Chemistry". 3rd Edition. Springer, 1999.
4. Vaclavik, V. A. and Christian E. W. "Essentials of Food Science". II Edition, Kluwer-Academic, Springer, 2003.
5. Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.
6. Gibney, Michael J., et al., "Introduction to Human Nutrition". 2nd Edition. Blackwell,2009.
7. Gropper, Sareen S. and Jack L.Smith "Advanced Nutrition and Human Metabolism". 5 th Edition. Wadsworth Publishing, 2008.


**REFERENCES:**


1. Gopalan C., B.V. Rama Sastri, and S.C. Balasubramanian S. C. "Nutritive Value of Indian Foods". NIN, ICMR, 2004.
2. Damodaran, S., K.L. Parkin and O.R. Fennema. "Fennema's Food Chemistry". 4th Edition, CRC Press, 2008
3. Belitz,H.-D, Grosch W and Schieberle P. "Food Chemistry", 3rd Rev. Edition, Springer-Verlag, 2004.
4. Walstra, P. " Physical Chemistry of Foods". Marcel Dekker Inc. 2003.
5. Owusu-Apenten, Richard. "Introduction to Food Chemistry". CRC Press, 2005.


**EE7151 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To impart the knowledge on basic concepts of electrical circuits and electrical machines.
- To impart the knowledge on basic concepts of electronic components, devices and circuits

**UNIT I BASIC CONCEPTS AND DC CIRCUITS 9**

Ohm's law - Electrical resistance - Series /Parallel resistive circuits - Star/Delta transformations - Kirchoff's law - Node and Mesh analysis - Thevenin's and Norton's theorem.

**UNIT II A.C.CIRCUITS 9**

RMS and average value of periodic waves - Form factor - Phase and Phase difference - Simple RC.RL and RLC circuits - series and parallel resonance - power and power factor - introduction to three phase systems – power measurement in 3 phase system.

**UNIT III D.C. MACHINES 10**

Construction details of DC machines - principle of operation of DC generator - EMF equation - principle of DC motor - Back EMF - Voltage and torque equation - Principle of transformer - construction and type - EMF equation - Tests on transformer - Equivalent circuit - Induction motor - Construction and basic principle of operation - Starting and Running torques.

**UNIT IV ELECTRONIC COMPONENTS AND DEVICES 9**

Operating principle and characteristics of Simple PN Junction Diodes, Zener diode, Bipolar Junction transistor - Field Effect Transistors – UJT – SCR.

**UNIT V ANALOG CIRCUITS 8**

Rectifier and Power Supply Circuits, clipper, clamper using diodes, Operational Amplifiers (Ideal) - properties and typical circuits like differentiator, integrator, summer, comparator.

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Theraja, B.L., " A Text Books of Electrical Technology ", S.S.Chand and Co., New Delhi, 1998.
2. Edminister J.A., " Theory and Problems on Electric circuits ", McGraw Hill International Edition, 1994.
3. Kosow, I.L., " Electrical Machinery and Transformers ", 4th Edition, Prentice Hall of India, 1991.
4. Nagrath I.J. and Kothari D.P., "Theory and Problems of Basic Electrical Engineering", Prentice Hall of India, 1998.
5. Millman.J. and Grabel.S., Integrated Electronics, Tata McGraw Hill, 1995.
6. Horowits.P. and Hill.W., The Art of Electronics, McGraw Hill, 1995.


**FT7301 FLUID MECHANICS IN MECHANICAL OPERATIONS L T P C**
**4 0 0 4**

**OBJECTIVES:**

- To introduce the students to the mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids under static conditions. The dynamics of fluids is introduced through the control volume approach which gives an integrated understanding of the transport of mass, momentum and energy.
- To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on vanes.

**OUTCOMES:**

- The students will be able to get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
- They will also gain the knowledge of the applicability of physical laws in addressing problems in hydraulics.

**UNIT I PROPERTIES OF FLUIDS 12**

Properties of fluids – definition – units of measurement - Mass density – specific weight, specific volume – specific gravity equation of state – perfect gas - Viscosity – vapour pressure – compressibility and elasticity surface tension – capillarity. Fluid pressure and measurement – simple, differential and micro manometers - Mechanical gages – calibration. Hydrostatic forces

on surfaces – total pressure and centre of pressure - Horizontal- vertical and inclined plane surface - Pressure diagram – total pressure on curved surface. Archimedes principles – buoyancy – meta centre – metacentric height

**UNIT II FLUID FLOW ANALYSIS 12**

Types of fluid flow – velocity and acceleration of a fluid particle - Rotational – irrotational – circulation and vorticity - Flow pattern – stream line – equipotential line – stream tube – path line – steak line – flow net – velocity potential – stream function. Principles of conservation of mass – energy – momentum – continuity equation in Cartesian co-ordinates - Euler's equation of motion.

**UNIT III FLOW MEASUREMENTS 12**

Bernoulli's equation – applications - Venturimeter – orifice meter – nozzle meter rota meter – elbow meter pitot tube – Orifice – sharp edged orifice discharging free – submerged orifice – mouth piece - Flow through orifice under variable head – time of emptying a tank with and without inflow. Flow through pipes – laminar and turbulent flow in pipes - Reynold's experiment - Darcy – Weisbach equation for friction head loss – Chezy's formula – Manning's formula – Hazen-William's formula - Major and minor losses in pipes – hydraulic gradient line – energy gradient line. Siphon – water hammer in pipes – gradual and sudden closure of values

**UNIT IV OPEN CHANNEL FLOW 12**

Types of flow in channel – uniform flow – most economical section of channel – rectangular – trapezoidal. Specific energy and critical depth - momentum in open channel flow – specific force - critical flow – computation. Flow measurement in channels – notches – rectangular, Cippollette and triangular – float method - Flow measurement in rivers/ streams/ canals – weirs – free and submerged flow – current meter – Parshall flume.

**UNIT V DIMENSIONAL ANALYSIS & PUMPS 12**

Dimensional analysis – concept of geometric, kinematic and dynamic similarity.Important nondimensional numbers – Reynolds, Froude, Euler, Mach and Weber. Pump terminology – suction lift, suction head, delivery head, discharge, water horse power – selection of pump capacity. Centrifugal pumps – components – working – types of pumps and impellers - Priming – cavitation – specific speed – characteristics curves. Turbine and submersible pumps - Jet pump – jet assembly - Other pumps – Air lift pump - reciprocating pump - sludge pump and vacuum pump-Hydraulic ram

**TOTAL: 60 PERIODS**

**TEXT BOOKS:**


1. Modi, P.N. and Seth S.M. "Hydraulics and fluid mechanics". Standard Publishers Distributors, New Delhi,2010
2. Streeter, V.L. Wylie, E. B. and Bedford K.W, Fluid Mechanics. (9th ed) Tata McGraw Hill, New Delhi, 1998


**REFERENCES:**


1. Bansal, R.K., "A text book of fluid mechanics and hydraulic machinery", Laxmi publications (P) Ltd., New Delhi, 2002.
2. Grade, RJ.,."Fluid mechanics through problems". Wiley eastern Ltd., Madras,2002
3. Jain A. K. "Fluid Mechanics". Khanna Publishers 1995.
4. JagadishLal,."Hydraulic machines". Metropolitan book house, New Delhi, 2000
5. Michael, A.M.."Irrigation Theory and practice", Vikas publishing house, New Delhi, 2008


**FT7312 FOOD MICROBIOLOGY LAB L T P C**
**0 0 4 2**

**OBJECTIVES:**

- Enable students to understand the methods of isolating and characterizing various microbes associated with foods and food groups.
- Enable students to understand and use various microbiological techniques for the study of foods.
- Understand the methods used to detect pathogens in foods.

**OUTCOMES:**

- Complete understanding of isolation, characterization of various microbes associated with foods and food groups.
- Familiarize with microbiological techniques for the study of foods.
- Better understanding of methods to detect pathogens in foods.

**LAB EXPERIMENTS:**

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques; Culture Media-Types and Use; Preparation of Nutrient broth and agar
2. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
3. Microscopy – Working and care of Microscope; Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram's Staining
4. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in food products TVC
5. Microbiological Quality of Water (MPN)
6. Microbiological quality of milk
7. Enumeration of Lactic acid bacteria from fermented foods
8. Yeast & Mould count from fruits
9. Enumeration of spores from pepper
10. Inhibitory effect of spices on microbial load in fish & flesh foods
11. Enumeration & Isolation of E. colifrom processed meat/chicken
12. Thermal destruction of microbes: TDT & TDP
13. Enumeration & Isolation of Staphylococcifrom ready to eat street foods
14. Effect of cleaning and disinfection on microbial load

**EQUIPMENTS:**

| | |
|---|---|
| Auto-calve | 1 |
| Hot Air Oven | 1 |
| Incubators | 2 |
| Light Microscopes | 4 |
| Incubator Shaker | 1 |
| Colorimeter | 2 |
| Lamina Flow Chamber | 2 |

Glassware, Chemicals, Media as required

**TOTAL : 60 PERIODS**

**REFERENCE**

1. Harrigan, W.F. "Laboratory Methods in Food Microbiology" Academic Press, 2011

**FT7311 FOOD CHEMISTRY AND NUTRITION LAB L T P C**
**0 0 4 2**

**OBJECTIVES:**

- To study and understand the physical and chemical properties of foods
- This course will enable the students to – be familiar with nutrient composition of foods
- To gain knowledge in quantitative methods in assessing nutritional status of individuals and groups

**OUTCOMES:**

- Better understanding the physical and chemical properties of food.
- Familiarize in precipitation of casein and gellation of starch.
- Understanding the food groups, constituents of food, energy from food
- Exposing to nutritional assessment, food constituents and their daily dietary allowances

**EXPERIMENTS:**

1. Estimation of Viscosity of foods
2. Properties of solutions- sugar & salt
3. Preparation of emulsions
4. Solubility, specific gravity, Refractive index and Oxidative rancidity of fats and oils
5. Iso-electric precipitation of casein, Effect of rennin on milk proteins
6. Gelling properties of starch
7. Study of gluten formation
8. Enzymatic Browning in foods
9. Enzymatic hydrolysis of sucrose and measurement of optical rotation
10. Calculation and Computing of nutrient composition of foods
11. Nutritional anthropometry - Standards for reference – WHO Growth Charts from birth to 18 years, Body Mass Index and reference value
12. Techniques of measuring height, weight, head, chest and arm circumference, waist to hip ratio, skin-fold thickness, Calculation of percent Body fat using skin folds callipers
13. Calculation of energy balance of individuals based on 3 day dietary recall.
14. Dietary survey of a group of individuals/community
15. Comparison of Food Composition data bases

**TOTAL: 60 PERIODS**

**MA7357 PROBABILITY AND STATISTICS L T P C**
**4 0 0 4**

**OBJECTIVES:**

- To make the students acquire a sound knowledge in statistical techniques that model engineering problems.
- The Students will have a fundamental knowledge of the concepts of probability.

**UNIT I RANDOM VARIABLES 12**

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions - Functions of a random variable.

**UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 12**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

**UNIT III TESTS OF SIGNIFICANCE 12**

Sampling distributions - Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – $\chi^2$- test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank - sum test (Wilcoxon test).

**UNIT IV DESIGN OF EXPERIMENTS 12**

Completely randomized design – Randomized block design – Latin square design - $2^2$ - factorial design - Taguchi's robust parameter design.

**UNIT V STATISTICAL QUALITY CONTROL 12**

Control charts for measurements ($\overline{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

**TOTAL : 60 PERIODS**

**TEXT BOOKS:**

1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, New Delhi, 4th Edition, 3rd Reprint, 2008.
2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2011.

**REFERENCES:**

1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, New Delhi, 7th Edition, 2008.
2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", Elsevier, New Delhi, 3rd Edition, 2004.
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill, New Delhi, 2004.

**GE7251 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVES:**

**To the study of nature and the facts about environment.**

- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14**

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Field study of common plants, insects, birds

Field study of simple ecosystems – pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION 8**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution

(c)Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards– soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.
Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

**UNIT III NATURAL RESOURCES 10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

**UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act– Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

**UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

**TEXT BOOKS:**


1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education 2004.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.


**REFERENCES:**

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia',Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.

**FT7402 INTRODUCTION TO FOOD PROCESSING L T P C**
**3 0 0 3**

**OBJECTIVES:**

The course aims to introduce the students to the area of Food Processing. This isnecessary for effective understanding of a detailed study of food processing andtechnology subjects. This course will enable students to appreciate the importance offood processing with respect to the producer, manufacturer and consumer.

**UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE 9**

Source of food - food of plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

**UNIT II METHODS OF FOOD HANDLING AND STORAGE 9**

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

**UNIT III LARGE-SCALE FOOD PROCESSING 12**

Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc.; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.

**UNIT IV FOOD WASTES IN VARIOUS PROCESSES 6**

Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.

**UNIT V FOOD HYGIENE 9**

Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training
& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of the course the students are expected to



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- Be aware of the different methods applied to processing foods.
- Be able to understand the significance of food processing and the role of foodand beverage industries in the supply of foods.

**TEXT BOOKS:**


1. Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M "Food Preservation and Safety Principles and Practice".Surbhi Publications, 2001.
3. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005.


**FT7404 UNIT OPERATIONS FOR FOOD INDUSTRIES L T P C**
**4 0 0 4**

**OBJECTIVES:**

To understand the principles involved in separation methods.

**UNIT I EVAPORATION AND CONCENTRATION 12**

Unit operations in food processing –conservation of mass and energy – overall view of an engineering process-dimensions and units – dimensional and unit consistency – dimensionless ratios-evaporation – definition – liquid characteristics – single and multiple effect evaporation-performance of evaporators and boiling point elevation – capacity – economy and heat balance-types of evaporators – once through and circulation evaporators – short tube evaporators and long tube evaporators – agitated film evaporator

**UNIT II MECHANICAL SEPARATION 12**

Filtration – definition –filter media – types and requirements-constant rate filtration – constant pressure filtration – filter cake resistance-filtration equipment – rotary vacuum filter – filter press-sedimentation – gravitational sedimentation of particles in a fluid – Stoke's law, sedimentation of particles in gas-cyclones – settling under sedimentation and gravitational sedimentation-centrifugal separations – rate of separations – liquid – liquid separation – centrifuge equipment.

**UNIT III SIZE REDUCTION 12**

Size reduction – grinding and cutting – principles of comminuting – characteristics of comminuted products – particle size distribution in comminuted products-energy and power requirements in comminuting – crushing efficiency – Rittinger's, Bond's and Kick's laws for crushing-size reduction equipments – crushers – jaw crusher, gyratory crusher-crushing rolls – grinders – hammer mills – rolling compression mills - attrition, rod, ball and tube mills – construction and operation.

