# Sri Krishna College of Engineering and Technology

## CURRICULUM DESIGN UNDER REGULATION 2015

## MECHATRONICS ENGINEERING

| SEMESTER I | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S No.** | **Course Code** | **Course** | **L/T/P** | **Contact hrs/week** | **Credits** | **Ext/Int** | **Category** |
| **1** | 15UH101 | Communication Skills – I | 2/0/2 | 4 | 3 | 60/40 | HS |
| **2** | 15UH202 | Engineering Physics | 3/0/0 | 3 | 3 | 60/40 | BS |
| **3** | 15UH203 | Engineering Chemistry | 3/0/0 | 3 | 3 | 60/40 | BS |
| **4** | 15UH201 | Mathematics – I | 2/2/0 | 3 | 3 | 60/40 | BS |
| **5** | 15UC301 | Fundamentals of Computing and C Programming | 3/0/0 | 3 | 3 | 60/40 | ES |
| **6** | 15UE301 | Technical Drawing | 0/1/3 | 4 | 2 | 60/40 | PC |
| **7** | 15UE302 | Basic Mechatronics Engineering | 1/2/0 | 3 | 2 | 0/100 | PC |
| **8** | 15UC351 | Fundamentals of Computing and C Programming Laboratory | 0/0/3 | 3 | 2 | 60/40 | ES |
| **9** | 15UE351 | Mechatronics Drawing Laboratory – I | 0/1/3 | 4 | 2 | 60/40 | PC |
| | | | **Total** | **30** | **23** | **900** | |

| SEMESTER II | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S No.** | **Course Code** | **Course** | **L/T/P** | **Contact hrs/week** | **Credit** | **Ext/Int** | **Category** |
| **1** | 15UH102 | Communication Skills – II | 2/0/2 | 4 | 3 | 60/40 | HS |
| **2** | 15UH301 | Material Science | 3/0/0 | 3 | 3 | 60/40 | ES |
| **3** | 15UH204 | Mathematics – II | 2/2/0 | 3 | 3 | 60/40 | BS |
| **4** | 15UE303 | Statics and Dynamics | 2/2/0 | 3 | 3 | 60/40 | PC |
| **5** | 15UE304 | Production Technology | 3/0/0 | 3 | 3 | 60/40 | PC |
| **6** | 15UE305 | Fundamentals of Electrical Circuits and Electron Devices | 3/0/0 | 3 | 3 | 60/40 | PC |
| **7** | 15UH251 | Physical Science Laboratory | 0/0/4 | 4 | 2 | 60/40 | BS |
| **8** | 15UE352 | Basic Engineering Laboratory | 0/0/2 | 2 | 1 | 60/40 | ES |
| **9** | 15UE151 | Critical and Creative Thinking | 0/0/2 | 2 | 1 | 0/100 | HS |
| | | | **Total** | **27** | **22** | **900** | |

| SEMESTER III | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S No.** | **Course Code** | **Course** | **L/T/P** | **Contact hrs/week** | **Credit** | **Ext/Int** | **Category** |
| **1** | 15MA103 | Fourier Analysis and Statistical Quality Control | 3/2/0 | 5 | 4 | 60/40 | BS |
| **2** | 15MT304/ 15ME306 | Strength of Materials | 2/2/0 | 4 | 3 | 60/40 | PC |
| **3** | 15MT305 | Thermal and Fluid Engineering | 3/1/0 | 4 | 4 | 60/40 | PC |
| **4** | 15MT306 | Electrical Engineering | 3/0/0 | 3 | 3 | 60/40 | PC |
| **5** | 15CS206 | Object Oriented Programming | 3/0/2 | 5 | 4 | 40/60 | ES |
| **6** | 15MT301 | Mechatronics Drawing Laboratory | 3/0/0 | 3 | 3 | 40/60 | PC |
| **7** | 15MT307 | Thermal and Fluid Engineering Laboratory | 0/0/3 | 3 | 2 | 40/60 | PC |
| **8** | 15MT308 | Electrical and Electronics Engineering Laboratory | 0/0/3 | 3 | 2 | 40/60 | PC |
| **9** | 15MT701 | Mandatory Course-I | 2/0/0 | 2 | 1 | 0/100 | MC |
| | | | **Total** | **32** | **26** | **900** | |

| SEMESTER IV | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S No.** | **Course Code** | **Course** | **L/T/P** | **Contact hrs/week** | **Credit** | **Ext/Int** | **Category** |
| **1** | 15MA107 | Theory of Probability and Mathematical Statistics | 3/2/0 | 5 | 4 | 60/40 | BS |
| **2** | 15MT309 | Microcontroller and its applications | 3/0/0 | 3 | 3 | 60/40 | PC |
| **3** | 15MT310/ 17MT309 | Theory of Machines | 3/1/0 | 4 | 4 | 60/40 | PC |
| **4** | 15MT311 | Theory of Control Systems | 3/1/0 | 4 | 4 | 60/40 | PC |
| **5** | 15MT312 | Theory of Machines Laboratory | 0/0/3 | 3 | 2 | 40/60 | PC |
| **6** | 15MT313 | Microcontroller Laboratory | 0/0/3 | 3 | 2 | 40/60 | PC |
| **7** | 15MT314 | Production Laboratory (Project Based Lab) | 0/0/3 | 3 | 2 | 40/60 | PC |
| **8** | 15CH702/ 15MT702 | Mandatory Course-II | 2/0/0 | 2 | 1 | 0/100 | MC |
| **9** | 15MT601 | Mini Project | - | 2 | 2 | 40/60 | PW |
| | | **Total** | | **29** | **24** | **900** | |

| SEMESTER V | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S No.** | **Course Code** | **Course** | **L/T/P** | **Contact hrs/week** | **Credit** | **Ext/Int** | **Category** |
| **1** | 15MT315/ 16MT313/ 17MT313 | Hydraulics and Pneumatics | 3/0/0 | 3 | 3 | 60/40 | PC |
| **2** | 15MT316/ 16MT314/ 17MT314 | Embedded System | 3/0/0 | 3 | 3 | 60/40 | PC |
| **3** | 15MT317/ 16MT315/ 17MT315 | Power Electronics and Electrical Drives (Theory and Lab) | 3/0/3 | 6 | 4 | 40/60 | PC |
| **4** | 15MT318/ 16MT316/ 17MT316 | Machine Design | 3/2/0 | 5 | 4 | 60/40 | PC |
| **5** | 15MT319/ 16MT317/ 17MT317 | Sensor, Measurements and Instrumentation | 3/0/0 | 3 | 3 | 60/40 | PC |
| **6** | 15MT4XX/ 16MT4XX/ 17MT4XX | Professional Elective-I | 3/0/0 | 3 | 3 | 60/40 | PE |
| **7** | 15MT320/ 16MT318/ 17MT318 | Hydraulics and Pneumatics Laboratory | 0/0/3 | 3 | 2 | 40/60 | PC |
| **8** | 15MT321/ 16MT319/ 17MT319 | Sensor and Instrumentation Laboratory (Project Based Lab) | 0/0/3 | 3 | 2 | 40/60 | PC |
| **9** | 15MT703/ 16MT703/ 17MT703 | Mandatory Course-III | 2/0/0 | 2 | 1 | 0/100 | MC |
| | | **Total** | | **31** | **25** | **900** | |

| SEMESTER VI | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S No.** | **Course Code** | **Course** | **L/T/P** | **Contact hrs/week** | **Credit** | **Ext/Int** | **Category** |
| **1** | 15MT322/ 16MT320/ 17MT320 | Computer Integrated Manufacturing | 3/0/0 | 3 | 3 | 60/40 | PC |
| **2** | 15MT323/ 16MT321/ 17MT321 | Virtual Instrumentation (Theoryand Lab) | 3/0/3 | 6 | 4 | 40/60 | PC |
| **3** | 15MT324/ 16MT322/ 17MT322 | Industrial Automation | 3/0/0 | 3 | 3 | 60/40 | PC |
| **4** | 15MT4XX/ 16MT4XX/ 17MT4XX | Professional Elective-II | 3/0/0 | 3 | 3 | 60/40 | PE |
| **5** | 15MT4XX/ 16MT4XX/ 17MT4XX | Professional Elective-III | 3/0/0 | 3 | 3 | 60/40 | PE |
| **6** | 15XX5XX/ 16XX5XX/ 17XX5XX | Open Elective | 3/0/0 | 3 | 3 | 60/40 | OE |
| **7** | 15MT325 | CAE Laboratory | 0/0/3 | 3 | 2 | 40/60 | PC |
| **8** | 15MT326/ 16MT324/ 17MT324 | Industrial Automation Laboratory | 0/0/3 | 3 | 2 | 40/60 | PC |
| **9** | 15MT704/ 16MT704/ 17MT704 | Mandatory Course-IV | 2/0/0 | 2 | 1 | 0/100 | MC |
| **10** | 15MT602/ 16MT602/ 17MT602 | Industrial Field Training | - | 2 | 2 | 0/100 | PW |
| | | **Total** | | **31** | **26** | **1000** | |

| SEMESTER VII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S No.** | **Course Code** | **Course** | **L/T/P** | **Contact hrs/week** | **Credit** | **Ext/Int** | **Category** |
| **1** | 15MT327/ 16MT325/ 17MT325 | Robotics and Machine vision System | 3/0/0 | 3 | 3 | 60/40 | PC |
| 2 | 15MT328/ 16MT326/ 17MT326 | Design and Modelling of Mechatronics Systems | 3/2/0 | 5 | 3 | 60/40 | PC |
| **3** | 15HS003/ 16HS004/ 17HS003 | Industrial Management and Professional Ethics (Industry Based Course) | 3/0/0 | 3 | 3 | 0/100 | HS |
| **4** | 15MT4XX/ 16MT4XX/ 17MT4XX | Professional Elective-IV | 3/0/0 | 3 | 3 | 60/40 | PE |
| **5** | 15MT4XX/ 16MT4XX/ 17MT4XX | Professional Elective-V | 3/0/0 | 3 | 3 | 60/40 | PE |
| **6** | 15MT4XX/ 16MT4XX/ 17MT4XX | Professional Elective-VI | 3/0/0 | 3 | 3 | 60/40 | PE |
| **7** | 15MT329/ 16MT327/ 17MT327 | Robotics Laboratory | 0/0/3 | 3 | 2 | 40/60 | PC |
| **8** | 15MT505/ 16MT505/ 17MT505 | MOOC Certification | 0/0/3 | 3 | 1 | 0/100 | OE |
| | | **Total** | | **26** | **21** | **800** | |

| SEMESTER VIII | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S No.** | **Course Code** | **Course** | **L/T/P** | **Contact hrs/week** | **Credit** | **Ext/Int** | **Category** |
| **1** | 15MT603/ 16MT603/ 17MT603 | Industrial Project | 0/0/24 | 24 | 12 | 40/60 | PW |
| | | **Total** | | **24** | **12** | **100** | |