**UNIT IV CONTACT EQUILIBRIUM SEPARATION 12**

Contact equilibrium separation processes – concentrations – gas-liquid and solid-liquid equilibrium – equilibrium concentration relationships – operating conditions-calculation of separation in contact – equilibrium processes-gas absorption – rate of gas absorption – stage – equilibrium gas – absorption equipment-properties of tower packing – types – construction – flow through packed towers-extraction – rate of extraction – stage equilibrium extraction-equipment for leaching coarse solids – intermediate solids – basket extractor-extraction of fine material – Dorr agitator – continuous leaching – decantation systems – extraction towers-washing – equipments

**UNIT V CRYSTALLIZATION AND DISTILLATION 12**

Crystallization – equilibrium -solubility and equilibrium diagram – rate of crystal growth – equilibrium crystallization-crystallization equipment – classification – construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers-distillation – binary mixtures – flash and differential distillationsteam distillation – theory – consumption – continuous distillation with

rectification – vacuum distillation - batch distillation – operation and process – advantages and limitations-distillation equipments – construction and operation – factors influencing the operation.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

To understand Principles of separation methods used in the process industry. To appreciate different equipments developed for separation.

**TEXT BOOKS:**

1. Geankoplis, C.J. "Transport Processes and Separation Process Principles", 4th Edition, Prentice Hall, 2003.
2. McCabe W.L., Smith J.C. "Unit Operations in Chemical Engineering", 7th Edition, McGraw – Hill Int., 2001,
3. Earle, R.L. 2003. Unit Operations in Food Processing. Pergamon Press. Oxford. U.K.
4. Geankoplis C.J.1999. Transport Process and Unit Operations. Prentice-Hall of India Private Limited, New Delhi.

**REFERENCE:**

1. Richardson, J.E. etal., "Coulson & Richardson's Chemical Engineering" Vol.2 (Praticle Technology & Separation Processes") 5th Edition, Butterworth – Heinemann / Elsevier, 2003.
2. Coulson, J.M and J.F. Richardson,"Chemical Engineering". Volume I to V. The Pergamon Press. New York, 1999
3. McCabe, W.L., J.C.Smith and P.Harriot,"Unit Operations of Chemical Engineering". McGrawHill. Inc. Kosaido Printing Ltd. Tokyo, Japan, 2001
4. Sahay, K. M. and K.K.Singh,"Unit operation of Agricultural Processing", Vikas Publishing House Pvt. Ltd., New Delhi, 2004

**FT7403 REFRIGERATION AND COLD CHAIN MANAGEMENT L T P C**
**4 0 0 4**

**OBJECTIVES:**

- To understand the underlying principles of operation in different Refrigeration & cold storage systems and its components.
- To provide knowledge on design aspects of cold storage systems

**UNIT I REFRIGERATION PRINCIPLES 12**

Refrigeration – principles - refrigeration effect – coefficient of performance – units of refrigeration - simple vapour compression cycle – T-S diagram – p-h chart - application of refrigeration

**UNIT II VAPOUR COMPRESSION REFRIGERATION AND COMPONENTS 12**

Vapour compression system - refrigeration components – compressor and condenser – types, construction and working - expansion device and evaporators – types, construction and working

**UNIT III REFRIGERANTS AND VAPOUR ABSORPTION CYCLE 12**

Refrigerants – properties – classification – comparison and advantages – chloroflouro carbon (CFC) refrigerants - effect on environmental pollution - alternate refrigerants - vapour absorption cycle – theoretical - deviation in practice - Electrolux refrigerator – construction and principles.

**UNIT IV SHELF – LIFE OF FOOD PRODUCTS 12**

Defining overall Shelf-life, remaining shelf life in the context of Chilled & Frozen foods; - Deterioration modes of food items; Models of quality deteriroration- Kinetic model; shelf-life

model; Q10/q10 model; TTT model for the remaining shelf – life; General procedure for shelf – life testing – the 11 steps procedure.
Storage of frozen foods; - Basic design requirements of storage to uphold the shelf –life – size , insulation, entry –exit position, palletization, proper disk-space for air-circulation, automatic door –closing, proper lighting, temperature monitoring and recording facility; stacking systems, emergency exits, material handling devices like fork-lifts, pallet trucks, etc floor heaters, vapour barriers, etc.

**UNIT V COLD CHAIN 12**

What is cold chain? Need for the chain for chilled / frozen food item, various links of the chain; importance of shelf- life; just – in-time deliveries; Temperature limits;-in various countries-Europe, US, Australia etc; Chilling and freezing;- Chilling injury, cook-chilling systems; cold – shortening; PPP and TTT concepts; Temperature monitoring; -Critical temperatures; Temperature –time indicators(TTI); Time –temperature –correlation-the kinetic approach, effective temperature; Transportation regulations; Role of packaging in cold chain– MAS, MAP, CAS, CAP etc; Thaw indicators.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students will be able to demonstrate the operations in different Refrigeration & cold storage systems and also able to design Refrigeration & cold storage systems.

**TEXT BOOKS:**


1. Anand, M.L. " Refrigeration& Air-Conditioning".Asian Books Pvt., Ltd., 2002.
2. Sun, Da-Wen. " Advances in Food Refrigeration". Leatherhead Publishing, 2001.
3. Kennedy, Christopher J. "Managing Frozen Foods". CRC / Woodhead Publishing, 2000.
4. James, S.J. and C. James. " Meat Refrigeration". CRC / Woodhead Publishing, 2002.
5. Stringer, Mike and C. Dennis. "Chilled Foods : A Comprehensive Guide". 2nd Edition, CRC / Woodhead Publishing, 2002.


**REFERENCES:**


1. Evans, Judith. "Frozen Food Science and Technology". Wiley-Blackwell , 2008.
2. Hui, Y.H. etal., " Handbook of Frozen Foods". Marcel Dekker, 2004.


**FT7401 FOOD PROCESSING AND PRESERVATION TECHNOLOGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

To expose the students to the principles and different methods of food processing and preservation.

**UNIT I PRINCIPLES OF MASS AND ENERGY BALANCE 9**

Transport phenomena with respect to foods; Factors affecting heat and mass transfer; Study of heat transfer and its application in the design of thermal processes and freezing. Thermal processing; calculation of process time temperature-schedules.

**UNIT II CANNING OF FOOD PRODUCTS 9**

Newer methods of thermal processing; batch and continuous; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods.

**UNIT III DRYING PROCESS FOR TYPICAL FOODS 9**

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychrometric chart, freezing and cold storage.freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

**UNIT IV NON-THERMAL METHODS 9**

Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology,

**UNIT V FOOD PACKAGING 9**

Basic packaging materials, types of packaging, packaging design, packaging for different types of foods, retort pouch packing, costs of packaging and recycling of materials.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- To understand the principles of food processing and preservation.
- To understand the role of different methods the processing of different foods and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.
- To familiarize with the recent methods of minimal processing of foods
- To understand the materials and types of packaging for foods

**TEXT BOOKS**


1. Sivasankar, B. “Food Processing and Preservation”. Prentice Hall of India, 2002.
2. Khetarpaul, Neelam. “Food Processing and Preservation.” Daya Publications, 2005
3. Singh, M.K. “Food Preservation” Discovery Publishing, 2007.
4. Fellows, P.J. “Food Processing Technology : Principles and Practice”. 2nd Edition, CRC Wood Head Publishing, 2000.
5. GopalaRao, Chandra. “Essentials of Food Process Engineering”. B.S. Publications, 2006.


**REFERENCES**


1. Rahman, M. Shafiur. “Handbook of Food Preservation”. Marcel & Dekker, 2006.
2. Zeuthen, Peter and Bogh-Sarensen, Leif. “Food Preservation Techniques”. CRC / Wood Head Publishing, 2003.
3. Ranganna, S. “Handbook of Canning and Aseptic Packaging”. Tata McGraw-Hill, 2000.


**FT7411 FOOD PROCESSING AND PRESERVATION LAB L T P C**
**0 0 4 2**

**OBJECTIVES:**

To develop skills related to

- Preservation of foods
- Use of various techniques and additives for food processing and Preservation

**EXPERIMENTS:**

1. Heat transfer studies in a plate heat exchanger (Parallel and counter flow)
2. Refrigeration and Freezing of vegetables and fruits
3. Drying of vegetables and fruits with and without additives - Drying rate studies including, constant rate and falling rate periods and the effects of various factors on them.
4. Osmotic drying of foods with salt and sugar.
5. Canning & bottling of vegetable and fruit products
6. Filtration and concentration of fruit juices
7. Production of extruded products.
8. Spray drying of juices/milk
9. Pasteurization of milk

10. Retort processing of foods
11. Determination of Water vapor transmission rate of different packaging materials
12. Determination of migration characteristics of packaging materials
13. Determination of tensile and burst strength of given packaging material

**TOTAL: 60 PERIODS**

**OUTCOMES:**

• Ability to select the specific preservation technology suitable for a specific food
• Ability to Process the different categories of food

**REFERENCES:**


1. Rahman, M.S. “Handbook of Food Preservation”, Marcel Dekker, 1999.
2. Ranganna, S. “Handbook of Canning and Aseptic Packaging” Vol. I, II & III, Tata McGraw – Hill, New Delhi, 2000
3. Pandey, H. et al., “Experiments in Food Process Engineering”. CBS Publishers, 2004.


**FT7412 UNIT OPERATIONS IN FOOD INDUSTRIES LAB L T P C**
**0 0 4 2**

**OBJECTIVE:**

- To develop knowledge in handling basic operation equipment’s

**OUTCOMES:**

Upon completion of this practical course the student will

- Have knowledge on the basic principles of chemical engineering and its applications.
- Be able to apply the skill of material balance and energy balance in unit operations unit process

**EXPERIMENTS:**

1. Flow measurement a) Artifice meter b) Venturimeter, c) Rotameter
2. Determination of economy and thermal efficiency of rotary flash evaporator
3. Solving problems on single and multiple effect evaporator
4. Determination of separation efficiency of centrifugal separator.
5. Determination of collection efficiency in cyclone separator.
6. Determination of efficiency of liquid solid separation by filtration.
7. Determination of absorption efficiency in a packing tower
8. Determination of porosity, coefficient of friction and angle of repose of grains.
9. Determination of particle size of granular foods by sieve analysis.
10. Performance evaluation of a sieve.
11. Determination of performance characteristics in size reduction using the burr mill.
12. Determination of energy requirement in size reduction using the ball mill andhammer mill.
13. Performance evaluation of pin mill and hammer mill.
14. Performance evaluation of a steam distillation process.
15. Visit to a solvent extraction, sugar industry.

**TOTAL: 60 PERIODS**

**FT7502 FUNDAMENTALS OF HEAT AND MASS TRANSFER L T P C**
**4 0 0 4**

**OBJECTIVES:**

To understand the principles and applications of heat and mass transfer operations.

**UNIT I HEAT TRANSFER – CONDUCTION 12**

Basic transfer processes – heat, mass and momentum – heat transfer process - conductors and insulators - conduction – Fourier's fundamental equation – thermal conductivity and thermal resistance - linear heat flow – heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and sphere – extended surfaces (fins) –– solving problems in heat transfer by conduction.

**UNIT II HEAT TRANSFER - CONVECTION 12**

Newton Rikhman's law – film coefficient of heat transfer - convection – free and forced convection - dimensional analysis and its application – factors affecting the heat transfer coefficient in free and forced convection heat transfer – overall heat transfer coefficient - solving problems in heat transfer by convection.

**UNIT III HEAT TRANSFER – HEAT EXCHANGER 12**

Heat exchangers – parallel, counter and cross flow – evaporator and condensers - Logarithmic Mean Temperature Difference – overall coefficient of heat transfer – tube in tube heat exchanger, shell and tube heat exchanger, plate heat exchanger – applications of heat exchangers - solving problems in heat exchangers.

**UNIT IV HEAT TRANSFER: RADIATION 12**

Radiation heat transfer – concept of black and grey body - monochromatic total emissive power – Kirchoff's law – Planck's law - Stefan-Boltzman's law – heat exchange through non-absorbing media - solving problems in heat transfer by radiation.

**UNIT V MASS TRANSFER 12**

Mass transfer – introduction – Fick's law for molecular diffusion - molecular diffusion in gases – equimolar counters diffusion in gases and diffusion of gas A through non diffusing or stagnant B - diffusion through a varying cross sectional area and diffusion coefficients for gases - molecular diffusion in liquids, biological solutions and gels.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

To understand and apply the principles in heat transfer phenomena To understand and apply the principles in mass transfer phenomena To design heat and mass transfer equipments.

**TEXT BOOKS:**


1. Bellaney, P.L. "Thermal Engineering". Khanna Publishers, New Delhi, 2001
2. Geankoplis C.J. "Transport Process and Unit Operations". Prentice-Hall of India Private Limited, New Delhi, 1999


**REFERENCES:**


1. Jacob and Hawkins. "Elements of Heat Transfer".John Willey and Sons Inc. New York, 1983
2. EcKert, E.R.G. "Heat and Mass Transfer". McGraw Hill Book Co., New York, 1981
3. Holman, E.P. "Heat Transfer". McGraw-Hill Publishing Co. New Delhi, 2001
4. Coulson, J.M. and etal. "Coulson & Richardson's Chemical Engineering", 6th Edition, Vol. I & II, Butterworth – Heinman (an imprint of Elsevier), 2004
5. McCabe, W.L., J.C. Smith and P.Harriot "Unit Operations of Chemical Engineering", 6th Edition, McGraw Hill, 2003.


**FT7503 PRINCIPLES OF BIOCHEMICAL ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the Enzyme kinetics, Inhibition kinetics, Immobilization
- To understand the concept of basic fermentation processes and its control systems etc.

- To get a practical knowledge about running the fermenter and its scale – up and modes of operation etc.

**UNIT I INTRODUCTION TO ENZYMES 9**

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics of enzyme substrate complex formation; specificity of enzyme action; principles of catalysis – collision theory, transition state theory; role of entropy in catalysis.

**UNIT II KINETICS OF ENZYME ACTION 9**

Kinetics of single substrate reactions; estimation of Michelis – Menten parameters, multisubstrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product. Allosteric regulation of enzymes, Monod changeuxwyman model, ph and temperature effect on enzymes & deactivation kinetics.

**UNIT III ENZYME IMMOBILIZATION 6**

Physical and chemical techniques for enzyme immobilization – adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., - examples, advantages and disadvantages.

**UNIT IV OVERVIEW OF FERMENTATION PROCESSES 9**

Overview of fermentation industry, general requirements of fermentation processes, basic configuration of fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes.

**UNIT V RAW MATERIALS AND MEDIA DESIGN FOR FERMENTATION PROCESS 12**

Criteria for good medium, medium requirements for fermentation processes, carbon, nitrogen, minerals, vitamins and other complex nutrients, oxygen requirements, medium formulation of optimal growth and product formation, examples of simple and complex media, design of various commercial media for industrial fermentations – medium optimization methods

**TOTAL : 45 PERIODS**

**OUTCOMES:**

The student will be able to

- Understand the fundamentals of Enzyme kinetics, Inhibition kinetics and Immobilization
- Understand the concept of basic fermentation processes and its application during scale up operations.

**TEXT BOOKS:**


1. Bailey, J.E. and Ollis, D.F. “Biochemical Engineering Fundamentals”, 2nd Edition, McGraw Hill, 1986.
2. Blanch, H.W. and D.S. Clark “Biochemical Engineering”, Marcal Dekker, Inc., 1997.
3. Lee, James M. “Biochemical Engineering”, Prentice – Hall, 1992.


**REFERENCES:**


1. Palmer, Trevor “Enzymes : Biochemistry, Biotechnology, Clinical Chemistry”, Affiliated East-West Press Pvt. Ltd., 2004.
2. Stanbury, P.F., A. Whitaker and S.J. Hall “Principles of Fermentation Technology”, 2nd Edition, Butterworth – Heinemann (an imprint of Elsevier), 1995.
3. Wiseman, Alan “Handbook of Enzyme Biotechnology”, 3rd Edition, Ellis Harwood Publications, 1999.
4. Hartmeier, Winfried “Immobilized Biocatalysts : An Introduction”, Springer –Verlag, 1986


**FT7501 FOOD ANALYSIS L T P C**

**3 0 0 3**

**OBJECTIVES:**

To expose the students to the principles, methods and techniques of chemical and instrumental methods of food analysis.

**UNIT I INTRODUCTION 10**

Introduction, food regulations and standards; sampling methods, and sample preparation for analysis; statistical evaluation of analytical data. General methods of food analysis- Moisture determination by different methods; ash analysis-different methods; titrable acidity in foods; determination of crude fiber and dietary fibre.

**UNIT II LIPIDS, PROTEINS AND CARBOHYDRATE ANALYSIS 10**

Analysis of oils and fats for physical and chemical parameters and quality standards, protein analysis by different techniques; analysis of carbohydrates by different techniques.

**UNIT III SPECTROSCOPIC TECHNIQUES 10**

Basic principles; application of UV-Visible spectrophotometer in the analysis of food additives; IR Spectroscopy in online determination of components of food- FT-IR tintometer in color intensity determination; application of Atomic Absorption Spectrophotometer and ICP-AES in analysis of mineral elements and fluorimeter in vitamin analysis.

**UNIT IV CHROMATOGRAPHIC TECHNIQUES 10**

Basic principles; application of paper chromatography and TLC in food analysis; detection of adulterants in foods; Column chromatography for purification analysis- Ion exchange and affinity chromatography; HPLC and GC in food analysis; Significance of MS detectors in HPLC and GC; FAME analysis in oils and fats.

**UNIT V ELECTROPHORESIS, REFRACTOMETRY AND POLARIMETRY 5**

Basic principles; application of the electrophoresis in food analysis; Brixs value of fruit juices; total soluble solids in fruit products; Refractive indices of oils and fats; specific rotations of sugars; Estimation of simple sugars and disaccharides by polarimeter.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- To understand the principles behind analytical techniques in food analysis.
- To know the methods of selecting appropriate techniques in the analysis of food products.
- Appreciate the role of food analysis in food standards and regulations for the manufacture and the sale of food products and food quality control in food industries.
- To familiarize with the current state of knowledge in food analysis.

**TEXT BOOKS:**


1. Pomeranz, Yeshajahu. “Food Analysis : Theory and Practice”. 3rd Edition. Aspen Publishers / Springer, 2000.
2. Kirk, R.S. and R. Sawyer “Pearson’s Composition and Analysis of Food”. 9th Edition. Longman, New York, 1991
3. Nielsen, S. Suzanne. “Food Analysis”. 3rd Edition. Springer, 2003.


**REFERENCES:**


1. Otles, Semih. “Methods of Analysis of Food Components and Additives”. CRC Press, 2005.
2. Nollet, Leo M.L. “Hand Book of Food Analysis” II Rev. Edition. Vol. I, II & III, Marcel & Dekker, 2004.
3. Nollet, Leo M.L. “ Food Analysis by HPLC”. II Rev. Edition, Marcel & Dekker, 2000
4. Otles, Semih. “Handbook of Food Analysis Instruments”. CRC Press, 2009.


**FT7511 BIOCHEMICAL ENGINEERING LAB L T P C**

**0 0 4 2**

**OBJECTIVES:**

To enable the students to understand the concepts and operation of equipment in handling of enzymes and cultivation of microbes in industrial scale .

**OUTCOMES:**

To sterilize a bioreactor
To operate a bioreactor
To design experiments to evaluate the performance of the bioreactor.
To develop enzyme immobilized processes.

**EXPERIMENT:**

1. Growth of bacteria – estimation of biomass, calculation of specific growth rate, yield coefficient
2. Medium optimization – Plackett Burman design, response surface methodology
3. Enzyme kinetics – Michelis Menton parameter, effect of temperature and pH
4. Enzyme immobilization – gel entrapment, cross linking
5. Preparation of bioreactor, utilities for bioreactor operation
6. Thermal death kinetics
7. Batch sterilization design
8. Batch cultivation, estimation of kla – dynamic gassing method, exhaust gas analysis – carbon balancing, gas balancing
9. Fed batch cultivation, exhaust gas analysis – carbon balancing, gas balancing
10. Estimation of kla – sulphite oxidation method
11. Estimation of overall heat transfer coefficient

**TOTAL: 60 PERIODS**

**REFERENCES:**


1. Bailey, J.E. and Ollis, D.F. “Biochemical Engineering Fundamentals” II Edition, McGraw – Hill, 1988.
2. Lee, James M. “Biochemical Engineering”, PHI, U.S.A, 2009
3. Stanbury, P.F. “Principles of Fermentation Technology”, II Edition, Butterworth – Heinemann / Elsevier, 1995.
4. El-Mansi, E.M.T. etal., “Fermentation Microbiology and Biotechnology”, II Edition, CRC / Taylor & Francis, 2007.
5. Peppler, H.J. and D. Perlman “ Microbial Technology” (vol. I Microbial Processes and Vol. I Fermentation Technology)” II Edition, Academic Press / Elsevier, 2004.


**FT7512 FOOD ANALYSIS LAB**

**L T P C**
**0 0 4 2**

**OBJECTIVES:**

Analysis of foods and food products for chemical components, compliance to standards; detection of adulterants in foods.

**OUTCOME:**

- Better understanding in analysis of foods and food products for chemical components.
- Knowing standards for food products.
- Obtain knowledge of adulterants in foods.

**LAB EXPERIMENTS:**

1. Determination of moisture in spices powder by distillation method and Hot air oven method.
2. Determination of total fat, protein in milk and milk products.
3. Rancidity test for fried foods to assess primary and secondary oxidative products.
4. Determination of Vitamin C in fruit juices.

5. Estimation of synthetic Food colour in sweets, confectioneries and beverages.
6. Determination of Iron content in foods.
7. Determination of Iodine content in iodized salt.
8. Detection of Annatto, lead, MSG, sulphur-di-oxide, Emulsifiers and stabilizers in food products.
9. Detection of anti oxidant in foods.
10. Determination of soluble and insoluble fibre in foods.
11. Detection of adulterants in edible oil and ghee.
12. Column chromatographic separation of colours
13. The identification of sugars in fruit juice using TLC.

**TOTAL : 60 PERIODS**

**TEXTBOOKS:**


1. Skoog, D.A. etal. “Principles of Instrumental Analysis”, V Edition, Thomson / Brooks – Cole,1998.
2. Braun, R.D. “Introduction to Instrumental Analysis”, Pharma Book Syndicate, 1987.
3. Willard, H.H. etal. “Instrumental Methods of Analysis”, VII Edition, CBS, 1986.
4. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, V Edition, McGraw-Hill, 1985.


**GE7652 TOTAL QUALITY MANAGEMENT L T P C**
**3 0 0 3**

**AIM**

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

**OBJECTIVES**

- To understand the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- To understand the TQM Principles.
- To learn and apply the various tools and techniques of TQM.
- To understand and apply QMS and EMS in any organization.

**UNIT I INTRODUCTION 9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM –-Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

**UNIT II TQM PRINCIPLES 9**

Leadership--The Deming Philosophy, Quality council, Quality statements and Strategic planning-- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal--Continuous process improvement –Juran Trilogy, PDSA cycle, 5s and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

**UNIT III TQM TOOLS & TECHNIQUES I 9**

The seven traditional tools of quality – New management tools – Six-sigma Process Capability– Bench marking – Reasons to bench mark, Bench marking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using

the findings, Pitfalls and Criticisms of Bench Marking – FMEA – Intent of FMEA, FMEA Documentation, Stages, Design FMEA and Process FMEA.

**UNIT IV TQM TOOLS & TECHNIQUES II 9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures-- Cost of Quality - BPR.

**UNIT V QUALITY MANAGEMENT SYSTEM 9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Ability to apply TQM concepts in a selected enterprise.
- Ability to apply TQM principles in a selected enterprise.
- Ability to apply the various tools and techniques of TQM.
- Ability to apply QMS and EMS in any organization.

**TEXT BOOK:**

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

**REFERENCE BOOKS:**

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”,Prentice Hall (India) Pvt. Ltd., 2006.

**FT7603 FOOD PROCESS ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVES:**

To expose the students to the fundamental knowledge of food, its properties and different methods of food processing

**UNIT I 11**

Rheology and texture of food materials: Concept of rheology, elastic, plastic and viscous behaviour, viscoelasticity, rheological models and constitutive equations. Methods of texture evaluation, subjective and objective measurements. Aerodynamic and hydrodynamic characteristics. Application to separation, pneumatic handling and conveying. Material handling: Material handling machines and conveyors. Pre-treatment unit operations: Cleaning, Dehulling and Dehusking, Sorting & Grading, Peeling, Mixing and Forming. Size reduction and separation. Agitation and Mixing. Mechanical Separations: Centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machines. Filtration: Principles involved in filtration. Pressure and vacuum filtration. Expression: batch and continuous type. Baking,

Roasting and Frying equipment. Extraction and Leaching, Crystallization and Distillation: Basic principles involved.

**UNIT II** **9**

Concept of thermo bacteriology: Arrhenius analogy, its application in design. Determination of heat resistance of micro organisms. Analysis of Thermal Resiliance Duration mathematics of conduction heating. Thermal processing: Blanching, Pasteurizations and Sterilization - principles, different methods and equipments. Processing in containers, process time, T-evaluation, Design of batch and continuous sterilization. Design and analysis of fermenter. Introduction of biochemical Engineering : Kinetics, product yield. Engineering of Gas liquid mass transfer in microbial system.

Shelf life : Calculation of shelf life. Shelf life requirements, Deteriorative reactions. Accelerated testing. Transport properties of barriers. Simulations of product - package environment interaction. Shelf life simulation for moisture, oxygen, and light sensitive products.

**UNIT III** **9**

Raults Law. Water sorption Isotherms - Hysteresis. Water activity measurement method. Water binding and its effect on enzymatic and non-enzymatic reactions and food texture. Control of water activity and moisture. Permeability: Theoretical considerations. Permeability of gases and vapours. Permeability of multilayer materials. Permeability in relation to packaging requirement of foods.

**UNIT IV** **11**

Low Temperature: Freezing of Foods, Types of freezers including, ice cream freezers, Freeze concentration and freeze drying. Freezing curves, phase diagrams, methods of freeze concentration, design problems. Membrane processes : Ultra filtration, Reverse osmosis, Electrodialysis, per-evaporation and micro filtration. High Temperature: Extrusion : Extrusion cookers, cold extrusion, single and twin screw extrusion. Low pressure and high pressure extrusion, properties of Food materials, its significance in equipment design, processing and handling Evaporation : Principles of evaporation, types and selection evaporators, mass and energy balance. Design of single and multiple effect evaporators, recompression heat and mass recovery and vacuum creating divises. Fouling of evaporators and heat exchanges. Drying : Principles of drying, drying rate kinetics, Classification, mass and energy balance. Different types of dryers and components - roller, spray, tray, compartment, fluidized bed etc. Non – Thermal Methods: Microwave and Dielectric & Infrared heating: Physical parameters. Heat transfer phenomenon. Equipment and application. Irradiation - Principle and its equipments, Blending and pulverization equipments.

**UNIT V HYGIENE PRACTICES** **5**

Cleaning and sanitation of food equipments and contains: can, crate, bottle, washing, CIP and COP cleaning. Hygienic design of Food processing equipment. Sanitary requirement, sanitary pipes and fittings.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Students will understand the importance of quality control and food packaging in shelf life of foods.
- Understand thermal processing of food and hygiene practices in food industry.

**TEXTBOOK:**

1. Toledo, Romeo T. “Fundamentals of Food Process Engineering” II Edition. CBS Publishers, 2000.
2. Fellows P. J “Food Processing Technology” Woodhead Publishing, 1998.
3. Smith P. G “Introduction to Food Process Engineering”. Springer, 2005

4. Earle, R.L, “Unit Operations in Food Processing”. Pergamon Press. Oxford. U.K, 2003

**REFERENCES:**

1. Sahay, K. M. and K.K.Singh..“Unit operation of Agricultural Processing”, Vikas Publishing House Pvt. Ltd., New Delhi, 2004
2. Berk, Zeki. “Food Process Engineering and Technology”. Elsevier, 2009.

**FT7602 FOOD ADDITIVES L T P C**
**3 0 0 3**

**OBJECTIVES:**

To expose the students to the use of different chemical additives in foods during food processing and preservation

**UNIT I INTRODUCTION 9**

Definition, role of food additives, classification of food additives based on their role, dual role of certain additives, INS numbering system of food additives, safety requirements of food additives, Acceptable daily intake of food additives, JECFA and Food Chemical Codexstandards for food additives, status of food additives with respect to Indian laws, GMP and permissible upper levels of food additives under Indian food laws.

**UNIT II ACIDITY REGULATORS AND PRESERVATIVES 9**

Acidity Regulators – definition, chemical structure, role and importance, pH modulation and taste, acidity profile, permitted acidity regulators, levels of usage and food applications. Preservatives of chemical and microbial origin; mode of action on spoilage organisms and pathogens, factors affecting the performance of preservatives, active forms of preservatives, necessity in a food and levels of usage; permitted preservatives and food applications. Case studies / illustrations

**UNIT III EMULSIFIERS, STABILIZERS AND THICKENERS 9**

Emulsion, surface tension, oil in water and water in oil emulsion, Hydrophilic and Lipophilic balance (HLB), role of emulsifiers, different classes of emulsifiers and their chemical structure, their HLB values and role in emulsion stabilization; role of different stabilizers and other substances in emulsion stability; emulsion formation process and equipment; measurement of emulsion stability; permitted emulsifiers and stabilizers and food applications. Thickeners – definition, chemical structure, role in food processing and product end characteristics, list of permitted thickeners and food applications.

**UNIT IV ANTIOXIDANTS AND ANTI-CAKING AGENTS 9**

Antioxidants - Chemistry of oxidative deterioration of food and its constituents and its effect on the quality; defining antioxidant; water soluble and oil soluble antioxidants and their chemical structure, permitted antioxidants; mechanism of action, permitted levels and food application. Anti-foaming and propellants, Anti-caking agents – definition, role in preventing spoilage, mode of action, permitted list of anti-caking agents and food application.