## SCHEME OF CREDIT DISTRIBUTION - SUMMARY

| S. No | Stream | Credits/Semester | | | | | | | | Credits | % | AICTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | | | |
| 1. | Humanities (HS) | 3 | 4 | | | | | 3 | | **10** | **5.59** | **5-10** |
| 2. | Basic Sciences(BS) | 9 | 5 | 4 | 4 | | | | | **22** | **12.29** | **15-20** |
| 3. | Engineering Sciences(ES) | 5 | 4 | 4 | | | | | | **13** | **7.26** | **15-20** |
| 4. | Professional Core(PC) | 6 | 9 | 17 | 17 | 21 | 14 | 8 | | **92** | **51.40** | **30-40** |
| 5. | Professional Electives(PE) | | | | | 3 | 6 | 9 | | **18** | **10.06** | **10-15** |
| 6. | Open Electives(OE) | | | | | | 3 | 1 | | **4** | **2.23** | **5-10** |
| 7. | Project Work(PW) | | | | 2 | | 2 | | 12 | **16** | **8.94** | **10-15** |
| 8. | Mandatory Course (MC) | | | 1 | 1 | 1 | 1 | | | **4** | **2.23** | **-** |
| **Total** | | **23** | **22** | **26** | **24** | **25** | **26** | **21** | **12** | **179** | **100** | **100** |

## SCHEME OF SUBJECT DISTRIBUTION – SUMMARY

| S. No | Stream | Subjects/Semester | | | | | | | | Subjects |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | |
| 1. | Humanities (HS) | 1 | 2 | | | | | 1 | | **4** |
| 2. | Basic Sciences(BS) | 3 | 2 | 1 | 1 | | | | | **7** |
| 3. | Engineering Sciences(ES) | 2 | 2 | 1 | | | | | | **5** |
| 4. | Professional Core(PC) | 3 | 3 | 6 | 6 | 7 | 5 | 3 | | **33** |
| 5. | Professional Electives(PE) | | | | | 1 | 2 | 3 | | **6** |
| 6. | Open Electives(OE) | | | | | | 1 | 1 | | **2** |
| 7. | Project Work(PW) | | | | 1 | | 1 | | 1 | **3** |
| 8. | Mandatory Courses (MC) | | | 1 | 1 | 1 | 1 | | | **4** |
| **Total** | | **9** | **9** | **9** | **9** | **9** | **10** | **8** | **1** | **64** |

**OPEN ELECTIVE COURSES (3 Credits)**

| S. No | Course Code | Course Title | L/T/P | Contact Hrs/Wk | Credits | Ext/Int |
|---|---|---|---|---|---|---|
| **OPEN/EMERGING ELECTIVES** | | | | | | |
| 1. | 15MT501/ 16MT501/ 17MT501 | Reliability Engineering | 3/0/0 | 3 | 3 | 60/40 |
| 2. | 15MT502/ 16MT502/ 17MT502 | Vehicle Dynamics | 3/0/0 | 3 | 3 | 60/40 |
| 3. | 15MT503/ 16MT503/ 17MT503 | Micro and Nano Robotics | 3/0/0 | 3 | 3 | 60/40 |
| 4. | 15MT504/ 16MT504/ 17MT504 | Field and Service Robotics | 3/0/0 | 3 | 3 | 60/40 |

**PROFESSIONAL ELECTIVE COURSES (18 Credits)**

| S. No | Course Code | Course Title | L/T/P | Contact Hrs/Wk | Credits | Ext/Int |
|---|---|---|---|---|---|---|
| **PROFESSIONAL ELECTIVES** | | | | | | |
| **Stream I :Manufacturing and Design** | | | | | | |
| 1. | 15MT401/ 16MT401/ 17MT401 | Advanced Manufacturing Processes | 3/0/0 | 3 | 3 | 60/40 |
| 2. | 15MT402/ 16MT402/ 17MT402 | Micro and Nano Manufacturing | 3/0/0 | 3 | 3 | 60/40 |
| 3. | 15MT403/ 16MT403/ 17MT403 | Additive Manufacturing Processes | 3/0/0 | 3 | 3 | 60/40 |
| 4. | 15MT404/ 16MT404/ 17MT404 | Product Design and Manufacturing | 3/0/0 | 3 | 3 | 60/40 |
| 5. | 15MT405/ 16MT405/ 17MT405 | CNC Machines and Programming | 3/0/0 | 3 | 3 | 60/40 |
| 6. | 15MT406/ 16MT406/ 17MT406 | Mechanical Design for Robotics System | 3/0/0 | 3 | 3 | 60/40 |
| **Stream II : Automobile and Robotics** | | | | | | |
| 1. | 15MT407/ 16MT407/ 17MT407 | Theory of Automobile Engineering | 3/0/0 | 3 | 3 | 60/40 |
| 2. | 15MT408/ 16MT408/ 17MT408 | Automotive Electronics | 3/0/0 | 3 | 3 | 60/40 |
| 3. | 15MT409/ 16MT409/ 17MT409 | Autonomous Vehicle Guidance System | 3/0/0 | 3 | 3 | 60/40 |
| 4. | 15MT410/ 16MT410/ 17MT410 | Automated Material Handling Systems | 3/0/0 | 3 | 3 | 60/40 |
| 5. | 15MT411/ 16MT411/ 17MT411 | Medical Mechatronics | 3/0/0 | 3 | 3 | 60/40 |
| 6. | 15MT412/ 16MT412/ 17MT412 | Mobile Robotics | 3/0/0 | 3 | 3 | 60/40 |
| **Stream III :Intelligent Control System** | | | | | | |
| 1. | 15MT413/ 16MT413/ 17MT413 | Integrated Electronic Circuit | 3/0/0 | 3 | 3 | 60/40 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2. | 15MT414/ 16MT414/ 17MT414 | Principles of AI and Expert Systems | 3/0/0 | 3 | 3 | 60/40 |
| 3. | 15MT415/ 16MT415/ 17MT415 | Embedded System in Automation | 3/0/0 | 3 | 3 | 60/40 |
| 4. | 15MT416/ 16MT416/ 17MT416 | Internet of Things for Mechatronics (IoT) | 3/0/0 | 3 | 3 | 60/40 |
| 5. | 15MT417/ 16MT417/ 17MT417 | Automatic Control System | 3/0/0 | 3 | 3 | 60/40 |
| 6. | 15MT418/ 16MT418/ 17MT418 | Intelligent Control System | 3/0/0 | 3 | 3 | 60/40 |

**MANDATORY COURSES (4 Credits)**

| S.No | Course Code | Course Title | Semester | Ext/Int |
|---|---|---|---|---|
| 1. | 15MT701 | BEC Vantage | III | 0/100 |
| 2. | 15MT702/ 15CH702 | Environmental Science | IV | 0/100 |
| 3. | 15MT703/ 16MT703/ 17MT703 | Entrepreneurship Development | V | 0/100 |
| 4. | 15MT704/ 16MT704/ 17MT704 | Quantitative Aptitude and soft skills | VI | 0/100 |

**ONE CREDIT COURSES**

| S.No | Course Code | Course Title | Issuing / Approving Authority | Credits |
|---|---|---|---|---|
| 1. | 15MT901/ 16MT901/ 17MT901 | Lab view certification | National Instruments | 1 |
| 2. | 15MT902/ 16MT902/ 17MT902 | Certification in Embedded Software Development | Texas Instruments | 1 |
| 3. | 15MT903/ 16MT903/ 17MT903 | Certification in Creo/ANSYS | PTC/ ANSYS | 1 |
| 4. | 15MT904/ 16MT904/ 17MT904 | Industrial automation certification | Bosch, Rexroth, etc., | 1 |
| 5. | 15MT905/ 16MT905/ 17MT905 | Any other certification from MNCs | Department | 1 |
| 6. | 15MT906/ 16MT906/ 17MT906 | Participation in international exhibition / Seminar / fair | Department | 1 |
| 7. | 15MT907/ 16MT907/ 17MT907 | Online Course Certification from edx, Coursera, etc., | Department | 1 |
| 8. | 15MT908/ 16MT908/ 17MT908 | Certification in SAP – ERP Software | Department | 1 |
| 9. | 15MT909/ 16MT909/ 17MT909 | Certification in Six Sigma Belt | Department | 1 |
| 10. | 15MT910/ 16MT910/ 17MT910 | Certification in IELTS/TOEFL/GRE/GATE | IELTS/TOEFL/GRE/GATE | 1 |
| 11. | 15MT911/ 16MT911/ 17MT911 | Publications in reputed Journals | Department | 1 |
| 12. | 15MT912/ 16MT912/ 17MT912 | Any Certificate in IITs/NITs/Foreign Universities | Department | 1 |
| 13. | 15MT913/ 16MT913/ 17MT913 | Patent / Book Publications | Department | 1 |