**UNIT V COLOR AND ARTIFICIAL SWEETENERS 9**

Color – Natural and synthetic food colors, their chemical structure, shades imparted, stability, permitted list of colors, usage levels and food application. Artificial Sweeteners – list, structure, taste profile, permitted list, usage levels and food applications.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- To understand the principles of chemical preservation of foods

- To understand the role of different food additives in the processing of different foods and their specific functions in improving the shelf life, quality, texture and other physical and sensory characteristics of foods
- To know the regulations and the monitoring agencies involved in controlling the safer use of additives in foods

**TEXTBOOK:**

1. Mahindru, S. N. "Food Additives- Characteristics Detection and Estimation", TATA McGraw Hill, 2000
2. Wilson, R. "Ingredient Handbook Sweeteners", Blackwell, 2007

**REFERENCES:**

1. Emerton, V. "Food Colors", Blackwell, 2008
2. Peter A Williams and Glyn O Philips, " Gums and stabilizers for the Food Industry", RSC,2006.
3. Branen, A. L. "Food Additives" 2nd Edition, CRC press, 2002

**FT7601 DAIRY PROCESS TECHNOLOGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

To introduce the students to dairy industry, properties and processing of milk, manufacture of dairy products, sanitation and effluent treatment in dairy industry

**UNIT I PROPERTIES OF MILK 7**

Milk-Types-Composition-Physical-Chemical and Thermal Properties-Heat Capacity, Density-Freezing-Boiling point-Expansion-Agitation-Viscosity-Classification of milk Market and Special Milk Handling-effects of Merits on Milk-toxicity of metals.

**UNIT II PROCESSING AND QUALITY PARAMETERS OF MILK 10**

Processing of Milk- Pasteurization-HTST, UHT, sterilization, Homogenization, Filtering and Clarification of Milk-cream separation-Methods and Equipment's-Emulsification – Fortification, packaging of milk and milk products, judging and grading of milk, national and international standards of milk and milk products.

**UNIT III MILK PRODUCTS 12**

Traditional dairy products, Manufacturing of Yogurt, Cheese, Butter, Ghee, Ice-cream, malted products, evaporated milk products - properties, Classification-processing Methods, Equipment used, standards and quality parameters.

**UNIT IV MILK POWDER PROCESSING AND MILK SUBSTITUTES 9**

Processing of Milk Powder- Composition - Properties- methods of drying, substitutes for milk and milk products – casein, lactose and other by-products, weaning foods, therapeutic foods, fortification and enrichment.

**UNIT V STORAGE SANITATION AND EFFLUENT TREATMENT 7**

Storage of Milk in Tanks-Storage of ice cream and other milk products - in cold storage - Cleaning and Sanitation-Importance-Detergents-Properties-Cleaning procedures-Cleaning in place-Dairy effluent treatment and disposal.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will gain knowledge about dairy processing and understand the manufacturing processes of various dairy products

**TEXT BOOKS:**

1. Ananthakrishnan, C.P., and Sinha, N.N., “Technology and Engineering of Dairy Plant Operations, Laxmi Publications, New Delhi, 1984.
2. Warner, J.N., “Principles of Dairy Processing”, Wiley Eastern Pub. Co., New York, 1975.
3. Walstra, P., “Diary Technology : Principles of Milk Properties and Processes”. Marcel Dekker, 1999
4. Spreer, Edgar “Milk and Diary Product Technology”. Marcel Dekker, 2005.

**REFERENCES:**

1. Tufail Ahmed., “Dairy Plant Engineering and Management”, KitabMahal Publishers, Allahabad, 1997.
2. Lampert, Lincoln M. “Modern Dairy Products: Composition, Food Value, Processing, Chemistry, Bacteriology, Testing, Imitation Dairy Products”. Chemical Publishing Company, 1998.
3. Selia, Jane dos Reis Coimbra and Jose A. Teixeir “Engineering Aspects of Milk and Dairy Products”. Jane Selia dos Reis Coimbra & Jose A. Teixeir, CRC Press, 2009

**HS7551 EMPLOYABILITY SKILLS L T P C**
**3 0 0 3**

**COURSE DESCRIPTION**

This course aims to help the students acquire the employability skills necessary for the workplace situations. It also attempts to meet the expectations of the employers by giving special attention to language skills, presentation skills, group discussion skills and soft skills. This will be achieved through expert guidance and teaching activities focusing on employability skills.

**COURSE OBJECTIVES**

- To enhance the employability skills of students with a special focus on presentation skills, group discussion skills and interview skills
- To help them improve their reading skills, writing skills, and soft skills necessary for the workplace situations
- To make them employable graduates

**CONTENTS**

**UNIT I READING AND WRITING SKILLS 9**

Reading: skimming & scanning strategies – note making skills – interpreting visual material (charts & tables) – critical reading – fast reading necessary for reading letters & files - preparing job applications - writing covering letter and résumé - applying for jobs online - email etiquette – writing official letters (placing an order, letters to consumers, etc. ) writing reports – collecting, analyzing and interpreting data

**UNIT II SOFT SKILLS 9**

Hard skills & soft skills – soft skills: self-management skills & people skills - training in soft skills - persuasive skills – sociability skills –interpersonal skills – team building skills – leadership skills – problem solving skills – adaptability - stress management – motivation techniques – life skills -

**UNIT III PRESENTATION SKILLS 9**

Preparing slides with animation related to the topic – organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentation

**UNIT IV GROUP DISCUSSION SKILLS 9**

Participating in group discussions – understanding group dynamics - brainstorming the topic – questioning and clarifying –GD strategies (expressing opinions, accepting or refusing others

opinions, turn taking) – activities to improve GD skills – viewing recorded GD - mock GD

**UNIT V INTERVIEW SKILLS 9**

Interview etiquette – dress code – body language – mock interview -–attending job interviews – answering questions confidently – technical interview – telephone/Skype interview - practice in different types of questions – one to one interview &panel interview – FAQs related to job interview- Emotional and cultural intelligence.

**TOTAL: 45 PERIODS**

**LEARNING OUTCOMES**

- Students will be able to make presentations and participate in group discussions with high level of self-confidence.
- Students will be able to perform well in the interviews
- They will have adequate reading and writing skills needed for workplace situations

**REFERENCES:**


1. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: Tata-McGraw-Hill, 2009.
2. Dabreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
3. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
4. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.
5. Van Emden, Joan, and Lucinda Becker. Presentation Skills for Students. New York: Palgrave Macmillan, 2004.


**EXTENSIVE READING**


1. Covey, Stephen R. The 7 Habits of Highly Effective People. New York: Free Press, 2013.
2. Bagchi, Subroto. The Professional. New Delhi: Penguin Books India, 2009.


**WEB RESOURCES**

1. www.humanresources.about.com
2. www.careerride.com
3. https://bemycareercoach.com/softskills

**FT7611 DAIRY PROCESS TECHNOLOGY LAB L T P C**

**0 0 4 2**

**OBJECTIVES:**

To develop skills related to

- Preservation and analytical techniques in milk and milk products
- Use of various techniques and additives for milk product processing and quality analysis

**OUTCOMES:**

On the completion of the course, the students will able to get experience on dairy process technology.

**EXPERIMENTS:**

Properties of milk

1. Determination of viscosity, density and specific gravity of milk
2. Determination of redox potential, acidity and pH of milk
1. Analysis of milk
2. Platform test - Methylene Blue Reduction Test, clot on boiling test
3. Determination of protein in milk by formol titration (pynes method)
4. Determination of lactose content of milk by polarimeter

5. Estimation of milk fat by Gerber method or Milko tester
6. Phosphatase test
7. Determination of adulterant and preservatives of milk
8. Efficiency of sterilization in preparation of sterilized milk by turbidity test.

Milk products and Quality Analysis

10. Preparation and analysis of Yoghurt
11. Preparation and analysis of Cottage cheese
12. Preparation and analysis of Ice-cream/ Cream
13. Preparation and analysis of Butter/ Ghee

**TOTAL: 60 PERIODS**

**REFERENCE BOOK:**

1. Ralph Early, "Technology of Dairy Products" Springer Science & Business Media, 1998
2. Edgar R. Ling, "Textbook of Dairy Chemistry", Vol II, London, 1945

**FT7702 FOOD PACKAGING TECHNOLOGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

The course aims to develop the knowledge of students in the area of packaging of foods and the related technology used. This course will enable students to appreciate the application of scientific principles in the packaging of foods.

**UNIT I BASICS OF PACKAGING 6**

Packaging –Concepts, definition, Significance, classification. Packaging – Development, Retail/Unit; Packaging of foods –fresh and processed

**UNIT II PACKAGING MEDIA & MATERIALS 12**

Primary packaging media – Properties and application, Paper boards, metals, plastics, wood and plywood, glass, flexible materials Labels, caps and closures and adhesives, inks and lacquers, cushioning materials, reinforcements; Testing & evaluation of packaging media – retail packs & transport packages

**UNIT III PACKAGING SYSTEMS AND METHODS 12**

Vacuum packaging, gas flush packaging, CAP & MAP, aseptic & retort packaging, box in box. Food products-General classification and packaging types, varieties and trends Storage handling and distribution of packages-including pallets & containers

**UNIT IV PACKAGING DESIGN 7**

Food marketing and role of packaging; Packaging aesthetic and graphic design; Packaging – Laws and regulations

**UNIT V ENVIRONMENTAL ISSUES IN PACKAGING 8**

Coding and marking including bar coding and Environmental, ecological & Economic issues, recycling and waste disposal.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

To gain knowledge on

- The different types of materials and media used for packaging foods.
- Hazards and toxicity associated with packaging materials and laws, regulations and the monitoring agencies involved food safety, labelling of foods
- Methods of packaging, shelf life and food factors affecting packaging

**TEXT BOOKS:**

1. Robertson, G.L. “Food Packaging: Principles and Practice”. 2nd Edition. Taylor & Francis, 2006.
2. Han, Jung H. “Innovations in Food Packaging”. Elsevier, 2005.
3. Ahvenainen, Raija. “Novel Food Packaging Techniques”. Wood Head Publishing, 2003.
4. Mathlouthi, M. “Food packaging and Preservation”. Aspen Publications, 1999.

**FT7703 FOOD SAFETY, QUALITY AND REGULATION L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
- To help become skilled in systems for food safety surveillance
- To be aware of the regulatory and statutory bodies in India and the world
- To ensure processed food meets global standards

**UNIT I** **10**

Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

**UNIT II** **8**

Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

**UNIT III** **9**

Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

**UNIT IV** **9**

Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

**UNIT V** **9**

Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
- Awareness on regulatory and statutory bodies in India and the world

**REFERENCES:**

1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009

3. Nutritional and safety aspects of food processing by Tannenbaum SR, Marcel Dekker Inc., New York 1979
4. Microbiological safety of Food by Hobbs BC, 1973
5. Food Safety Handbook by Ronald H. Schmidt, Gary E. Rodrick, A John Wiley & Sons Publication, 2003

**FT7651 CREATIVITY, INNOVATION AND NEW PRODUCTDEVELOPMENT L T P C**
**3 0 0 3**

**OBJECTIVES:**
To study the various issues related to Creativity, Innovation and New Product Development.

**UNIT I INTRODUCTION 9**
The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving - brain storming - different techniques

**UNIT II PROJECT SELECTION AND EVALUATION 9**
Collection of ideas and purpose of project - Selection criteria - screening ideas for new products (evaluation techniques)

**UNIT III NEW PRODUCT PLANNING 9**
Design of proto type - testing - quality standards - marketing research - introducing new products

**UNIT IV NEW PRODUCT DEVELOPMENT 9**
Research and new product development - Patents - Patent search - Patent laws - International code for patents - Intellectual property rights (IPR).

**UNIT V MODEL PREPARATION & EVALUATION 9**
Creative design - Model Preparation - Testing - Cost evaluation - Patent application

**TOTAL: 45 PERIODS**

**OUTCOMES:**
To impart the knowledge of various aspects of Creativity, Innovation and New Product Development

**TEXT BOOKS:**
1. Twiss, Brian. “Managing Technological Innovation”, Pitman Publishing Ltd., 1992.
2. Watton, Harry B. “New Product Planning”, Prentice Hall Inc., 1992.

**REFERENCES:**
1. Nystrom, Harry “Creativity and Innovation”, John Wiley & Sons, 1979.
2. Khandwalla, N. – “Fourth Eye (Excellence through Creativity) - Wheeler Publishing”, 1992.
3. I.P.R. Bulletins, TIFAC, New Delhi, 1997.

**FT7701 BAKING AND CONFECTIONERY TECHNOLOGY L T P C**
**3 0 0 3**

**OBJECTIVES:**
This course will enable the student to
- Familiarize with the commercial methods of baking bread and recent advances in bakery industry

- Learn microbiological aspects of bakery products, sanitation and hygiene of baking industries.

**OUTCOMES:**

- Better understanding of process technology of bakery and confectionery products
- Complete learning - use of sanitation and safety practices in bakery and confectionery production

**UNIT I INTRODUCTION TO BAKING 9**

Classification of bakery products. Bakery ingredients and their functions-Essential ingredients: Flour, yeast and sour dough, water, salt- Other ingredients: Sugar, color, flavor, fat, milk, milk powder and bread improvers. Leaveners and yeast foods. Shortenings, emulsifiers and antioxidants.

**UNIT II EQUIPMENTS 9**

Introduction to utensils and equipments used in bakery industry with their purpose.Bulk handling of ingredients- Dough mixing and mixers, Dividing, rounding, sheeting, and laminating-Fermentation enclosures and brew equipment - Ovens and Slicers. Rheology of dough-Farinograph, Amylograph, Alveograph and Extensiograph.

**UNIT III BREAD MAKING PROCESS 9**

The Chemistry of dough Development. Bread making methods- Straight dough/bulk fermentation - Sponge and dough- Activated dough development- Chorley wood bread process-Dough retarding and freezing-emergency No time process. Advantages and disadvantages of various methods of bread-making. Characteristics of good bread: Internal characters; external characters. Bread defects/faults and remedies. Spoilage of bread-Causes, detection and prevention.

**UNIT IV BAKERY PRODUCTS 9**

Production of cakes and cookies/biscuits. Types of biscuit dough‘s –Developed dough, short dough‘s, semi-sweet, enzyme modified dough‘s and batters. Cake making: Ingredients and their function Structure builders. Tenderizers, moisteners and flavor enhancers. Production process for Wafers- type of flour, raising agents and maturing. Other miscellaneous products- puff pastry, chemically leavened. Problems of baking.

**UNIT V CONFECTIONERY PRODUCTS 9**

Definition, importance of sugar confectionery. General technical aspects of industrial sugar confectionery manufacture - compositional effects. Manufacture methods of high boiled sweets: - Ingredients -.prevention of recrystalization and stickiness Types of confectionery products-Caramel, Toffee and Fudge and other confections-:- ingredients - Formulation - Processing method- Quality control- Aerated confectionery- Methods of aeration- Manufacturing process-Chemistry of Hydrocolloids, Hydrocolloid pre treatment Processes -product quality parameters, faults and corrective measures. Spoilage of confectionery products.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**


1. Matz, Samuel A., —Bakery Technology and Engineering, III Edition, Chapman & Hall, London.
2. Cauvain, Stanley P, and Young, Linda S., —Technology of Bread Making, II Edition Aspen publication. Maryland, 1999


**REFERENCES:**


1. Edwards W.P. — Science of bakery products, RSC, UK,2007
2. Samuel A. Matz., —Equipment for Bakers, Pan Tech International Publication. 1988.