# SEMESTER I

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UH101 | COMMUNICATION SKILLS -I<br>(Common to all B.E./B.Tech. and I MCA) | 2 | 0 | 2 | 3 |

1. **Course pre-requisites** : NIL

2. **Course learning objectives** :
   i. To emphasis and develop language skills to satisfy the needs of work environment
   ii. To inculcate reading and listening habits and thereby improvising speaking and writing skills.
   iii. To familiarize students with business terms through BEC Preliminary examination

3. **Expected Level of Output** : Conceptual Level

4. **Department Offered** : Science & Humanities (English)

5. **Nature of the Course** : Group C –90% Descriptive & 10% Analytical

**Continuous Internal Assessment (CIA)** : **40 Marks**
**Semester End Examination (SEE)** : **60 Marks**

6. **Course Input** :

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **GENERAL INTRODUCTION** | | | | | | | | |
| | Getting to know people- Introduction- Talking about job ( Present simple)- Talking about working conditions (Adverb of frequency) | A | 1,1a,1 b | 3 | U,R | 9 | 5 | 4 | 4 |
| | Talking about company history and structure (Past simple, Prepositions of time) - Talking about company activities (Connectors of addition and contrast, Present Continuous) | A | 2a, 2b | 2 | U,R | | 4 | 2 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Focus on language -Parts of Speech- Gerunds and Infinitives- Instructions | B | 25, 31 | 4 | R, Ap, U | | 3 | 1 | 3 |
| II | **WORD POWER** | | | | | | | | |
| | Vocabulary practice- Telephoning Leaving and taking messages)- Requests and obligation | A | 3,4a, 4b | 3 | U,R,A, Ap | 10 | 4 | 3 | 4 |
| | Describing trends (Adjectives and adverbs)- Talking about company performance (Present perfect and past simple, Reasons and consequences) | A | 5a,5 b | 2 | E,U | | 4 | 4 | 2 |
| | Reading Test Practice | A | 6 | 1 | R | | 5 | 4 | 4 |
| | Describing products Dimensions, (Comparatives and superlatives, Question formation)- Talking about product development (Sequencing words, Present continuous and going to) | A | 7a,7 b | 2 | A,U | | 4 | 3 | 2 |
| | Articles- Prepositions- Synonyms- Antonyms- Recommendations | B | 3,32 | 2 | R, Ap | | 4 | 1 | 3 |
| III | **ESP / ENGLISH FOR ENGINEERS** | | | | | | | | |
| | Talking about business equipment (Giving Instruction)- Letter Phrases | A | 8a,8 b | 2 | R,A | 8 | 4 | 2 | 2 |
| | Writing Test Practice | A | 9 | 1 | R | | 5 | 4 | 4 |
| | Talking about hotel facilities (Asking for and giving direction)- Talking about traffic and transport (making predictions) | A | 10a, 10b | 2 | U,A | | 4 | 2 | 2 |
| | Tenses- Present-Past-Future-Forms of verbs- Word techniques-Formation- Prefixes-Suffixes. | B | 12 41,6 | 3 | U,R,Ap | | 4 | 1 | 2 |
| IV | **PRESENTATION SKILLS AND EVENT MANAGEMENT** | | | | | | | | |
| | Talking about conference arrangement (Checking and confirming)- Talking about a conference before, after, when, until, etc. | A | 11a, 11b | 2 | C,A,E | 7 | 5 | 3 | 3 |
| | Listening Test Practice | A | 12 | 1 | U | | 5 | 4 | 4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Talking about production processes- passive- Talking about quality control Conditional 1 (real) (Making suggestions) | A | 13a, 13b | 2 | A,E | | 4 | 3 | 2 |
| | Itinerary- Jumbled Sentences. | B | 30 | 2 | Ap,R | | 4 | 0 | 4 |
| **V** | **ENGLISH FOR CORPORATE** | | | | | | | | |
| | Talking about call centers, insurance and changes in working practices (Future possibility/ Probability- Talking about banking | A | 14a, 14b | 2 | U,A,E | 11 | 4 | 2 | 2 |
| | Speaking Test Practice | A | 15 | 1 | R, U | | 5 | 4 | 4 |
| | Talking about delivery services (prepositions of time) - Talking about trading (Tense review) | A | 16a, 16b | 2 | U,A | | 4 | 2 | 2 |
| | Talking about recruitment Conditional 2 ( hypothetical) - Talking about job applications (Indirect questions)- Reading, Writing and Listening Test | A | 17a, 17b, 18 | 3 | U,R,Ap | | 5 | 3 | 4 |
| | Job Application Letter and Resume Writing-Permission Letters. | B | 34 | 3 | U,Ap | | 5 | 4 | 4 |

**Bloom's Legends:**

**R-**Remembering **U-**Understanding **AP-** Applying

**A-**Analyzing **C-**Creating **E –** Evaluating

## 7. TEXT BOOKS

A. Wood, Ian, Anne Williams with Anna Cowper Pass Cambridge BEC Preliminary learning Second Edition. 2013

B. Dr Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited, 2005

## REFERENCE BOOKS:

C. Whitby, Norman. Cambridge University Press- Students Book. 2013.

D. Jawahar, Jewelcy, Rathna P, English Work book, VRB Publications Pvt Ltd, 2006.

E. Gunasekaran S, 'A Text and Workbook of Technical English I", United Global Publishers, June 2010.

## 8. Assessing Level of Bloom's Taxonomy in Numbers:

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 3 | 3 | 1 | 0 | 0 | 0 | 7 |
| **UNIT II** | 3 | 3 | 2 | 2 | 1 | 0 | 11 |
| **UNIT III** | 3 | 2 | 1 | 2 | 0 | 0 | 8 |
| **UNIT IV** | 1 | 1 | 1 | 2 | 2 | 1 | 8 |
| **UNIT V** | 2 | 5 | 2 | 2 | 1 | 0 | 12 |
| | | | | | | **TOTAL** | **46** |

**9. Weightage of Bloom's Taxonomy in the Syllabus**

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 6.5 | 6.5 | 2.1 | 0 | 0 | 0 | 15.1 |
| **UNIT II** | 6.5 | 6.5 | 4.3 | 4.3 | 2.1 | 0 | 23.7 |
| **UNIT III** | 6.5 | 4.3 | 2.1 | 4.3 | 0 | 0 | 17.2 |
| **UNIT IV** | 2.1 | 2.1 | 2.1 | 4.3 | 4.3 | 2.1 | 17 |
| **UNIT V** | 4.3 | 10.8 | 4.3 | 4.3 | 2.1 | 0 | 25.8 |
| **Lower Order Thinking (%)** | | | | **71%** | | | |
| **Higher Order Thinking (%)** | | | | **29%** | | | |

**10. Expected outcome of the course:**

***Upon successful completion of this course, the student will be able to***:

**CO1.** Understand and intensely focus on improving and increasing LSRW Skills.

**CO2** Apply a good command over basic writing and reading skills.

**CO3.** Remember language skills for business related situations.

**CO4.** Analyze and use vocabulary in corporate work environment.

**11.Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | Ap | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √ | √√ | | | | |
| **CO2** | | √ | √√ | | | |
| **CO3** | √ | | | √√ | | |
| **CO4** | | √ | | √√ | | |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | | | | | | | | | | | |
| **CO2** | √√ | | | | | | | | | | | |
| **CO3** | √√ | | | | | | | | | | | |
| **CO4** | √√ | | | | | | | | | | | |

**13. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | | | | | √√ | | |
| **CO2** | | | | | | | | | √√ | | |
| **CO3** | | | | | | | | | √√ | | |
| **CO4** | | | | | | | | | √√ | | |

**14. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| **CO1** | | | | √√ | |
| **CO2** | | | | √√ | |
| **CO3** | | | | √√ | |
| **CO4** | | | | √√ | |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UH202 | ENGINEERING PHYSICS (Common to all B.E./B.Tech) | 3 | 0 | 0 | 3 |

**1. Course pre-requisites** : NIL

**2. Course learning objectives** :

i). To impart the fundamental knowledge on acoustics
ii). To understand the advanced technology of laser and optical fiber in the field ofEngineering and medicine
iii). To exposure the behaviour of heat