Attested



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3. Sugar Confectionery manufacture-(Ed) E.B.Jackson, II edition, Blackie Academic and professional, Glasgow,1995.

**FT7712 SKILLS FOR FOOD PRODUCT DESIGN AND DEVELOPMENT L T P C**
**0 0 4 2**

**OVERVIEW (THEORY) 5**

Organization and assignment of team, Definition of roles; Product Concepts; factors to consider; concept methodology; consumer testing; Product attributes; Concept testing approaches; Development of product specifications: Prototype development; role of ingredients and processing in defining attributes; scale up; Process flow sheet development; factors to consider in process development; process optimization; Factors to consider beyond formulation and processing - shelf life requirements; product performance testing; market positioning, Packaging and labelling, costing; Marketing: developing test market strategies

GROUP PROJECTS TO DEVELOP FOOD PRODUCTS AT LABORATORY SCALE

**(PRACTICAL) 40**

Project Identification: Products/Processes Review, Project Feasibility, Design and Product Specification
Project Planning: Identifying Objectives, Identifying Tools/Methods, Use of Information/Communication Technology
Project Execution: Product Trials and Standardization, Product Quality Profiling – Sensory, Microbial, Nutrient, Shelf Life, Costing, Packaging and Labeling, Product Scale up feasibility
Project Presentation: Documentation and Report, Viva Voce

**TOTAL: 60 PERIODS**

**TEXTBOOKS:**

1. Brody, Aaron L. and John B. Lord. " Developing New Food Products for a Changing Marketplace". II Edition, CRC Press, 2008.
2. Side, Catherine. "Food Product Development : Based on Experience". IOWA State Press, 2002.
3. MacFie, Hal. "Consumer-Led Food Product Development".CRC Press, 2007.

**REFERENCES:**

1. Fuller, G. W. "New Food Product Development from Concept to Marketplace". CRC Press, 1994.
2. Lyon, D. H. "Guidelines for Sensory Analysis in Food Product Development and Quality Control".Chapman and Hall, 1992.
3. Robinson, J., H. Roberts, E. Barnard, and T. Shepard. "Design and Make It Food Technology". Nelson Thomes, 2001.
4. Gould, W. A."Research and Development Guidelines for the Food Industry". Woodhead, 1991.

**FT7711 BAKING AND CONFECTIONERY LABORATORY LAB L T P C**
**0 0 4 2**

**OBJECTIVE:**

This course will enable the student to acquaint with the preparation of various bakery products and perform quality analysis for the same

**EXPERIMENTS**

1. Study of ingredients (major and minor): characteristics of flour, yeast, shortening, sugar, egg and salts.
2. Experiment on leavening action of baking powder, sodium- bicarbonate and ammonium-bi-carbonate.
3. Determination sedimentation value of flour
4. Estimation of water absorption power (atta, and maida)
5. Determination dough rising capacity of yeast
6. Studies of dough characteristics farinographic and extensographic
7. Preparation of biscuits-different types.
8. Preparation of bread-different types.
9. Preparation of toffees.
10. Preparation of sugar boiled confectionary.
11. Preparation of candy.
12. Visit to a bakery/confectionary industry.

**TOTAL: 60 PERIODS**

**REFERENCES / MANUALS/SOFTWARE:**

Sugar Confectionery manufacture-(Ed) E.B.Jackson, II edition. Blackie Academic and professional, Glasgow(1995).

**FT7005 FOOD FLAVOURS TECHNOLOGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the flavour compounds involved in development of flavor
- To understand the analytical techniques involved in flavor analysis

**OUTCOMES:**

- Better understanding and knowledge of contribution of different compounds for the development of flavor and Analytical techniques involved in flavor analysis.

**UNIT I INTRODUCTION 9**

Problems in flavour research – classification of food flavours; chemical compounds responsible for flavour.

**UNIT II FLAVOUR COMPOUNDS 9**

Chemical compound classes and their flavour responses; flavour development during biogenesis, flavour development during food processing; use of biotechnology to develop flavours.

**UNIT III THE CHEMICAL SENSES 9**

Anatomy of the chemical senses; neural development of the chemical senses; receptor mechanisms, neural coding; the control of eating.

**UNIT IV FLAVOUR ANALYSIS 9**

Subjective versus Objective methods of analysis; psychophysics and sensory evaluation; Instrumental analysis; sample handling and artifacts; data handling

**UNIT V TEACHING FLAVOUR CONCEPTS 9**

Problem based learning; tongue and nose; Onion-Beverage-Maillard reaction-Thio-stench

**TOTAL: 45 PERIODS**



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**TEXT BOOKS:**


1. Fisher, Carolyn and Thomas R. Scott. “Food Flavours : Biology and Chemistry”. The Royal Society of Chemistry, 1997.
2. Heath, H.B. and G. Reineccius. “ Flavor Chemistry and Technology”. CBS Publishers, 1996.
3. Reineccius, Gary. “Flavor Chemistry and Technology”. II Edition, Taylor & Francis, 2006.
4. Shahidi, Fereidoon and Chi-Tang Ho. “Flavor Chemistry of Ethnic Foods”. Kluwer Academic / Plenum, 1999.
5. Ashurst, Philip R. “Food Flavorings”. III Edition, Aspen Publications, 1999.


**REFERENCES:**


1. Hofmann, Thomas. “Challenges in Taste Chemistry and Biology”. American Chemical Society Publications, 2004.
2. Charalambous, G. “Food Flavors: Generation, Analysis and Process Influence”. Elsevier, 1995.


**FT7002 CEREAL TECHNOLOGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- The course aims to develop the knowledge of students in the area of Cereal processing and technology.
- This is necessary for effective understanding specific aspects of food processing related to these foods.
- This course will enable students to appreciate the application of scientific principles in the processing of these materials.

**OUTCOMES:**

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for cereals
- Understand the application of scientific principles in the processing technologies specific to the materials.

**UNIT I PRODUCTION, STRUCTURE AND COMPOSITION 6**

Status, major growing areas and production of cereals and millets in India and the world, structure, Physical properties; Density, Bulk density, Angle of repose, Hardness, asperity, porosity, stack of milling and moisture on physical properties. Chemical composition, Distribution of nutrients and Aroma of cereals and millets; anti-nutritional factors.

**UNIT II WHEAT AND RICE 15**

Wheat: Morphology, Physicochemical properties, Wheat Quality, Wheat Milling, quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products – Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Milling of rice: Conventional Milling, Modern milling, Advantages and disadvantages of milling machineries, By products of rice milling, Parboiling of rice: Aging of rice: Enrichment: - Need of Enrichment, Methods of enrichment, Enrichment levels, fortification of amino acids. -Processed Foods from rice: Breakfast cereals, flakes, puffing, canning and instant rice.

**UNIT III OTHER CEREALS 9**

Corn - Morphology, Physico-chemical properties, Corn milling - Wet and dry milling, Milling fractions and modify starches Corn Products – Corn flakes, Corn starch, canned corn products, puffed product; HFCS; Oats- Milling, Oat Products – Steel cut, rolled oats, quick cooking; Rye bread; Traditional and Fermented cereal products

**UNIT IV MILLETS 6**

Sorghum, Pearl Millet, Finger millet, Foxtail millet, Kodo Millet - storage, insect control; processing - Pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

**UNIT V BAKED AND EXTRUDED PRODUCTS 6**

Baked foods - chemical dough development, mechanical dough development, sheeting extrusion other rapid methods; Bread staling – theory, manifestation, retardation measures; Indian Confectionery. Extrusion processing – methods and products.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**


1. Matz, Samuel A. " The Chemistry and Technology of Cereals as Food and Feed" II Edition, CBS, 1996.
2. Delcour, Jan A. and R. Carl Hoseney. "Principles of Cereal Science and Technology". III Edition. American Association of Cereal Chemists, 2010.
3. Kulp, Karel "Handbook of Cereal Science and Technology". IIEdition,CRC Press, 2000.
4. Morris, Peter C. and James H Bryce "Cereal Biotechnology". CRC / Woodhead, 2000


**FT7004 FOOD FERMENTATION TECHNOLOGY L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To impart knowledge and skills related to process technologies and equipment used for the production of various fermented food products.

**OUTCOMES:**

- Understanding concepts, principles and procedures involved in the area of fermented food production.
- Familiarizing with different fermenter types and their design criteria.

**UNIT I HISTORICAL PERSPECTIVE OF FOOD FERMENTATION 6**

History of food fermentations; types of fermented foods and substrates/raw materials used, traditional fermented foods, biotransformation of raw materials

**UNIT II FERMENTING ORGANISMS AND THEIR ROLE 9**

Principles of food and industrial fermentations; microorganisms of importance in food fermentations, Biochemistry of fermentations/fermentation pathways. Lactic Acid Bacteria and starter cultures (Taxonomy, ecology, physiology, genetics and biotechnology, phage control)
Brewers and Bakers yeasts, Yeast starter culture maintenance,
Moulds used in food fermentations;
Genetic manipulation of fermenting microbes, Strain specific traits

**UNIT III TECHNOLOGY OF FERMENTED FOODS 12**

Dairy fermentations - Yeast fermentations - Wine and beer fermentations, bread making,Mould fermentations – soy based fermented foods – miso, tempeh, soy sauces Manufacture of cheese, yoghurt, wine, beer, bread, soy sauce; processes and equipment used for manufacture; bottling / packaging, aging, storage and shelf life of fermented foods; Prevention of spoilage of fermentations.

**UNIT IV PRODUCTS OF MIXED FERMENTATIONS 9**

Meats, sausages, fish sauces, sauerkraut, idli, Manufacture of different types of sausages, fish sauces, sauerkraut, idli batter- processes and equipment used for manufacture; packaging, aging, storage and shelf life of the products; Prevention of spoilage of fermentations.

Attested



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**UNIT V OTHER PRODUCTS FROM FERMENTATION 9**

Fermentation production of flavor components, acids, alcohol, enzymes, pigments/colours

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**


1. Joshi, V. K. "Biotechnology: Food Fermentation" Volume 1. Educational Publishers & Distributors, 2004.
2. Hui Y. H "Handbook of Food and Beverage Fermentation Technology". Marcel Dekker, 2004.
3. Wood, Brian J. B. "Microbiology of Fermented Foods" Volume 1 & 2. II Edition. Blackie Academic & Professional, 1998.


**REFERENCES:**


1. Farnworth, Edward R. "Handbook of Fermented Functional Foods" II Edition. CRC Press, 2008.
2. Lea, Andrew G. H & John R. Piggott "Fermented Beverage Production" II Edition. Kluwer Academic/ Plenum Publishers, 2010.


**FT7003 FOOD ALLERGY AND TOXICOLOGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- Familiarize with hazards, and toxicity associated with food and their implications for health.
- Know the various kinds of allergens and basis of allergic reactions
- Be familiar with various natural toxins in food.

**OUTCOMES:**

Awareness about the different types of allergens and Natural toxins associated with food

**UNIT I INTRODUCTION 9**

Definition and need for understanding food toxicology; Hazards - Microbiological, nutritional and environmental. Basics of immune resources - humoral and cell media resources. Allergen and mechanism of allergic resources.

**UNIT II FOOD ALLERGY AND SENSITIVITY 9**

Chemistry of food allergens, celiac disease, food disorders associated with metabolism, lactose intolerance, and asthma

**UNIT III PRINCIPLES OF TOXICOLOGY 9**

Natural food toxicants - toxicity of mushroom alkaloids, seafood, vegetables, fruits, pulses, and antinutritional compounds. Biological factors that influence toxicity, toxin absorption in the G.I.track, Industrial microflora, blood, brain barrier, storage and excretion of toxins

**UNIT IV DETERMINATION OF TOXICANTS IN FOOD SAMPLING 9**

Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants Assessment of food safety – Risk assessment and risk benefit indices of human exposure, acute toxicity, mutagen city and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioural effect, immunotoxicity.

**UNIT V TOXICANTS FORMED DURING FOOD PROCESSING 9**

Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavour enhancers, food colours, indirect additives, residues and contaminants, heavy metals, other organic residues and packaging materials.

Toxicity of heated and processed foods, food carcinogens and mutagens - Polycyclic aromatic hydrocarbons, N - nitrosamines, Acrylamide and their mode of action

**TOTAL: 45 PERIODS**

**TEXTBOOKS:**


1. Helferich, William and Carl K.Winter "Food Toxicology" CRC Press, 2001.
2. Alluwalia, Vikas "Food Hygiene and Toxicology" Paragon International Publishers, 2007
3. Shibamoto, Taka yuki and Leonard F.Bjeldanzes "Introduction to Food Toxicology" II Edition.Academic Press, 2009.
4. Maleki, Soheila J. A.Wesley Burks, and RickiM.Helm "Food Allergy" ASM Press, 2006.


**REFERENCES:**


1. Labbe, Ronald G. and Santos Garcia "Guide to Food Borne Pathogens" John Wiley & Sons, 2001.
2. Cliver, Dean O. and Hans P.Riemann "Food Borne Diseases" II Edition., Academic Press/Elsevier, 2002.
3. Riemann, Hans P. and Dean O. Cliver "Food Borne Infections and Intoxications" III Edition., Academic Press/Elsevier, 2006.


**FT7009 GENETIC ENGINEERING AND GENETICALLY MODIFIED FOOD L T P C**
**3 0 0 3**

**OBJECTIVES:**

Introduction to GM foods and their methods of production, advantages

- To study genetically modified plants which are commercially available
- To study transgenic animals and their engineering method
- To understand genetically modified microorganisms and their applications in foods
- To know about Pharmaceutical applications of genetically engineered plants
- To understand Risk and safety assessment of the GM foods and their labeling

**OUTCOME:**

- Better understanding of genetically modified plants, animals and modified microorganisms
- Familiarize in Pharmaceutical applications of genetically engineered plants
- Obtain knowledge in Risk and safety assessment of the GM foods and their label

**UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 9**

Manipulation of DNA and RNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.

**UNIT II DNA LIBRARIES 9**

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Screening of DNA libraries using nucleic acid probes and antisera.

**UNIT III SEQUENCING AND AMPLIFICATION OF DNA 9**

Maxam Gilbert's and Sanger's methods of DNA sequencing. Inverse PCR, Nested PCR, AFLP-PCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

**UNIT IV TRANSGENIC TECHNOLOGY 9**

DNA microinjection, Retroviral vectors, Transgenic animals – Knock in and knock out animals, Transgenic plants – Ti plasmid.

**UNIT V APPLICATIONS OF RDNA TECHNOLOGY IN FOODS (Remove company names) 9**

Genetically engineered proteins: Bovine Somatotropin in Milk; Genetically engineered bacteria: ChymosinLite beer; Tryptophan; Transgenic plants: Calgene Flavr Savr TM tomato, Monsanto Round-Up TM Ready, Ciba GeigyBasta TM resistant crops; Edible vaccines: Cholera vaccine in potatoes; Transgenic Fish: Atlantic salmon.