**3. Expected Level of Output** : Conceptual Level

**4. Department Offered** : Science & Humanities (Physics)

**5. Nature of the Course** : Group C - 75% Descriptive & 25% Analytical

**Continuous Internal Assessment (CIA)** : **40 Marks**
**Semester End Examination (SEE)** : **60 Marks**

**6. Course Input** :

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **ACOUSTICS** | | | | | | | | |
| | Characteristics of musical sound – Loudness, Weber-Fechner law – decibel | A | 40 | 2 | R | 9 | 2 | 1 | 1 |
| | absorption coefficient – reverberation time | A | 41 | 2 | U | | 1 | 1 | 1 |
| | Sabine's formula | B | 4 | 2 | AP | | 2 | 1 | 2 |
| | Acoustics of buildings | A | 41 | 1 | U | | 2 | 1 | 2 |
| | Ultrasonics: Production of ultrasonics using piezoelectric method, magnetostriction - Applications of ultrasonics: Sonogram, SONAR. | A B | 41, 42 , 5 | 2 | AP | | 1 | 2 | 1 |
| II | **LASER** | | | | | | | | |
| | Introduction, Principle – Spontaneous emission, Stimulated emission, Population inversion, Pumping | A | 31 | 2 | U | 9 | 2 | 2 | 2 |
| | Types of Laser | A | 31 | 1 | R | | 1 | 1 | 1 |
| | Nd-YAG, $CO_2$ Laser, Semiconductor Laser. | A | 31 | 3 | U | | 1 | 1 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lasers in Microelectronics: Thermal Effect Drilling, Welding, Cutting, Medical Field | B | 11 | 2 | AP | | 2 | 1 | 2 |
| | Holography | B | 11 | 1 | AP | | 2 | 1 | 2 |
| III | **FIBER OPTICS** | | | | | | | | |
| | Principle, modes of propagation numerical aperture, acceptance angle and fractional index change of an optical fiber | A | 32 | 2 | AP | 9 | 2 | 1 | 2 |
| | Classification based on materials, refractive index profile and modes | A | 32 | 2 | U | | 1 | 1 | 2 |
| | Fabrication techniques: Rod & Tube method, Crucible-Crucible technique | D | 3 | 1 | U | | 1 | 1 | 1 |
| | Splicing, losses in optical fiber, light sources for fiber optics, detectors: PIN, Avalanche photo diode. | B | 12 | 2 | U | | 1 | 1 | 2 |
| | Application: Fiber optical communication links and endoscope. | A | 32 | 2 | AP | | 2 | 1 | 2 |
| IV | **HEAT AND THERMODYNAMICS** | | | | | | | | |
| | Thermal Conductivity, Forbe's method, Lees disc method | E | 3 | 2 | AP | 9 | 2 | 1 | 1 |
| | Radial flow of heat, Thermal conductivity of rubber and glass | E | 3 | 2 | U | | 1 | 1 | 1 |
| | Laws of thermodynamics - Concepts of entropy, | A | 15 | 1 | R | | 2 | 1 | 2 |
| | Carnot cycle, heat engine and refrigerator, Carnot theorem | A | 15 | 2 | AP | | 2 | 2 | 2 |
| | ideal otto and diesel engines | A | 15 | 2 | U | | 2 | 1 | 1 |
| V | **QUANTUM PHYSICS** | | | | | | | | |
| | Inadequacy of classical mechanics: Black body radiation, photoelectric effect, | A | 56 | 2 | R | 9 | 1 | 1 | 1 |
| | Dual nature, de-Broglie concept of matter waves, electron diffraction, Davisson–Germer experiment – Heisenberg's uncertainty principle, | A | 57 | 2 | U | | 2 | 1 | 1 |
| | Schrodinger wave equation, time dependent and time independent | A | 57 | 2 | AP | | 2 | 1 | 1 |
| | Application of Schrodinger wave equation (particle in one dimensional box) | A | 57 | 1 | AP | | 1 | 1 | 1 |
| | Electron microscope - SEM and TEM | A | 57 | 2 | U | | 1 | 1 | 2 |

**Bloom's Legends:**

**R -** Remembering **U -** Understanding **AP-** Applying
**A -** Analyzing **C -** Creating **E –** Evaluating

**7.TEXT BOOKS**


**A.** R.K. Gaur and SL Gupta "Engineering Physics" DhanpatRai Publications 2014

**B.** Rajendran "Engineering Physics" Tata McGraw-Hill Education, New Delhi – 2011

**REFERENCE BOOKS**


**C.** Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2010

**D.** M.N. Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi 2005

**E.** Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2013


## 8. Assessing Level of Bloom's Taxonomy in Numbers:

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | **1** | **2** | **2** | **-** | - | - | **5** |
| **UNIT II** | **1** | **2** | **2** | **-** | - | - | **5** |
| **UNIT III** | **-** | **3** | **2** | **-** | - | - | **5** |
| **UNIT IV** | **1** | **1** | **3** | **-** | - | - | **5** |
| **UNIT V** | **1** | **2** | **2** | **-** | - | - | **5** |
| | | | | | | **TOTAL** | **25** |

## 9. Weightage of Bloom's Taxonomy in the Syllabus

| | R | U | AP | A | E | C | TOTAL ( %) |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 4 | 8 | 8 | **-** | - | - | 20 |
| **UNIT II** | 4 | 8 | 8 | **-** | - | - | 20 |
| **UNIT III** | - | 12 | 8 | **-** | - | - | 20 |
| **UNIT IV** | 4 | 4 | 12 | **-** | - | - | 20 |
| **UNIT V** | 4 | 8 | 8 | **-** | - | - | 20 |
| **TOTAL** | 16 | 40 | 44 | **-** | - | - | 100 |
| **Lower Order Thinking (%)** | | | | **100 %** | | | |
| **Higher Order Thinking (%)** | | | | **NIL** | | | |

## 10. Expected outcome of the course:

***Upon successful completion of this course, the student will be able to:***

**CO1**. Present a technical overview of architectural acoustics
**CO2**. Understand modern device and technology based on laser and optical fiber
**CO3**. Design the heat engine having greater efficiency

## 11. Mapping course outcome with Bloom's Taxonomy LOT and HOT:

| | R | U | AP | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √ | | | | | |
| **CO2** | | √√ | | | | |
| **CO3** | | | √ | | | |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √ | √ | √ | √ | | | | √ | | | |
| **CO2** | √√ | √ | √ | √ | √ | | | | √ | | | |
| **CO3** | √√ | √ | √ | √ | √ | | | | √ | | | |

**13. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √√ | | | | | | | | | |
| **CO2** | √√ | √√ | | | | | | | | | |
| **CO3** | √√ | √√ | | | | | | | | | |

**14. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| **CO1** | √√ | √ | | | |
| **CO2** | √√ | √ | | | |
| **CO3** | √√ | √ | | | |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UH203 | ENGINEERING CHEMISTRY (Common to all B.E./B.Tech.) | 3 | 0 | 0 | 3 |

**1. Course pre-requisites** : NIL

**2. Course learning objectives** :

i. To impart knowledge on the role of chemistry in everyday life along with the basic nature, types, preparation and uses of polymers.

ii. To demonstrate the principle and working of electrochemistry, corrosion science and to impart knowledge on various analytical techniques used in the field of basic sciences.

**3. Expected Level of Output** : Conceptual Level

**4. Department Offered** : Science & Humanities (Chemistry)

**5. Nature of the Course** : Group A – 100 % Descriptive

**Continuous Internal Assessment (CIA)** : **40 Marks**
**Semester End Examination (SEE)** : **60 Marks**

**6. Course Input** :

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **CHEMISTRY IN EVERYDAY LIFE** | | | | | | | | |
| | Chemicals in medicines-analgesics, antiseptics, antacids, disinfectants-chemicals in food preservatives-artificial sweetening agents | 1B | 1 | 2 | U, R | 9 | 4 | 4 | 4 |
| | Characteristics of water-hardness-types and estimation by EDTA method. Problems based on EDTA method | A,1B | 1,1 | 3 | U, R | | 4 | 3 | 2 |
| | Domestic water treatment-disinfection methods | 1B | 1 | 4 | U | | 4 | 3 | 2 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (chlorination,ozonation,UVtreatment)-demineralisation process-desalination-reverse osmosis | | | | | | | | |
| **II** | **CHEMISTRY FOR ENGINEERING PLASTICS** | | | | | | | | |
| | Introduction-monomers and polymers-classification of polymers | A,1B | 2,3 | 1 | U | 9 | 5 | 1 | 0 |
| | Polymerisation--mechanism of addition polymerization(free radical mechanism) | A,1B | 2,3 | 2 | U,R | | 5 | 1 | 0 |
| | Plastics- classification -preparation, properties and uses of PVC,Teflon, Nylon 6,6, moulding methods | A,1B | 2,3 | 4 | R | | 5 | 4 | 1 |
| | Rubber-vulcanisation of rubber-synthetic rubber (Butyl rubber and SBR) | A,1B | 2,3 | 2 | U, R | | 4 | 0 | 0 |
| **III** | **NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES** | | | | | | | | |
| | Nuclear energy-fission and fusion reaction | A,1B | 4,20 | 1 | R | 9 | 5 | 2 | 1 |
| | Light water nuclear reactor for power generation (block diagram only)-breeder reactor | A,1B | 4,20 | 2 | R | | 5 | 1 | 2 |
| | Solar energy conversion-solar cells-wind energy | A | 4 | 1 | U,R | | 4 | 0 | 0 |
| | Fuel cells-hydrogen oxygen fuel cells | A | 4 | 2 | R | | 4 | 1 | 0 |
| | Batteries-alkaline batteries-lead acid,nickel cadmium and lithium batteries. | A,2B | 6,6 | 3 | R | | 3 | 3 | 3 |
| **IV** | **ELECTROCHEMISTRY AND CORROSION SCIENCES** | | | | | | | | |
| | Electrochemical cells-single electrode potential-measurement of emf | A,2B | 6,2 | 2 | R | 9 | 4 | 2 | 1 |
| | Reference electrode-SHE-calomel electrode-glass electrode and measurement of pH. Ion selective electrode | A,2B | 6,2 | 2 | R | | 3 | 3 | 3 |
| | Corrosion-chemical corrosion-electrochemical corrosion-galvanic corrosion-differential corrosion | A,2B | 7,3 | 3 | R | | 4 | 3 | 4 |
| | Protective coatings-electroplating of gold-electroless plating of Nickel. | A,2B | 8,4 | 2 | R | | 4 | 3 | 4 |
| V | **ANALYTICAL TECHNIQUES** | | | | | | | | |
| | Laws of absorption-Principles | A,2B | 35,8 | 1 | R | 9 | 4 | 3 | 1 |
| | Colorimetry-Estimation of Iron by colorimetry | A,2B | 34,8 | 1 | R,Ap | | 4 | 0 | 0 |
| | Instrumentation and applications-UV-Visible spectroscopy-IR spectroscopy | A,2B | 35,8 | 3 | R | | 4 | 2 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Flame photometry-Estimation of sodium by flame photometry | A,2B | 35,8 | 2 | R,Ap | | 4 | 0 | 0 |
| | Atomic absorption spectroscopy-Estimation of Nickel by atomic absorption spectroscopy. | 2B | 8 | 2 | R,Ap | | 3 | 0 | 0 |