**TOTAL: 45 PERIODS**

**TEXTBOOKS:**

1. Rees, Andy "Genetically Modifies Food: A Short Guide for the Confused". Pluto Press, 2006.
2. Ahmed, Farid E. "Testing of Genetically Modified Organisms in Food". Food Products Press, 2004.

**REFERENCE:**

1. Halford, Nigel G. "Genetically Modified Crops". Imperial College Press, 2003.

**FT7010 INSTRUMENTATION AND PROCESS CONTROL L T P C**
**3 0 0 3**

**OBJECTIVE:**

To introduce students to the principles and methods of biological instruments.

**OUTCOME:**

To provide to the students the fundamentals of instrument knowledge and their applications in biology.

**UNIT I OPTICAL SPECTROSCOPY 9**

Design of Experiments – Error Analysis – S/N ratio – Limit of Detection – UV –VIS Spectroscopy,
Applications, Instruments – single beam, double beam and Photo-diode array – applications – IR & Raman – Uses – Design – FT-IR, Raman.

**UNIT II CHROMATOGRAPHY 9**

Distribution coefficients – solid-liquid, liquid-liquid and gas chromatography – theory of chromatography-normal phase & reverse phase chromatography – gel permeation – ion exchange & affinity chromatography – HPLC- Instrumentation & case studies.

**UNIT III STRUCTURAL ELUCIDATION 9**

Nuclear Magnetic Resonance – Introduction-spin states – lH, 13C NMR – Instrumentation-use in structural elucidation. Electron Paramagnetic Resonance-concept & instrumentation – use in metal containing proteins & membrane studies. X-Ray : X-ray spectroscopy –Auger – EELS Instrumentation & applications in Biology- X-ray diffraction- Instrumentation –small molecule & macromolecular crystallography.

**UNIT IV MASS SPECTROMETRY 9**

Introduction – Instrumentation – CI, EI-Methods of Ionization- Methods for separation of Ions –Method for Detection. MALDI- TOF, ESI and FT-MS.

**UNIT V ELECTROCHEMICAL MEASUREMENTS 9**

Different types of electrochemical apparatus – Measuring Electrode potentials- Red-Ox proteins – Porous Silicon.

**TOTAL: 45 PERIODS**

**TEXTBOOKS:**

1. Skoog, D.A. et al., "Principles of Instrumental Analysis". VI Edition, Thomson/Brooks/ Cole, 2007.
2. Willard, Hobart H, "Instrumental Methods of Analysis".VII Edition, CBS Publishers, 2008.
3. Braun, R.D. "Introduction to Instrumental Analysis". McGraw-Hill, 1987.

**FT7012 MEAT, FISH AND POULTRY PROCESS TECHNOLOGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- The course aims to develop the knowledge of students in the area of animal product processing and technology.
- This course will enable students to appreciate the application of scientific principles in the processing of these materials.

**OUTCOMES:**

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for meat and such foods and the various products derived from these materials.
- Grasp the changes in the composition of foods with respect to the type of processing technology used.

**UNIT I INTRODUCTION 9**

Recent trends in meat processing. Types of Meat and its sources, composition, structure, of meat and meat products. Ante mortem handling, slaughtering of animals, Mechanical deboning, inspection and grading of meat. Post-mortem changes of meat. Color, flavors, microbiology and spoilage factors of meat and meat products.

**UNIT II MEAT PROCESSING 9**

Factors affecting post-mortem changes, properties and shelf-life of meat. Meat tenderization and Meat quality evaluation. Modern abattoirs, slaughter house and its features. Preservation of meat-aging, pickling, smoking. Dried and Cured meat. Canned meat, Frozen meat, Cooked and Refrigerated meat, Sausages.

**UNIT III FISH PROCESSING 9**

Types of fish, composition, structure and spoilage factors of fish. Post-mortem changes in fish. Handling and transportation of fish. Bacteriology of fish, Chilling of fish, Freezing and Individual quick freezing. Canning and smoking operations, Salting and drying of fish, pickling. Radiation processing of fish and fish products. Seafood quality Assurance, Advances in fishery by products technology.

**UNIT IV POULTRY 9**

Introduction, Types and characteristics of poultry products, composition, nutritive value, calculation of nutritive value of poultry products. Unit operation involved in poultry processing.

**UNIT V EGG PROCESSING 9**

Structure, composition, nutritive value, calculation of nutritive value and functional properties of eggs, Factor affecting egg quality and measures of egg quality.Preservation of egg by different methods.Egg powder processing.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Govindan. T.K, —Fish Processing Technology, Oxford and IBH Publishers, New Delhi, 1985.
2. Lawrie, R.A. —Meat Science, Second Edition. Pergamon Press, Oxford, UK. 1975.
3. Stadelmen, W.J. and Cotterill, O.J., —Egg Science and Technology , Second Edition, AVI, Westport, 1977.

**REFERENCES**

1. Joseph Kerry, John Kerry and David Ledwood. —Meat Processing , Woodhead Publishing Limited, England (CRC Press), 2002.
2. Mead, G. —Poultry Meat Processing and Quality, Woodhead Publishing, England, 2004.
3. Wheaton, F.W. and Lawson, T.B., —Processing of Aquatic Food Products, John Wiley & Sons Publishers, New York. 1985.

**FT7007 FRUITS AND VEGETABLE PROCESSING TECHNOLOGY LT P C**
**3 0 0 3**

**OBJECTIVES:**

The course aims to develop the knowledge of students in the area of vegetable and fruit processing and technology.

This course will enable students to appreciate the application of scientific principles in the processing of fruits and vegetables.

**OUTCOME:**

On completion of the course the students are expected to

- Better understanding of the concepts of physiological characteristics of fruits and vegetables
- Better insight about fruit losses during storage and ways to prevent it.
- Thorough Knowledge and understandings of the specific processing technologies used for different foods and the various products derived from these materials.

**UNIT I BASIC AGRICULTURAL ASPECTS OF VEGETABLES AND FRUITS 8**

Ability to identify all commercially important fruits and vegetables with their names in important Indian languages, important regions, season, Morphology, structure and composition of fruit and vegetable. Production and processing scenario of fruits and vegetable: India and World. Scope of Fruit and Vegetable Preservation Industry in India. Present status, constraints and prospectus.

**UNIT II FRESH FRUITS AND VEGETABLES 8**

Physical, Textural characteristics, structure and composition. Maturity standards; Importance, methods of Maturity determinations maturityindices for selected fruits and vegetables. Harvesting of important fruits and vegetables. Fruit ripening- chemical changes, regulations, methods. Storage practices: Control atmospheric, Bead atmosphere, hypotactic storage, cool store, Zero emerge cool chamber, stores striation. Commodity pre-treatment's - chemicals, wax coating, pre-packaging, phytonutrients in fruits and vegetables grading, cleaning, Physiological post harvest diseases chilling injury and disease. Handling and packaging of fruits and vegetables

**UNIT III FREEZING & DEHYDRATION OF FRUITS AND VEGETABLES 9**

General pre processing, different freezing methods and equipments, problems associated with specific fruits and vegetables; Dehydration – General pre processing, different methods of drying including sun, tray, spray drying and low temperature, osmotic dehydration and other modern methods; Indian Food Regulation and Quality assurance.

**UNIT IV CANNING, PUREES AND JUICES 12**

Canning- General pre processing, specific or salient points in fruits and vegetables like – Blanching, exhausting, processing conditions; Indian Food Regulation and Quality assurance Fruit Juice / pulp/ Nectar/Drinks, concentrates – General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance Vegetable Purees/ pastes - General and specific processing, different packing including aseptic. Indian Food Regulation and Quality assurance

**UNIT V FRUIT AND VEGETABLE PRODUCTS 8**

Ready to eat fruit and vegetable products, Jams/Marmalades, Squashes/cordials, Ketchup/sauces, Chutneys, Fruit Bar, Soup powders, Candied Fruits, Natural colors, Fruit and Vegetable Fibres- General and specific processing, different packing including aseptic, Dried Onion, Powder. Garlic: Dried Garlic, Powder, Oil. Potato: Wafer; starch, Papad, Carrot: Preserve, candy, Pickle, Jam. Cauliflower and cabbage: Dried cauliflower and cabbage, Sauerkraut, Pickle Leafy vegetables; Dried Leafy Vegetables. (Spinach, Fenugreek, Coriander leaves, Curry leaves).Bitter gourd: Pickle, Dried bitter gourd. Indian Food Regulation and Quality assurance

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**


1. Fellows, P J. “Food Processing Technology : Principles and Practice”. 2nd Edition, CRC/ Woodhead, 1997.
2. Salunke,D. K and S. S Kadam “Hand Book of Fruit Science and Technology : Production, Composition, Storage and Processing”. Marcel Dekker, 1995.
3. Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.


**FT7015 PULSE AND OIL SEED TECHNOLOGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

The course aims to develop the knowledge of students in the area of pulse and oil seed processing and technology. This is necessary for effective understanding specific aspects of food processing related to these foods. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

**OUTCOME:**

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for pulses and oil seeds and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies specific to the materials.
- Grasp the changes in the composition of foods with respect to the type of processing technology used.

**UNIT I INTRODUCTION 9**

Present status and future prospectus of Pulse and Oil seeds, Morphology of legume. Classification and types of legumes and pulses. Chemical composition and nutritional value. Anti-nutritional factors, their chemistry, methods of removal of anti-nutritional factors.

**UNIT II LEGUMES 9**

Processing of legumes: Home scale, Cottage Scale and commercial methods of dehulling. Modern techniques in Dal mills. Processing of Red gram, Bengal gram, Green gram, Black gram. Dal milling – Principle, methods, equipments and effect on quality. Principle products, Dry and Wet milling of pulses, Fermented Products of legumes. Soaking – Principles, Methods of socking - Sprouting, Puffing, Roasting & Parboiling of Legumes, Physical and Bio-chemical changes during these processes. Cooking quality of dhal – methods, factors affecting quality of dhal and cooking of dhal. Quick cooking dhal, Instant dhal.

**UNIT III SOYA PROCESSING 9**

Soya as a source of protein and oil; Processing of Soya - soya milk, soy protein Isolate, soya paneer, soya sauce; extrusion technology and production of textured vegetable proteins.

**UNIT IV OIL SEEDS 9**

Chemical composition and characters of oil seed and Oils, Anti-nutritional factors, elimination Methods. Post Harvest Technology of Oil seeds, Handling Drying, Storage, Grading, Pre treatments, cleaning, Dehulling, Size reduction and flaking. Oil extraction: Traditional Methods, Ghani, Power Ghanis, Expellers - Principle of Expeller, structure design of expeller. Solvent extraction process: Principle, Pre treatment - Breaking, Cracking, flaking.

**UNIT V OIL SEED PROCESSING 9**

Extraction principles, factors affecting the extraction process. Desolventization. Refining of Oils - Degumming, neutralization, bleaching, filtration, deodorization, their Principles and process controls. New Technologies in oil seed processing, utilization of oil seed meals of different food uses. High protein Product, like protein concentrate and isolates.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Lawson, Harry “Food Oils and Fats : Technology, Utilization, and Nutrition”. CBS Publishers, 1997.
2. Hamm, Wolf and Richard J Hamilton “Edible Oil Processing” Blackwell Publishing, 2004
3. Gunstone, Frank D. “The Chemistry of Oils and Fats : Sources, Composition, Properties and Uses” Blackwell Publishing, 2004.

**REFERENCES:**

1. Rajah, Kanes K. “Fats in Food Technology”, Blackwell / Ane Books, 2004.
2. Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.



**FT7017 SPICES AND PLANTATION TECHNOLOGY L T P C**
**3 0 0 3**

**OBJECTIVES:**

To enable the students to understand about

- Coffee and its processing techniques, instant coffee, and quality grading
- Different types of tea and its manufacturing techniques, instant tea, quality parameters of tea
- Cocoa and its processing, chocolate manufacturing technology
- Processing and chemistry of major spices
- Processing and chemistry of minor spices

**OUTCOMES:**

On completion of the subject, students will be able to understand the processing steps involved for different plantation products and spices.

**UNIT I IMPORTANCE AND PROCESSING OF SPICES 9**

**A. Major Spices**

Post Harvest Technology, composition, processed products of - Pepper, Cardamom, onion, ginger and turmeric – Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles –Enzymatic synthesis of flavour identical - Quality control, Flavour of major spices - Spice oil and oleoresins.

**B. Minor Spices**

Post Harvest Technology, composition, processed products of - Cumin, Coriander, Cinnamon, fenugreek, pepper, Garlic, Clove and Vanilla - Oleoresins and essential oils – Method of manufacture – Chemistry of the volatiles – flavours, Quality control, Present trends in synthesis of volatiles – micro-organisms, plant suspension cultures

**UNIT II PROCESSING OF COFFEE AND TEA 12**

**A. Coffee** - Occurrence – chemical constituents – harvesting – fermentation of coffee beans – changes taking place during fermentation – drying – roasting – Process flow sheet for the manufacture of coffee powder – Instant coffee, methods, process and equipment involved– Chicory chemistry - Quality grading of coffee

**B. Tea** - Occurrence – chemistry of constituents – harvesting – types of tea – green, oolong and ctc – Chemistry and technology of CTC tea – Manufacturing process and equipment involved – Green tea manufacture – Instant tea manufacture – Grading of tea, Processing and quality control.

**UNIT III CHEMISTRY AND TECHNOLOGY OF COCOA AND COCOA PRODUCTS 9**

Occurrence - Chemistry of the cocoa bean – changes taking place during fermentation of cocoa bean – Processing of cocoa bean – cocoa powder – cocoa liquor manufacture Chocolates – Types – Chemistry and technology of chocolate manufacture – Quality control of chocolates

**UNIT IV PROCESSING OF COCONUT, OILPALM, ARECANUT AND CASHEW 9**

Processing of plantation crops – production and importance – processing of coconut, oilpalm, arecanut, cashew– harvesting and stages of harvest – drying, cleaning and grading – production of value added products – packaging and storage of produces.

**UNIT V PACKAGING, GRADING AND QUALITY ANALYSIS OF SPICES 6**

Cleaning and grading of spices - packaging and storage of spices – grading specifications – Agmark, ASTA, ESA specifications - processes involved in the manufacture of oleoresins and essential oils – quality analysis of spices and their derivatives

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**


1. Pandey, P. H. 2002. Post Harvest Engineering of Horticultural Crops through Objectives.SarojPrakasam, Allahabad.
2. Pruthi, J.S. 1998. Major Spices of India – Crop Management and Post Harvest Technology.Indian Council of Agricultural Research, KrishiAnusandhanBhavan, Pusa, New Delhi.PP. 514.


**REFERENCES**


1. ASTA, Official analytical methods of the American Spice Trade Association, IV Edition, 1997
2. Purseglove, J.W., E.G.Brown, G.L.Green and S.R.J.Robbins. 1981.
3. Cardamom – Chemistry. Spices, Vol. I, Tropical Agricultural Series, Longman, London, 1981
4. Pruthi, J.S. Spices and Condiments: Chemistry, Microbiology and Technology. First Edition. Academic Press Inc., New York, USA. 1980..