**Bloom's Legends:**

**R-**Remembering **U-**Understanding **AP-**Applying
**A-**Analyzing **C-**Creating **E –** Evaluating

## 7. TEXT BOOKS

**A** . Jain and Jain, Engineering Chemistry, DhanpatRai Publishing Company, New Delhi, 2011

**1B.** Ravikrishnan, A., Engineering Chemistry – I Sri Krishna Hitech Publishing Company, 2012.

**2B.** Ravikrishnan, A., Engineering Chemistry – II, Sri Krishna Hitech Publishing Company, 2012.

**REFERENCE BOOKS**

**C**. Sunita Rattan, A Text Book of Engineering Chemistry,SKKataria Publishers, 2010

**D**. Uppal& Bhatia, Engineering Chemistry, Khanna Publishers, 2010.

## 8. Assessing Level of Bloom's Taxonomy in Numbers:

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 2 | 3 | 0 | 0 | 0 | 0 | 5 |
| **UNIT II** | 3 | 3 | 0 | 0 | 0 | 0 | 6 |
| **UNIT III** | 5 | 1 | 0 | 0 | 0 | 0 | 6 |
| **UNIT IV** | 4 | 0 | 0 | 0 | 0 | 0 | 4 |
| **UNIT V** | 5 | 0 | 3 | 0 | 0 | 0 | 8 |
| | | | | | | **TOTAL** | **29** |

## 9. Weight age of Bloom's Taxonomy in the Syllabus

| | R | U | AP | A | E | C | TOTAL ( %) |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 6.8 | 10.3 | 0 | 0 | 0 | 0 | 17.1 |
| **UNIT II** | 10.3 | 10.3 | 0 | 0 | 0 | 0 | 20.6 |
| **UNIT III** | 17.2 | 3.4 | 0 | 0 | 0 | 0 | 20.6 |
| **UNIT IV** | 13.7 | 0 | 0 | 0 | 0 | 0 | 13.7 |
| **UNIT V** | 17.2 | 0 | 10.3 | 0 | 0 | 0 | 27.5 |
| **TOTAL** | 65.2 | 24.0 | 10.3 | 0 | 0 | 0 | 99.5 |
| **Lower Order Thinking (%)** | | | | **100 %** | | | |
| **Higher Order Thinking (%)** | | | | **NIL** | | | |

**10. Expected outcome of the course:**

Upon successful completion of this course, the student will be able to:

**CO1**. List the different materials, its properties and importance in everyday life

**CO2**. Understand the different types of polymers, its properties, preparation and uses

**CO3**. Examine the properties and uses of electrochemicals and corrosive agents.

**CO4**. Understand the principle, working and applications of different analytical techniques

**11. Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | Ap | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √√ | | | | | |
| **CO2** | | √√ | | | | |
| **CO3** | | | √√ | | | |
| **CO4** | | | √√ | | | |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | | | | | | | | | | | |
| **CO2** | √√ | | | | | | | | | | | |
| **CO3** | √√ | | | | | | | | | | | |
| **CO4** | √√ | | | | | | | | | | | |

**13. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √√ | | | | | | | | | |
| **CO2** | √√ | √√ | | | | | | | | | |
| **CO3** | √√ | √√ | | | | | | | | | |
| **CO4** | √√ | √√ | | | | | | | | | |

**14. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 |
|---|---|---|---|---|
| **CO1** | √√ | √√ | | |
| **CO2** | √√ | √√ | | |
| **CO3** | √√ | √√ | | |
| **CO4** | √√ | √√ | | |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UH201 | MATHEMATICS I<br>(Common to all B.E./B.Tech.) | 2 | 2 | 0 | 3 |

1. **Course pre-requisites** : Basic concepts on Matrices, Basic Differential andIntegral Calculus.

2. **Course learning objectives** :

   i) To have a well-founded knowledge on Eigen values and Eigen vectors to handle problems that arise in Engineering and Scientific fields.

   ii) To emphasize the applications of Differential and Integral calculus for solving different kinds of Mathematical modeling problems.

   iii) To give adequate exposure in applying numerical methods in predicting missing data.

3. **Expected Level of Output** : Conceptual Level

4. **Department Offered** : Science & Humanities (Mathematics)

5. **Nature of the Course** : Group B – 100% Analytical

**Continuous Internal Assessment (CIA)** : **40 Marks**

**Semester End Examination (SEE)** : **60 Marks**

6. **Course Input** :

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **MATRICES** | | | | | | | | |
| | Characteristic Equation, Eigen values and Eigen vectors of a real matrix | A | 14 | 3 | R,U | 12 | 3 | 0 | 3 |
| | Properties | A | 14 | 2 | R | | 3 | 0 | 3 |
| | Cayley-Hamilton theorem (excluding proof) | A | 14 | 2 | U | | 3 | 0 | 3 |
| | Orthogonal transformation of a symmetric matrix to diagonal form. | A | 14 | 2 | U | | 3 | 0 | 3 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation | A | 14 | 2 | U | | 3 | 0 | 2 |
| | Nature of Quadratic forms | A | 14 | 1 | U | | 2 | 0 | 2 |
| **II** | **INTERPOLATION AND APPROXIMATION** | | | | | | | | |
| | Difference Operators: Forward and Backward difference operators | B | 4 | 2 | R,U | 12 | 4 | 0 | 3 |
| | Interpolation with equal intervals of arguments : Newton's forward and backward interpolation | B | 4 | 4 | U | | 3 | 0 | 3 |
| | Central interpolation using Bessel formula | B | 4 | 2 | U | | 3 | 0 | 2 |
| | Divided differences – Newton's divided difference formula | B | 4 | 2 | U | | 3 | 0 | 2 |
| | Lagrangian Polynomials | B | 4 | 2 | U | | 3 | 0 | 2 |
| **III** | **APPLICATIONS OF DIFFERENTIAL CALCULUS** | | | | | | | | |
| | Limits and Continuity - Differentiation of standard functions (Concepts only) | A | 2 | 1 | R,U | 12 | 4 | 2 | 3 |
| | Curvature in Cartesian co-ordinates, Centre of curvature | A | 2 | 2 | R,U | | 4 | 2 | 3 |
| | Radius of curvature | A | 2 | 2 | U, Ap | | 3 | 1 | 2 |
| | Circle of curvature | A | 2 | 2 | U, Ap | | 2 | 1 | 2 |
| | Evolutes of Standard curves | A | 2 | 3 | U | | 3 | 0 | 2 |
| | Envelopes of curves in one and two parameters. | A | 2 | 2 | U | | 3 | 0 | 2 |
| **IV** | **DEFINITE INTEGRALS** | | | | | | | | |
| | Definite Integrals – Even and Odd functions | A | 6 | 2 | U | 12 | 4 | 3 | 3 |
| | Properties of the definite integrals - simple problems | A | 6 | 2 | U | | 3 | 2 | 3 |
| | Integration by parts and Extension | A | 6 | 3 | U | | 3 | 2 | 3 |
| | Trapezoidal rule – Simpson's 1/3 and 3/8 rules | B | 5 | 3 | U | | 3 | 0 | 2 |
| | Two and Three point Gaussian Quadrature Formulae | B | 5 | 2 | U | | 3 | 0 | 2 |
| **V** | **MULTIPLE INTEGRALS** | | | | | | | | |
| | Double integration –Cartesian and Polar Coordinates | A | 7 | 2 | U | 12 | 3 | 1 | 3 |
| | Change the order of integration | A | 7 | 3 | U | | 2 | 2 | 4 |
| | Triple integration in Cartesian coordinates | A | 7 | 1 | U | | 3 | 1 | 3 |
| | Area as double integral | A | 7 | 2 | U,Ap | | 3 | 1 | 3 |
| | Volume as triple integral(Cartesian coordinates) | A | 7 | 2 | U,Ap | | 3 | 1 | 3 |
| | Double integrals using Trapezoidal and Simpson's rules | B | 5 | 2 | U | | 3 | 0 | 2 |

**Bloom's Legends:**

**R–** Remembering **U–** Understanding **AP – Applying**

**A –** Analyzing **C –** Creating **E –**Evaluating

## 7. TEXT BOOKS

A. Ramana B.V, 'Higher Engineering Mathematics', Tata McGraw Hill Publishing Company, New Delhi, 2011.

B. Jain, M.K., Iyengar, S.R.K and Jain R.K., 'Numerical Methods for Scientific and Engineering Computation', New Age international Publishers, New Delhi, 2012.

## REFERENCE BOOKS

C. Grewal, B. S., Higher Engineering Mathematics,42nd Edition, Khanna Publishers, New Delhi, 2014.

D. D.Veerarajan, T.,Engineering Mathematics, Tata Mc. Graw Hill Publishing Companu, New Delhi, 2011.

E. Bali.N.P and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications, New Delhi, 2011.

## 8. Assessing Level of Bloom's Taxonomy in Numbers:

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 2 | 5 | 0 | 0 | 0 | 0 | 7 |
| **UNIT II** | 1 | 5 | 0 | 0 | 0 | 0 | 6 |
| **UNIT III** | 1 | 5 | 2 | 0 | 0 | 0 | 8 |
| **UNIT IV** | 0 | 5 | 0 | 0 | 0 | 0 | 5 |
| **UNIT V** | 0 | 6 | 2 | 0 | 0 | 0 | 8 |
| | | | | | | **TOTAL** | **34** |

## 9. Weight age of Bloom's Taxonomy in the Syllabus

| | R | U | AP | A | E | C | TOTAL ( %) |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 5.88 | 14.71 | 0 | 0 | 0 | 0 | 20.59 |
| **UNIT II** | 2.94 | 14.71 | 0 | 0 | 0 | 0 | 17.65 |
| **UNIT III** | 2.94 | 14.71 | 5.88 | 0 | 0 | 0 | 23.53 |
| **UNIT IV** | 0 | 14.71 | 0 | 0 | 0 | 0 | 14.71 |
| **UNIT V** | 0 | 17.64 | 5.88 | 0 | 0 | 0 | 23.52 |
| **TOTAL** | 11.76 | 76.48 | 11.76 | 0 | 0 | 0 | 100 |
| **Lower Order Thinking (%)** | | | | **100 %** | | | |
| **Higher Order Thinking (%)** | | | | **NIL** | | | |

**10. Expected outcome of the course:**

Upon successful completion of this course, the student will be able to*:*

**CO1:** Apply the concepts of Eigen values and vectors in the field of theory of vibration, Robotic Engineering, Image Processing etc.