**FT7014 PROCESS ECONOMICS AND INDUSTRIAL MANAGEMENT IN FOOD INDUSTRIES** **L T P C**
**3 0 0 3**

**OBJECTIVES:**
To introduce process economics and industrial management principles to chemical engineers.

**OUTCOMES:**
The objective of this course is to teach principles of cost estimation, feasibility analysis, management, organization and quality control that will enable the students to perform as efficient managers.

**UNIT I PRINCIPLES OF PRODUCTION MANAGEMENT AND ORGANISATION 15**
Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure; types of organizations Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling; dispatching; costs and costs control, inventory and inventory control.

**UNIT II ENGINEERING ECONOMICS FOR PROCESS ENGINEERS - INTEREST, INVESTMENT COSTS AND COST ESTIMATION 10**
Time Value of money; capital costs and depreciation, estimation of capital cost, manufacturing costs and working capital, invested capital and profitability.

**UNIT III PROFITABILITY, INVESTMENT ALTERNATIVE AND REPLACEMENT 8**
Estimation of project profitability, sensitivity analysis; investment alternatives; replacement policy; forecasting sales; inflation and its impact.

**UNIT IV ANNUAL REPORTS AND ANALYSIS OF PERFORMANCE 4**
Principles of accounting; balance sheet; income statement; financial ratios; analysis of performance and growth.

**UNIT V ECONOMIC BALANCE AND QUALITY AND QUALITY CONTROL 8**
Essentials of economic balance – Economic balance approach, economic balance for insulation, evaporation, heat transfer. Elements of quality control, role of control charts in production and quality control.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Peters, M. S. and Timmerhaus, C. D., " Plant Design and Economics for Chemical Engineers", V Edn., McGraw Hill, 2002.
2. Holand, F.A., Watson, F.A. and Wilkinson, J.K., " Introduction to process Economics ", IIEdn., John Wiley, 1983.
3. Narang, G.B.S. and Kumar, V., " Production and Costing ", Khanna Publishers, New Delhi, 1988.


**REFERENCES:**

1. Allen, L.A., " Management and Organization", McGraw Hill.
2. Perry, R. H. and Green, D., " Chemical Engineer's Handbook ", VIIEdn., McGraw Hill.

**IB7072 BIOLOGICAL SPECTROSCOPY L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To deliver the knowledge of spectroscopic techniques and its functions
- To provide the technical information of spectroscopy for biological applications

**OUTCOMES:**

Upon completion of this course, the student would be able understand Basics of optical rotary dispersion methods and nuclear magnetic resonance

- Principles and applications of mass spectrometry and X-ray diffraction
- About the microscopic techniques and applications
- And apply the spectroscopic techniques for various biological applications

**UNIT I OPTICAL ROTATORY DISPERSION 5**

Polarized light – optical rotation – circular dichroism – circular dichroism of nucleic acids and proteins.

**UNIT II NUCLEAR MAGNETIC RESONANCE 10**

Chemical shifts – spin – spin coupling – relaxation mechanisms – nuclear overhauser effect – multidimensional NMR spectroscopy – detemination of macromolecular structure by nmr – magnetic resonance imaging.

**UNIT III MASS SPECTROMETRY 10**

Ion sources sample introduction – mass analyzers and ion detectors – biomolecule mass sepctrometry – peptide and protein analysis – carbohydrates and small molecules – specific applications.

**UNIT IV X-RAY DIFFRACTION 10**

Scattering by x- rays – diffraction by a crystal – measuring diffraction pattern – Bragg reflection – unit cell – phase problem – anomalous diffraction – determination of crystal structure – electron and neutron diffraction.

**UNIT V SPECIAL TOPICS AND APPLICATIONS 10**

Electron microscopy – transmission and scanning electron microscopy – scanning tunneling and atomic force microscopy – combinatorial chemistry and high throughput screening methods.

**TOTAL: 45 PERIODS**

**TEXT BOOKS**


1. Banwell, Colin N. and E.M. McCash. “Fundamentals of Molecular Spectroscopy” IV$^{th}$ Edition, Tata McGraw-Hill, 1994.
2. Aruldas, G. “Molecular Structure and Spectroscopy”. II$^{nd}$ Edition, Prentice Hall of India, 2007.
3. Pavia, D.L., G.M. Lampman and G.S. Kriz. “ Introduction to Spectroscopy:” III$^{rd}$ Edition, Thomson, Brooks/ Cole, 2001.
4. Williams, Dudley H. and Ian Fleming. ”Spectroscopic Methods in Organic Chemistry”. V$^{th}$ Edition, Tata McGraw-Hill, 1995.


**REFERENCES**


1. Siuzdak, Gary. “Mass Spectrometry for Biotechnology ”. Academic Press / Elsevier,1996.
2. Hammes, Gordon G. “Spectroscopy for the Biological Sciences”. John Wiley, 2005.
3. Campbell I.D and Dwek R.A., “ Biological Spectroscopy “, Benjamin Cummins and Company, 1986.
4. Atkins P.W., “Physical Chemistry “, Oxford IV Edition, 1990.

**GE7073 FUNDAMENTALS OF NANOSCIENCE L T P C**
**3 0 0 3**

**OBJECTIVES:**
To learn about basis of nanomaterial science, preparation method, types and application

**UNIT I INTRODUCTION 8**
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

**UNIT II GENERAL METHODS OF PREPARATION 9**
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

**UNIT III NANOMATERIALS 12**
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, 92 Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, $TiO_2$,MgO, $ZrO_2$, NiO, nanoalumina, CaO, $AgTiO_2$, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dotspreparation, properties and applications

**UNIT IV CHARACTERIZATION TECHNIQUES 9**
X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

**UNIT V APPLICATIONS 7**
NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

**TOTAL : 45 PERIODS**

**OUTCOMES:**
Upon completing this course, the students
- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

**TEXT BOOKS**
1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

**REFERENCES**

1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor),“The Hand Book of Nano Technology,Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

**IB7752 DOWNSTREAM PROCESSING L T P C**
**3 0 0 3**

**OBJECTIVES:**

To enable the students to

- Understand the methods to obtain pure proteins, enzymes and in general about product development R & D
- Have depth knowledge and hands on experience with on Downstream processes

**OUTCOMES:**

Upon success completion of this course, the students will be able to:

- Define the fundamentals of downstream processing for product recovery
- Understand the requirements for successful operations of downstream processing
- Describe the components of downstream equipment and explain the purpose of each
- Apply principles of various unit operations used in downstream processing and enhance problem solving techniques required in multi-factorial manufacturing environment in a structured and logical fashion

**UNIT I DOWNSTREAM PROCESSING 10**

Introduction to downstream processing, principles, characteristics of bio-molecules and bioprocesses. Cell disruption for product release – mechanical, enzymatic and chemical methods. Pre treatment and stabilisation of bio-products.

**UNIT II PHYSICAL METHODS OF SEPARATION 6**

Unit operations for solid-liquid separation - filtration and centrifugation.

**UNIT III ISOLATION OF PRODUCTS 12**

Adsorption, liquid-liquid extraction, aqueous two-phase extraction, membrane separation – ultrafiltration and reverse osmosis, dialysis, precipitation of proteins by different methods.

**UNIT IV PRODUCT PURIFICATION 12**

Chromatography – principles, instruments and practice, adsorption, reverse phase, ion-exchange, size exclusion, hydrophobic interaction, bio-affinity and pseudo affinity chromatographic techniques.

**UNIT V FINAL PRODUCT FORMULATION AND FINISHING OPERATIONS 5**

Crystallization, drying and lyophilization in final product formulation.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Belter, P.A., E.L. Cussler and Wei-Houhu “Bioseparations – Downstream Processing for Biotechnology”, John Wiley, 1988.
2. Sivasankar, B. “Bioseparations : Principles and Techniques”. PHI, 2005.
3. Asenjo, Juan A. “Separation Processes in Biotechnology”. CRC / Taylor & Francis, 1990.

**REFERENCES**

1. Ghosh, Raja “Principles of Bioseparations Engineering”. World Scientific, 2006.
2. “Product Recovery in Bioprocess Technology”. (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004.

**FT7006 FOOD PLANT DESIGN AND LAYOUT L T P C**
**3 0 0 3**

**OBJECTIVES:**

To enable the students understand the various concepts of process development, design consideration and cost estimation in food industry.

**OUTCOME:**

The students will be able to apply their knowledge to design projects for setting up a Food Processing Industry.

**UNIT I OVERALL DESIGN OF AN ENTERPRISE 9**

Plant design, sales planning for plant design. Plant Location, levels of Plant location. Location of layout: location factors, plant site selection. Location theory and models, industrial buildings and grounds. Classification of Dairy and Food Plants, farm level collection and Chilling center. Space requirement.

**UNIT II PREPARATION OF A PLANT LAYOUT 9**

Plant Layout problem, importance, objectives, classical types of layouts. Evaluation of Plant Layout. Advantages of good layout. Organizing for Plant Layout, Data forms.

**UNIT III DEVELOPMENT AND PRESENTATION OF LAYOUT 9**

Development of the pilot layout, constructing the detailed layout : Functional design : Sitting of different sections in a plant, Layout installations.

**UNIT IV QUANTITATIVE ANALYSIS FOR PLANT LAYOUT 9**

Engineering economy.Linear programming.Queing theory.Common Problems in Plant Layout and Process scheduling.Siting of Process sections, Equipment selection and capacity determination, Arrangement of process, and service equipment.Estimation of Services and Utilities.Office layout, line balancing, Flexibility.

**UNIT V PRACTICAL LAYOUTS 9**

PRACTICAL LAYOUTS:Common materials of construction of Food plant, building. Maintenance of Food Plant Building, Illumination and ventilation, Cleaning & sanitization, painting and colour coding, Fly and insect control.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. M Moore, Mac Millan, “Plant Layout & Design”. Lames, New York, 1971.
2. H.S. Hall & Y.S. Rosen, “Milk Plant Layou”. FAO Publication, Rome, 1963.
3. Antonio Lopez-Gomez, Gustavo V. Barbosa-Canovas,“Food Plant Design (Food Science and Technology)”, CRC Press, 2005.

**REFERENCE:**

1. “Food plant engineering system” by Theunis C. Robberts, II Edition, CRC Press, Washington, 2013

2. “Food plant economic” by Zacharias B. Maroulis and George D. Saravacos published by Taylor and Francis Group, LLC, 2008
3. John Holah, HuubLelieveld, “Hygienic Design of Food Factories”, Woodhead Publishing, 2011.
4. Slade, S. “Food Processing Plant” Vol. 1, Leonard Hill Books, 1990

**FT7016 SPECIALTY FOODS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To introduce students to various therapeutic and speciality foods.

**UNIT I** **9**

Need and scope of specialty foods: Specialty food based on ease in preparation cost health benefits; Functional foods, Convenience food, Health care and medical benefits, Nutritional status, Low cost foods.

**UNIT II** **12**

**A. Specialty foods based on sources;** Cereals and millets, Legumes and pulses, Fruits and vegetables, Animal food sources, By product based, Non conventional foods.
**B. Specialty foods based on process;** Innovative process technology, Food additives basis, Bioactive components, Novel neutraceuticals products, Packaging techniques, Adaptable technology basis, Fast and PET foods.
**C. Specialty foods based on growing condition** - organic, inorganic farming.

**UNIT III** **9**

Specialty food based on genetics ; Genetically modified foods, Transgenic foods, Biotechnological aspects of detoxification. Proprietary foods.Supplementary foods.

**UNIT IV** **9**

Therapeutic foods ; Modification of diets in disorders, feeding purposes Disease oriented of different organs ex: digestive tract, liver, cardiovascular system, kidney , metabolic disorders, allergy, endocrine disorders.

**UNIT V** **6**

Specific consumer oriented foods; Defence persons, Space / astronaut, High altitude mountain climbers, Disaster situation – crises, care, maintenance.

**TOTAL : 45 PERIODS**

**TEXT BOOK:**

1. Yanyun Zhao “Specialty Foods: Processing Technology, Quality, and Safety”, CRC Press, 2012

**REFERENCE:**

1. Steve Taylor, “Advances in Food and Nutrition Research”, Volume 49, Elsevier Inc. ,2005
2. Parvinder S. Bali, “Food Production Operation”, Oxford University, 2014

**IB7552 CHEMICAL REACTION ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To provide the basic concepts of types of reactions, variable affecting the rate of reaction, predicting the rate equations for different types of reactions.
- To provide the information about different reactor systems, deriving the performance equations and predicting the rate equations in chemical reaction engineering system.

**UNIT I SCOPE OF CHEMICAL KINETICS & CHEMICAL REACTION ENGINEERING 8**

Broad outline of chemical reactors; rate equations; concentration and temperature dependence; development of rate equations for different homogeneous reactions. Industrial scale reactors.

**UNIT II IDEAL REACTORS 10**

Isothermal batch, flow, semi-batch reactors; performance equations for single reactors; multiple reactor systems; multiple reactions.

**UNIT III IDEAL FLOW AND NON IDEAL FLOW 10**

RTD in non-ideal flow; non-ideal flow models; reactor performance with non-ideal flow.

**UNIT IV GAS-SOLID, GAS-LIQUID REACTIONS 9**

Resistances and rate equations; heterogeneous catalysis; reactions steps; resistances and rate equations.

**UNIT V FIXED BED AND FLUID BED REACTORS 8**

G/L reactions on solid catalysis; trickle bed, slurry reactors; three phase-fluidized beds; reactors for fluid-fluid reactions; tank reactors.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The student will be able to

- Write the rate equation for any type of reaction.
- Design reactors for heterogeneous reactions and optimize operating conditions.
- Relate and calculate the conversions, concentrations and rates in a reaction and identify, formulate and solve chemical engineering problems.

**TEXT BOOKS:**


1. Levenspiel O. Chemical Reaction Engineering. III$^{rd}$ Edition. John Wiley.1999.
2. Fogler H.S. Elements Of Chemical Reaction Engineering. Prentice Hall India.2002


**REFERENCES:**


1. Missen R.W., Mims C.A., Saville B.A. Introduction to Chemical Reaction Engineering and Kinetics. John Wiley.1999
2. Dawande, S.D., "Principles of Reaction Engineering", I$^{st}$ Edition, Central Techno Publications, 2001.
3. Richardson, J.F. and Peacock, D.G., "Coulson Richardson - Chemical Engineering", Vol.III, III$^{rd}$ Edition, Butterworth- Heinemann- Elsevier, 2006


**FT7001 BIOTHERMODYNAMICS L T P C**
**3 0 0 3**

**OBJECTIVES:**

To introduce fundamental thermodynamic principles and their application.

**OUTCOMES:**

Students will learn laws of thermodynamics, thermodynamic property relations and their application to fluid flow, power generation and refrigeration processes.

**UNIT I THERMODYNAMIC LAW AND PROPERTIES OF FLUIDS 9**

First Law of thermodynamics, a generalized balance equation and conserved quantities, Volumetric properties of fluids exhibiting non ideal behavior; residual properties; estimation of thermodynamic properties using equations of state; calculations involving actual property exchanges; Maxwell's relations and applications.

**UNIT II SOLUTION THERMODYNAMICS 9**

Partial molar properties; concepts of chemical potential and fugacity; ideal and non-ideal solutions; concepts and applications of excess properties of mixtures; activity coefficient; composition models; Gibbs Duhem equation.

**UNIT III PHASE EQUILIBRIA 9**

Criteria for phase equilibria; VLE calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria.

**UNIT IV CHEMICAL REACTION EQUILIBRIA 9**

Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

**UNIT V THERMODYNAMIC DESCRIPTION OF MICROBIAL GROWTH AND PRODUCT FORMATION 9**

Thermodynamics of microbial growth stoichiometry thermodynamics of maintenance, Calculation of the Operational Stoichiometry of a growth process at Different growth rates, Including Heat using the Herbert –Pirt Relation for Electron Donor, thermodynamics and stoichiometry of Product Formation

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**


1. Smith J.M., Van Ness H.C., and Abbot M.M. "Introduction to Chemical Engineering Thermodynamics", VI Edition. Tata McGraw-Hill, 2003.
2. Narayanan K.V. "A Text Book of Chemical Engineering Thermodynamics", PHI, 2003.
3. Christiana D. Smolke, "The Metabolic Pathway Engineering Handbook Fundamentals", CRC Press Taylor & Francis Group, 2010.


**REFERENCE:**


1. Sandler S.I. "Chemical and Engineering Thermodynamics", John Wiley,1989.


**FT7013 POST HARVEST TECHNOLOGY L T P C**
**3 0 0 3**

**AIM:**

The course aims to develop the knowledge of students in the area of post harvest processing of various foods and related technology. This course will enable students to appreciate the application of scientific principles in the processing of these materials.

**OBJECTIVES:**

On completion of the course the students are expected to

- Be able to understand and identify the specific processing technologies used for different foods and the various products derived from these materials.
- Understand the application of scientific principles in the processing technologies specific to the materials.

**OUTCOME:**

- Better understanding of the concepts of physiological characteristics of fruits and vegetables
- Better insight about fruit losses during storage and ways to prevent it.
- Thorough Knowledge and understandings of the specific processing technologies used for different foods and the various products derived from these materials.
- Understandings of the application of scientific principles in the processing technologies specific to the materials.

**UNIT I CEREALS AND PULSES 9**

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat - milling, (Atta and maida), quality aspects of flour, wheat proteins and their function; wheat based baked products – Bread, Biscuit, Cakes, Extruded products, malting and malt products; Rice- Milling, Parboiling, Quick cooking rice. Pulses - Basic agricultural aspects, structure, composition, storage, insect control, processingMilling/splitting, dhal milling, products – puffed, flakes, flour, soya milk, soy protein Isolate.

**UNIT II VEGETABLES AND FRUITS 9**

Climatic and non climatic fruits, ripening process, phytonutrients in fruits and vegetables; Handling, transportation, controlled atmosphere ripening process, grading, cleaning, pre treatments, modified atmosphere packaging, chilling. General pre-processing, different freezing methods and equipments, problems associated with specific fruits and vegetables; Dehydration – General pre processing, different methods of drying, osmotic dehydration and other modern methods. Canning - General pre-processing, specific or salient points in fruits and vegetables like – Blanching, exhausting, processing conditions. Fruit Juice / pulp/ Nectar/Drinks, concentrates Vegetable Purees/pastes.

**UNIT III OIL SEEDS, NUTS AND SUGARS 9**

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, hydrogenation; oil blends. Honey- Composition and Quality aspects; Sugars- Manufacture of table sugar, High Fructose corn syrup and Glucose syrup; Jaggery – sources, manufacture.

**UNIT IV MILK AND MILK PRODUCTS 9**

Processing of Milk – Pasteurisation, homogenisation, sterilization, HTST and UHT processes; Processing and preservation of milk products - cream, sour cream, butter, ghee, skimmed 94 milk concentrate and skimmed milk powder, whey concentrate and whey powder, yoghurt, cheese and other products.

**UNIT V MEAT, FISH & POULTRY 9**

Common and commercially important meats; pre and post slaughter handling, meat inspection and grading; animal welfare and safety in slaughter plant. Structure and composition of meat, carcass chilling, ageing; storage of fresh meat - Modified atmosphere packaging, packaging of retail cuts; Processing and preservation - artificial tenderizing, chilling, freezing, curing, smoking, ready-to-eat meats and meat products; Kosher and Halal certification. Marine and fresh water fish, shell fish - composition and nutrition; commercially important fish and shell fish; spoilage factors, ship board operations, storage and transport. Processing and Preservation - chilling, freezing, canning, smoking, curing, salting and drying, fish meal and fish oils. Types of poultry, production, classification & designation, grading. Processing plant operations - slaughter, bleeding, scalding, de-feathering, eviscerating, chilling, packaging; composition and nutrition, poultry meat products Eggs- structure, composition, quality factors, storage, pasteurization, freezing and drying, egg substitutes.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Hamm, Wolf and Hamilton, R, J. “Edible Oil Processing”, Blackwell / Ane Books, 2004.
2. Morris, Peter C and Bryce, J.H. “Cereal Biotechnology”, CRC / Wood Head, 2000.
3. Arthey, David and Ashwat P.R. “Fruit Processing: Nutrition, Products, and Quality Management”, II Edition, Springer, 2005.
4. Eckles, C.H., W.B. Combs and H. Macy “Milk and Milk Products”, IV Edition, Tata McGraw-Hill, 1973.
5. Singh, I.S. “Post-Harvest Handling and Processing of Fruits and Vegetables” Westville Publishing, 2009.
6. Srivastava, A.P. et al., “Mechanisation of Vegetable Production and Post-Harvest Management”. Westville Publishing, 2009.

**REFERENCES:**

1. Rajah, Kanes K. “Fats in Food Technology”, Blackwell / Ane Books, 2004.
2. Valpuesta, Victoriano “Fruit and Vegetable Biotechnology” CRC / Wood Head Publishing, 2002.
3. Mujumdar, A.S. “Dehydration of Products of Biological Orgin”, Oxfords IBH, 2004.
4. Alzamora, S.M., Tapia, M.S. and Lopez – Malo, A. “Minimally Processed Fruits and Vegetables: Fundamental Aspects and Applications”, Springer, 2005.
5. Salunkhe, D.K. and Kadam, S.S. “Handbook of Fruit Science and Technology: Production, Composition, Storage, and Processing”, Marcel Dekker, 2005.
6. “Agro – Food Processing: Technology Vision 2020 Fruits & Vegetables Current Status and Vision”, TIFAC, 1996.
7. Sofos, J.N. “Improving and Safety of Fresh Meat” Wood Head Publishing / CRC, 2005.

**FT7008 FUNCTIONAL FOODS AND NUTRACEUTICALS L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease

**OUTCOME:**

- Knowledge of the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction
- Understand the role of Nutraceuticals and functional food in health and disease

**UNIT I INTRODUCTION AND SIGNIFICANCE 6**

Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoo chemicals and microbes in food, plants, animals and microbes

**UNIT II ANALYSIS OF PHYTOCHEMICALS 12**

Qualitative and quantitative methods: phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, Chitin; Carotenoids - Factors affecting bioavailability, chemical and histochemical characterization of cell wall polysaccharides in almond seed in relation to lipid bioavailability.

**UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY 12**

In vitro and In vivo methods for the assessment of antioxidant activity, Comparison of different In Vitro methods to evaluate the antioxidant, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources

**UNIT IV ROLE IN HEALTH AND DISEASE 12**

Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and symbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

**UNIT V SAFETY ISSUES 6**

Health Claims, regulations and safety issues- International and national.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**


1. Bisset, Normal Grainger and Max Wich H "Herbal Drugs and Phytopharmaceuticals", II Edition, CRC, 2001.
2. Wildman, Robert "Handbook of Nutraceuticals and Functional Foods". CRC, 2006.
3. Webb, P P. "Dietary Supplements and Functional Foods". Blackwell, 2006.
4. Ikan, Raphael "Natural Products: A Laboratory Guide", 2nd Edition, Academic Press / Elsevier, 2005.
5. Tipnis, H.P. "Bioavailability and Bioequivalence : An Update" New Age International,


**REFERENCES:**


1. Shi, John, FereidoonShahidi and Chi-Tang Ho "Asian Functional Foods". CRC/Taylor &Francis, 2007.
2. Watson, Robald Ross "Functional Foods and Nutraceuticals in Cancer Prevention". Blackwell Publishing, 2007.
3. Gibson, G.R. and C.M.Willams. "Functional Foods : Concept to Product". Woodhead, 2000.
4. Hanson, James R. "Natural Products: The Secondary Metabolites", Royal Society of Chemistry, 2003.


**GE7351 ENGINEERING ETHICS AND HUMAN VALUES L T P C**
**3 0 0 3**

**OBJECTIVES**

- To emphasise into awareness on Engineering Ethics and Human Values.
- To understand social responsibility of an engineer.
- To appreciate ethical dilemma while discharging duties in professional life.

**UNIT I HUMAN VALUES 3**

Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – Self-Confidence – Discrimination- Character.

**UNIT II ENGINEERING ETHICS 9**

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action - Self-interest –Professional Ideals and Virtues - uses of ethical theories. Valuing Time – Co-operation – Commitment –

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics – Importance of Industrial Standards - a balanced outlook on law – anticorruption- occupational crime -the challenger case study.

**UNIT IV ENGINEER'S RIGHTS AND RESPONSIBILITIESON 12**

Collegiality and loyalty – Respect for authority – Collective Bargaining – Confidentiality- Conflict of interest – Occupational Crime – Professional Rights – IPR- Safety and risk - assessment of

safety and risk - risk benefit analysis and reducing risk - the Three Mile Island, Bhopal Gas plant and chernobyl as case studies.

**UNIT V GLOBAL ISSUES** **12**

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - moral leadership-Sample code of conduct.

**TOTAL : 45 PERIODS**

**OUTCOMES**

- Students will have the ability to perform with professionalism , understand their rights , legal ,ethical issues and their responsibilities as it pertains to engineering profession with engaging in life-long learning with knowledge of contemporary issues.

**TEXT BOOKS**

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 2005.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

**REFERENCES**

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford Press , 2000
5. R.Subramanian , "Professional Ethics ",Oxford University Press ,Reprint ,2015.

**FT7018 TRADITIONAL FOODS** **L T P C**
**3 0 0 3**

**OBJECTIVES:**

To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.

**OUTCOME:**

- To understand the historical and traditional perspective of foods and food habits
- To understand the wide diversity and common features of traditional Indian foods and meal patterns.

**UNIT I HISTORICAL AND CULTURAL PERSPECTIVES** **9**

Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts.

**UNIT II TRADITIONAL METHODS OF FOOD PROCESSING** **9**

Traditional methods of milling grains – rice, wheat and corn – equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation – sun-drying, osmotic drying, brining, pickling and smoking.

**UNIT III TRADITIONAL FOOD PATTERNS 9**

Typical breakfast, meal and snack foods of different regions of India.Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods,pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods

**UNIT IV COMMERCIAL PRODUCTION OF TRADITIONAL FOODS 12**

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.

**UNIT V HEALTH ASPECTS OF TRADIONAL FOODS 6**

Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**


1. Sen, Colleen Taylor “Food Culture in India” Greenwood Press, 2005.
2. Davidar, Ruth N. “Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001.


**FT7011 MANAGEMENT OF FOOD WASTE L T P C**
**3 0 0 3**

**OBJECTIVES:**

- Importance of treating waste product from food industry.
- Treatment methods and recycling of waste product from food industry.

**OUTCOMES:**

- Awareness of Importance in treating waste product from food industry.
- Knowledge of Treatment methods and recycling of waste product from food industry

**UNIT I CLASSIFICATION & CHARACTERIZATION OF FOOD INDUSTRY WASTE 8**

Classification and characterization of waste from various food industries; Need for treating waste from various food industries.

**UNIT II WASTE FROM MEAT, DAIRY AND VEGETABLE PROCESSING INDUSTRY 9**

Classification, analysis and disposal of waste from meat; Bioremediation and utilization of dairy waste. Treatment of water from fruit and vegetable processing industry

**UNIT III TREATMENT METHODS OF WASTE FROM FOOD INDUSTRY 9**

Treatment methods for liquid waste from food industry; Design of activated sludge process, bioremediation, trickling filter process and Anaerobic Digestion Treatment methods for solid waste from food industry-drying, incineration and Design of solid waste management.

**UNIT IV RECYCLING AND UTILIZATION OF WASTE PRODUCT FROM FOODINDUSTRY 10**

Treatment of water from food industry -BOD, COD, RO. Recovery of protein from potato starch plant, utilization of molasses, utilization of waste from meat and fish for live stock and poultry.

**UNIT V REGULATORY ISSUES WITH FOOD INDUSTRY WASTE 9**

International and national scenario on disposal of waste from food industries; Regulatory issues with food industry waste

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Herzka, A. and Booth, R.G. "Food Industry and Trade: Recycling Waste". Applied Science Publishers, 1981.
2. Tegge, G., Green, J. H., and A. Kramer. "Food Processing Waste Management;: AVI Publishing, 1979 .

**REFERENCES:**

1. VassoOreopoulou and Winfried Russ. "Utilization of by-products and Treatment of Waste in the Food Industry". Springer, 2007.
2. Ioannis S. Arvanitoyannis. "Waste Management for the Food Industries". Academic Press, 2008.

**GE7071 DISASTER MANAGEMENT L T P C**
**3 0 0 3**

**OBJECTIVES:**

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

**UNIT I INTRODUCTION TO DISASTERS 9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

**UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

**UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

**UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

**UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context,
- Disaster damage assessment and management.

**TEXTBOOKS:**


1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.


**REFERENCES**


1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.


**GE7074 HUMAN RIGHTS L T P C**
**3 0 0 3**

**OBJECTIVES :**

- To sensitize the Engineering students to various aspects of Human Rights.

**UNIT I 9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

**UNIT II 9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

**UNIT III 9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

**UNIT IV** **9**

Human Rights in India – Constitutional Provisions / Guarantees.

**UNIT V** **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

**TOTAL : 45 PERIODS**

**OUTCOME :**

- Engineering students will acquire the basic knowledge of human rights.

**REFERENCES:**


1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.


| GE7072 | FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

**UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT** **9**

**Global Trends Analysis and Product decision -** Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies **-** Product Life Cycle – Product Development Planning and Management.

**UNIT II REQUIREMENTS AND SYSTEM DESIGN** **9**

**Requirement Engineering -** Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling -** Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

**UNIT III DESIGN AND TESTING** **9**

**Conceptualization -** Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept

Screening & Evaluation - **Detailed Design -** Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program **-** Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

**UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance -**Maintenance and Repair – Enhancements - **Product EoL -** Obsolescence Management – Configuration Management - EoL Disposal

**UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9**

**The Industry -** Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

**TEXTBOOKS:**


1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.


**REFERENCES:**


1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013