**CO2**: To apply differentiation and integration techniques to solve engineering problems.

**CO3.**To apply numerical methods to evaluate single and double integrals, interpolation of numerical data.

**11. Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | AP | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √ | √√ | | | | |
| **CO2** | √ | √√ | | | | |
| **CO3** | √ | √√ | | | | |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √√ | √√ | | | | | | | | | |
| **CO2** | √√ | √√ | √√ | | | | | | | | | |
| **CO3** | √√ | √√ | √√ | | | | | | | | | |

**13. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √√ | | | | | | | | | |
| **CO2** | √√ | √√ | | | | | | | | | |
| **CO3** | √√ | √√ | | | | | | | | | |
| **CO4** | √√ | √√ | | | | | | | | | |

**14. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| **CO1** | √√ | √ | | | |
| **CO2** | √√ | √ | | | |
| **CO3** | √√ | √ | | | |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UC301 | FUNDAMENTALS OF COMPUTING AND C PROGRAMMING | 3 | 0 | 0 | 3 |

1. **Course pre-requisites** : NIL
2. **Course learning objectives** :
   i. Extrapolate the basics about Computer and Computational Thinking.
   ii. Applying Systematic approach for problem solving with emphasis for Design skills
   iii. Understand the basics and features of Structured Programming
   iv. Understand the Syntax and Usage of Arrays, Strings, Functions, Pointers, Structures and unions in C.
   v. Write C programs using the concepts Arrays, Strings, Functions, Pointers Structures and Unions
3. **Expected Level of Output** : Conceptual Level
4. **Department Offered** : Computer Science and Engineering
5. **Nature of the Course** : Group C – 20 % Descriptive & 80% Programming

**Continuous Internal Assessment (CIA)** : **40 Marks**
**Semester End Examination (SEE)** : **60 Marks**

6. **Course Input** :

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **COMPUTATIONAL THINKING AND PROBLEM SOLVING** | | | | | | | | |
| | **Computational Thinking:** Introduction to Computational Thinking - History of Computation and Computational Thinking – Computer Systems – Computing Environments. | A, R1 | 1,1 | 2 | U | 9 | 2 | 3 | 3 |
| | How Real World Information Becomes Computational Data: Information and data | A | 2 | 1 | U | | 2 | 3 | 2 |
| | Converting Information into Data - Data Capacity – Data Types and Data Encoding. | A | 2 | 1 | AP | | 2 | 1 | 1 |
| | Solving Problems: Problem Definition – Logical Reasoning. | A, R1 | 3,1 | 1 | R | | 2 | 3 | 3 |
| | System /Software Development Life | A, R1 | 3,1 | 2 | U | | 5 | 4 | 3 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Cycle: Program Development – Analysis – Design: (Algorithm - Flow Chart - Pseudo Code) – Coding – Testing – Documentation. | | | | | | | | |
| | Case Study: Raptor and Scratch Tools – Installation – Programming Environment. | W1,W2 | | 2 | AP | | 3 | 3 | 2 |
| II | **INTRODUCTION TO C PROGRAMMING** | | | | | | | | |
| | Computer Languages – Overview of C – Creating and Running Programs. | B,R1 | 1,1 | 2 | U | 9 | 4 | 3 | 3 |
| | Character Set – **C Tokens:** (Keywords -Identifiers – Constants – Strings - Operators – Special Symbols) – Data Types. | B,R1 | 2,2 | 3 | R | | 3 | 3 | 3 |
| | Expression – Precedence and Associativity– Evaluating Expression – Type Conversion. | B | 3,3 | 2 | E | | 3 | 3 | 3 |
| | **Input and Output:** Unformatted Input and Output – Formatted Input and Output. | B | 4 | 2 | R | | 4 | 4 | 3 |
| III | **CONTROL FLOW CONSTRUCTIONS** | | | | | | | | |
| | **Decision Making and Branching:** Simple if – if else – Nested if – if else if – Conditional Expression – Switch case. | B | 5 | 3 | U | 9 | 4 | 3 | 3 |
| | Programming Examples | B | 5 | 1 | AP | | 5 | 3 | 3 |
| | **Decision Making and Looping:** for – while – do while – Nested Loop | B | 6 | 2 | U | | 4 | 3 | 3 |
| | Programming Examples | B | 6 | 1 | AP | | 5 | 3 | 3 |
| | **Jumps in Loops:**goto – Continue – break - Programming Examples | B | 6 | 2 | U | | 3 | 2 | 2 |
| IV | **ARRAYS AND STRINGS** | | | | | | | | |
| | **Arrays:** Introduction – Declaration and Initialization of Single Dimensional Arrays – Array Application - Declaration and Initialization of Two Dimensional Arrays – Multidimensional Arrays | B | 7 | 3 | U | 9 | 4 | 3 | 4 |
| | Programming Examples | B | 7 | 2 | AP | | 4 | 2 | 2 |
| | **Character Arrays and Strings:** Declaring and Initialing Strings – Reading and Writing Strings – String Manipulation Functions – Array of Strings | B | 8 | 2 | U | | 4 | 2 | 3 |
| | Programming Examples | B | 8 | 2 | AP | | 4 | 2 | 2 |
| | **POINTERS AND FUNCTIONS** | | | | | | | | |
| | **Pointers** – Introduction – Pointer Constants – Pointer Values – Pointer Variables – Accessing Variables through Pointers – Pointer Declaration and Definition – Declaration Versus Redirection – Initialization of Pointer Variables | R1 | 9 | 3 | U | 9 | 3 | 0 | 3 |
| | **Functions** – Introduction – Needs of Function – Elements of Function – | B | 9 | 3 | U | | 4 | 0 | 3 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| V | Category of Function - Recursion | | | | | | | | |
| | **Structures** – Introduction – Declaring and Defining Structure Variables – Accessing Structure Members – Structure Initialization – Array of structure - Unions | B | 10 | 3 | U | | 3 | 0 | 2 |
| | | | | | | | | | |

**Bloom's Legends:**

**R-**Remembering **U-**Understanding **AP-**Applying
**A-**Analyzing **C-**Creating **E –** Evaluating

**Text Book:**

**A**. David Riley and Kenny Hunt, "Computational Thinking for the Modern Problem Solver", Chapman &Hall/CRC, 2014.

**B**. E Balagurusamy, "Programming in ANSI C", 6E, TMH, 2012.

**Reference Books:**

1. Behrouz A. Forouzan& Richard F. Gilberg, "A Structured Programming Approach Using C", 3E, Cengage Learning, 2008.
2. Ashok N. Kamthane, "Programming in C", 2E, Pearson Education, 2012.
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

**Web Resource:**

1. http://raptor.martincarlisle.com/
2. https://scratch.mit.edu/

**7. Assessing Level of Bloom's Taxonomy in Numbers:**

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 1 | 3 | 2 | 0 | 0 | 0 | 6 |
| **UNIT II** | 2 | 1 | 0 | 0 | 1 | 0 | 4 |
| **UNIT III** | 0 | 3 | 2 | 0 | 0 | 0 | 5 |
| **UNIT IV** | 0 | 2 | 2 | 0 | 0 | 0 | 4 |
| **UNIT V** | 0 | 3 | 0 | 0 | 0 | 0 | 3 |
| | | | | | | **TOTAL** | **22** |

**8. Weight age of Bloom's Taxonomy in the Syllabus**

| | R | U | AP | A | E | C | TOTAL ( %) |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 4.55 | 13.64 | 9.09 | 0.00 | 0.00 | 0.00 | 27.27 |
| **UNIT II** | 9.09 | 4.55 | 0.00 | 0.00 | 4.55 | 0.00 | 18.18 |
| **UNIT III** | 0.00 | 13.64 | 9.09 | 0.00 | 0.00 | 0.00 | 22.73 |
| **UNIT IV** | 0.00 | 9.09 | 9.09 | 0.00 | 0.00 | 0.00 | 18.18 |
| **UNIT V** | 0.00 | 13.64 | 0.00 | 0.00 | 0.00 | 0.00 | 13.64 |
| **TOTAL** | 13.64 | 54.55 | 27.27 | 0.00 | 4.55 | 0.00 | 100.00 |
| **Lower Order Thinking (%)** | | | | **95.45** | | | |
| **Higher Order Thinking (%)** | | | | **4.55** | | | |

**9. Expected outcome of the course:**

**CO1:** Apply the knowledge and skills acquired in computing Environment.

**CO2:** Demonstrate problem solving and design skills including the ability to formulate problems and their solutions.

**CO3:** Select appropriate data types and control structures for solving a given problem.

**CO4:** Illustrate the representation of arrays, strings and usage of string operations.

**CO5:** Illustrate the representation of Pointers, Functions and Structure.

**10. Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | AP | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | | √ | √√ | | | |
| **CO2** | | √ | √√ | √√ | √ | |
| **CO3** | √ | | √ | | | |
| **CO4** | √ | | √ | | | |
| **CO5** | √ | | √ | | | |

**11. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √ | | | | | | | | | | |
| **CO2** | √√ | √√ | √√ | | | | | | | | | √ |
| **CO3** | | √ | √ | | | √ | | | | | | √ |
| **CO4** | | √ | √ | | | √ | | | | | | √ |
| **CO5** | | √ | √ | | | √ | | | | | | √ |

**12. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √ | | | | | | | | | |
| **CO2** | √√ | √√ | √√ | | | | | | | | |
| **CO3** | | √ | √ | | | √ | | | | | |
| **CO4** | | √ | √ | | | √ | | | | | |
| **CO5** | | √ | √ | | | √ | | | | | |

**13. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| **CO1** | √ | | | √ | |
| **CO2** | √ | | | √ | |
| **CO3** | √ | √ | | | |
| **CO4** | √ | √ | | | |
| **CO5** | √ | √ | | | |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UE301 | TECHNICAL DRAWING | 0 | 1 | 3 | 2 |

**1.Course pre-requisites** **:** NIL

**2.Course learning objectives** **:**

i. To develop in students, the visual science in the form of technical graphics.
ii. To make them learning theory of orthographic projections of points, lines, planes and solids as per the BIS codes prevalent to drawing practice.
iii. To develop in students the technical drafting skills of the engineering drawing concepts, ideas and design of engineering products.
iv. To familiarize students in technical drawing standards.

**3. Expected Level of Output** **:** Conceptual Level

**4. Department Offered** **:** Mechatronics

**5. Nature of the Course** **:** Group B – 100 % Analytical

**Continuous Internal Assessment (CIA)** **: 40 Marks**

**Semester End Examination (SEE)** **: 60 Marks**

**6. Course Input** **:**

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **GEOMETRICAL CONSTRUCTION AND ENGINEERING CURVES** | | | | | | | | |
| | Introduction of Drawing Instruments. | A | 1 | 1 | U | 12 | 4 | 5 | 3 |
| | Lines, Lettering and Dimensioning | B | 2 | 2 | U | | 4 | 4 | 2 |
| | Regular Polygons of given Side | B | 2 | 1 | Ap | | 3 | 3 | 0 |
| | Conic sections – Construction of Ellipse, Parabola, Hyperbola (Eccentricity method only) | A | 2 | 2 | Ap | | 3 | 1 | 1 |
| | Construction of Cycloid, Epicycloids and Hypocycloids. | A | 2 | 3 | C | | 3 | 1 | 0 |
| | Construction of circle and square of involutes, Archimedean Spiral and Cylindrical Helix | A | 2 | 3 | C | | 3 | 1 | 0 |
| | **PROJECTIONS OF POINTS AND LINES** | | | | | | | | |
| | Introduction of Projections | B | 7 | 1 | R | 12 | 4 | 3 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| II | Angle of Projections (First Angle and Third Angle Projections) | A | 3 | 1 | R | | 4 | 3 | 1 |
| | Projection of Points in Different Quadrants | A | 8 | 1 | Ap | | 3 | 2 | 1 |
| | Projection of Lines: Parallel to Both the Planes | A | 9 | 1 | Ap | | 3 | 1 | 1 |
| | Parallel to One and Perpendicular to Other Planes | A | 9 | 1 | Ap | | 3 | 1 | 1 |
| | Parallel to One and Inclined to Other Planes | A | 9 | 1 | Ap | | 3 | 1 | 1 |
| | Inclined to Both the Planes | A | 9 | 1 | Ap | | 3 | 1 | 1 |
| | Projection of Planes: (Triangular, Square, Rectangular, Pentagonal, Hexagonal and Circular Planes.) | B | 7 | 2 | R | | 3 | 2 | 2 |
| | Plane Parallel to One & Perpendicular to Other | B | 7 | 1 | Ap | | 3 | 2 | 2 |
| | Plane Perpendicular to Both the Planes. | B | 7 | 1 | Ap | | 3 | 2 | 2 |
| | Plane Perpendicular to One and Inclined to Other Plane. | B | 7 | 1 | Ap | | 3 | 2 | 2 |
| III | **PROJECTIONS AND SECTIONS OF SOLIDS** | | | | | | | | |
| | Projection of Solids: (Cube, Prism, Pyramid, Cylinder and Cone.) | A | 12 | 1 | U | 12 | 4 | 3 | 3 |
| | Axis is Perpendicular to One and Parallel to Other plane. | A | 12 | 2 | Ap | | 4 | 3 | 3 |
| | Axis is parallel to One and Inclined to Other Plane. | A | 12 | 2 | Ap | | 4 | 3 | 3 |
| | Axis is Parallel to both the Planes | A | 12 | 2 | Ap | | 4 | 3 | 3 |
| | Sectional of solids: Sectional Plane Perpendicular to one Reference Plane and Parallel to other | B | 9 | 3 | Ap | | 4 | 3 | 3 |
| | Sectional Plane Perpendicular to one plane and inclined to other | B | 9 | 2 | Ap | | 4 | 3 | 3 |
| IV | **ORTHOGRAPHIC AND ISOMETRIC VIEWS** | | | | | | | | |
| | Introduction to orthographic Projections | A | 20 | 1 | U | 14 | 4 | 4 | 3 |
| | Orthographic Projections of Simple Solid Object from Pictorial / Isometric view. | A | 20 | 6 | C | | 4 | 4 | 3 |
| | Introduction to isometric Projection: Isometric Scale and Isometric views | A | 18 | 1 | U | | 4 | 3 | 3 |
| | Isometric View of Prism, Pyramid, Cone, Cylinder. | B | 12 | 6 | C | | 4 | 3 | 3 |
| V | **DEVELOPMENT OF SURFACES** | | | | | | | | |
| | Introduction to Development of Surface | B | 10 | 1 | U | 10 | 4 | 3 | 3 |
| | Development of lateral surfaces of simple – Prisms, pyramids, cylinders and cones. | A | 14 | 2 | C | | 4 | 4 | 3 |
| | Development of lateral surfaces of truncated solids – Prisms, pyramids, cylinders and cones | A | 14 | 2 | C | | 4 | 4 | 3 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Development of Frustum of simple solids , Tray and Duct. | B | 15 | 2 | C | | 4 | 3 | 4 |
| | Development of Elbow, Lamp shade, funnel, T-Pipe and Y-Pipe. | B | 15 | 3 | C | | 4 | 3 | 4 |

**Bloom's Legends:**

**R-**Remembering **U-**Understanding **AP-**Applying
**A-**Analyzing **E –** Evaluating **C-**Creating

**7.TEXT BOOKS**

A.Venugopal.K, PrabuRaja.V, "Engineering Graphics" New Age International Publishers, 13th Edition, 2014.

B.Shah.M.B and Rana.B.C, "Engineering Drawing", Pearson Education, 2014.

**REFERENCE BOOK:**

C. Mathur.M.L&Vaishwanar.R.S, "Engineering Drawing and Graphics", JBA Publishers, 4th Edition, 2013.

D. Natarajan.K.V, "A textbook of Engineering Graphics", Dhanalakshmi Publishers, 2nd Edition, 2011.

E. BasantAgarwal and Agarwal C.M, "Engineering Drawing", Tata McGraw-Hill Education, 2nd Edition 2013.

**WEB RESOURCES**

- ✓ https://www.youtube.com/watch?feature=player_embedded&v=ZIZyQbCX30E
- ✓ https://www.youtube.com/watch?feature=player_embedded&v=2uWYn9-M1AU
- ✓ https://www.youtube.com/watch?feature=player_embedded&v=kdPAK00eIzk
- ✓ https://www.youtube.com/watch?feature=player_embedded&v=npuimTmDfRg

**8.Assessing Level of Bloom's Taxonomy in Numbers:**

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 0 | 2 | 2 | 0 | 0 | 2 | 6 |
| **UNIT II** | 3 | 0 | 8 | 0 | 0 | 0 | 11 |
| **UNIT III** | 0 | 1 | 5 | 0 | 0 | 0 | 6 |
| **UNIT IV** | 0 | 2 | 0 | 0 | 0 | 2 | 4 |
| **UNIT V** | 0 | 1 | 0 | 0 | 0 | 4 | 5 |
| | | | | | | **TOTAL** | **32** |

**9. Weightage of Bloom's Taxonomy in the Syllabus**

| | R | U | AP | A | E | C | TOTAL ( %) |
|---|---|---|---|---|---|---|---|
| **UNIT I** | **0** | **5.4** | **5.3** | **0** | **0** | **5.3** | **16** |
| **UNIT II** | **1.4** | **0** | **23.6** | **0** | **0** | **0** | **25** |
| **UNIT III** | **0** | **3.9** | **19.1** | **0** | **0** | **0** | **23** |
| **UNIT IV** | **0** | **8** | **0** | **0** | **0** | **8** | **16** |
| **UNIT V** | **0** | **4** | **0** | **0** | **0** | **16** | **20** |
| **TOTAL** | **1.4** | **21.3** | **48** | **0** | **0** | **29.3** | **100** |
| **Lower Order Thinking (%)** | | | | **70.7%** | | | |
| **Higher Order Thinking (%)** | | | | **29.3%** | | | |

**10. Expected outcome of the course:**

Upon successful completion of this course, the student will be able to:

**CO1**. Draw the projections of complex objects.
**CO2.** Distinguish the different techniques of engineering drawing.
**CO3.** Improve their visualization skills so that they can apply these skills in developing new products.
**CO4.** Prepare sheet metal layout.

**11. Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | Ap | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √ | √ | √ | | | |
| **CO2** | √ | √ | √ | √ | √ | √ |
| **CO3** | | √ | √ | √ | √ | √ |
| **CO4** | | | | | √ | √ |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √ | √ | | √ | √ | | | | | | | |
| **CO2** | √ | | | | | | | | | | | |
| **CO3** | √ | √ | √ | | √ | √ | √ | | | | | √ |
| **CO4** | √ | | | | √ | | | | | | | √ |

**13. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √ | | | √ | | | | | | | |
| **CO2** | √ | | | | | | | | | | |
| **CO3** | √ | √ | √ | √ | √ | | | | | | √ |
| **CO4** | √ | | √ | √ | | √ | | | | | √ |

**14. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| **CO1** | √√ | √ | | | |
| **CO2** | | | | √ | |
| **CO3** | √√ | √√ | √ | | √ |
| **CO4** | | √ | √√ | | √ |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UE302 | BASIC MECHATRONICS ENGINEERING | 1 | 2 | 0 | 2 |

**1. Course pre-requisites** **:** Nil

**2. Course learning objectives** **:**

Upon successful completion of this course, the student will be able to:

i. To understand the basic concepts of Role of Mechatronics in Industries
ii. To Understand the basics of sensors and actuators .
iii. To understand the basics concepts on mechanical, electrical and electronics engineering.
iv. To get knowledge on the various applications of Mechatronics.

**3. Expected Level of Output** **:** Conceptual Level

**4. Department Offered** **:** Mechatronics Engineering

**5. Nature of the Course** **:** Group G – 100 % Internal mode
**Continuous Internal Assessment (CIA)** **: 100 Marks**

**6. Course Input** **:**

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **INTRODUCTION** | | | | | | | | |
| | Introduction of Mechatronics | B | 1 | 2 | U | 9 | 4 | 2 | 3 |
| | Role of Various Engineering Disciplines in Mechatronics and scope of mechatronics | B | 1 | 2 | R | | 4 | 2 | 2 |
| | Historical development and design elements of Mechatronic systems | E | 1 | 3 | U | | 4 | 2 | 2 |
| | Comparison between Traditional and Mechatronics approach | A | 1 | 2 | R | | 4 | 3 | 2 |
| II | **SENSORS AND TRANSDUCERS** | | | | | | | | |
| | Basic Electrical and Electronics Elements | A | 2 | 2 | U | 9 | 5 | 4 | 4 |
| | Sensors and Transducers | A | 2 | 2 | AP | | 4 | 4 | 4 |
| | Displacement, Position Proximity and temperature sensors | A | 2 | 3 | AP | | 4 | 4 | 4 |
| | Encoder and Piezo electric sensor | A | 2 | 2 | AP | | 5 | 3 | 3 |
| | **DRIVES AND CONTROLS** | | | | | | | | |
| | Mechanical Drives - Gear, Belt and | A | 8 | 2 | U | 9 | 3 | 2 | 3 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| III | Chain, Lead screw and Ball Screw and its applications | | | | | | | | |
| | Electrical Drive: Introduction to Motors: DC Motor, Basics of Servo and Stepper motor and its applications. | A | 9 | 2 | AP | | 4 | 3 | 4 |
| | Hydraulic and pneumatic drives and basic components | A | 7 | 3 | U | | 4 | 3 | 3 |
| | Basics of Microprocessor, Microcontrollers and its applications. | A | 17 | 2 | U | | 4 | 3 | 3 |
| IV | **INDUSTRIAL AUTOMATION** | | | | | | | | |
| | Introduction to Industrial Automation. | A | 21 | 2 | U | 9 | 4 | 2 | 3 |
| | Basics of Programmable Logic Controller and its applications. | A | 21 | 2 | U | | 4 | 2 | 3 |
| | Introduction to Software's used in Industrial Automation. | A | 24 | 3 | C | | 4 | 2 | 3 |
| | Examples of Mechatronics System: Difference between Conventional Lathe and CNC Machine, Car parking Barriers, Tank liquid level Control system. | A | 24 | 2 | AP | | 4 | 2 | 3 |
| V | **Applications of Mechatronics** | | | | | | | | |
| | The Digital camera and autofocus. | A | 24 | 3 | U | 9 | 4 | 3 | 4 |
| | The Engine Management system and The pick and place Robot. | A | 24 | 2 | U | | 5 | 3 | 2 |
| | Bar code reader and Domestic washing machine. | A | 24 | 2 | U | | 3 | 3 | 3 |
| | Material Transfer application. | A | 24 | 2 | U | | 5 | 3 | 4 |

**Bloom's Legends:**

**R-**Remembering **U-**Understanding **AP-**Applying
**A-**Analyzing **E –** Evaluating **C-**Creating

## 7. TEXT BOOKS

A. W. Bolton., "Mechatronics", 4th Edition, Pearson Education, Inc 2010 (ISBN 978-81-317-3253-3).

B. M.D. Singh, J.G. Joshi., "Mechatronics", PHI Learning Pvt. Ltd, 2009 (ISBN 978-81-203-2986-7).

### REFERENCE BOOKS

C. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 2000.

D. Newton C. Braga., "Mechatronics Source Book, Thomson Delmar Learning, 2009 (ISBN 981-243-858-0).

E. Rolf Isermann., "Mechatronics Systems Fundamentals, Springer International Edition, 2006 (ISBN 81-8128-272-8).

### WEB RESOURCES

1. www.youtube.com/watch?v=3rlS7ZMFXZ8
2. www.youtube.com/watch?v=1iQ4QLqi-98
3. www.youtube.com/watch?v=UQ16Cous_tY

**8. Assessing Level of Bloom's Taxonomy in Numbers:**

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 2 | 2 | 0 | 0 | 0 | 0 | 4 |
| **UNIT II** | 0 | 1 | 3 | 0 | 0 | 0 | 4 |
| **UNIT III** | 0 | 3 | 1 | 0 | 0 | 0 | 4 |
| **UNIT IV** | 0 | 2 | 1 | 0 | 0 | 1 | 4 |
| **UNIT V** | 0 | 4 | 0 | 0 | 0 | 0 | 4 |
| | | | | | | **TOTAL** | **20** |

**9. Weightage of Bloom's Taxonomy in the Syllabus 244**

| | R | U | AP | A | E | C | TOTAL ( %) |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 8.8 | 8.8 | 0 | 0 | 0 | 0 | 17.6% |
| **UNIT II** | 0 | 5.9 | 17.6 | 0 | 0 | 0 | 23.4% |
| **UNIT III** | 0 | 14.7 | 4.9 | 0 | 0 | 0 | 19.6% |
| **UNIT IV** | 0 | 9.2 | 4.6 | 0 | 0 | 4.6 | 18.4% |
| **UNIT V** | 0 | 21 | 0 | 0 | 0 | 0 | 21% |
| **TOTAL** | 8.8 | 59.65 | 27.1 | 0 | 0 | 4.6 | 100% |
| **Lower Order Thinking (%)** | | | | **95.4%** | | | |
| **Higher Order Thinking (%)** | | | | **4.6%** | | | |

**10. Expected outcome of the course:**

Upon successful completion of this course, the student will be able to:

**CO1:** Understand the basic concepts of Role of Mechatronics in Industries.

**CO2**: Understand the basics of Sensors and Actuators.

**CO3:** Understand the basics concepts on mechanical, electrical and electronics engineering.

**CO4**: Get knowledge on the various applications of Mechatronics.

**11. Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | Ap | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √ | √ | √ | √ | | |
| **CO2** | √ | √ | √ | √ | | |
| **CO3** | | √ | √ | √ | | √ |
| **CO4** | √ | √ | √ | √ | | √ |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | √√ | √ | √√ | | √√ | √ | √ | √ | √ | √ | √ | √√ |
| CO2 | √√ | √ | √√ | √ | √√ | | √ | √ | | √ | √ | √√ |
| CO3 | √√ | √ | √√ | | √√ | | √ | √ | | √ | √√ | √√ |
| CO4 | √√ | √ | √ | √ | √√ | | √ | | √ | | | √√ |

**13. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √√ | √ | | √√ | √ | | √ | | | √√ |
| **CO2** | √√ | √ | √ | | √√ | √ | | | | | √√ |
| **CO3** | √√ | √ | √ | √√ | √√ | √ | √ | | | | √√ |
| **CO4** | √ | √√ | √ | √ | √ | | √ | | | | √√ |

**14. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| CO | √√ | √ | √ | √ | √ |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UC351 | FUNDAMENTALS OF COMPUTING AND C PROGRAMMING LABORATORY | 0 | 0 | 3 | 2 |

1. **Course pre-requisites** : NIL

2. **Course learning objectives** :
   i. Be exposed to problem solving techniques and to generate flow charts using Raptor Tool.
   ii. Be exposed to Animation, gaming and application creation using Scratch Tool
   iii. Be Familiar with Programming in C
   iv. To apply the various features of C

3. **Expected Level of Output** : **Practical**

4. **Department Offered** : Computer Science and Engineering

5. **Nature of the Course** : Group E - Practical

**Continuous Internal Assessment (CIA)** : **40 Marks**

**Semester End Examination (SEE)** : **60 Marks**

**6. List of Experiments:**

1. Draw Flowchart using Raptor Tool
   - Simple Flow Chart
   - Using Decision Making
   - Using Pre Test Loop
   - Using Post Test Loop
2. Create Animation / Gaming /Application using Scratch Tool
3. Program to process Data types, formatting inputs and outputs.
4. Program using Operators and Expression Evaluation
5. Program using Decision Making
6. Program using Looping Statements
7. Program using Single and Two Dimensional Arrays
8. Program for String manipulation
9. Program using Call by Value and Call by Reference.
10. Program using Recursive Function.
10. Program using Array of Structures

**7. Expected outcome of the course:**

**CO1:** Demonstrate problem solving and design skills including the ability to formulate problems and their solutions.

**CO2:** Select appropriate data types and control structures for solving a given problem.

**CO3:** Apply and practice logical ability to solve simple problems.

**CO4:** Demonstrate 'C' programs using arrays, strings.

**CO5:** Illustrate the representation of Pointers, Functions and Structure.

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UE351 | MECHATRONICS DRAWING LABORATORY - I | 0 | 1 | 3 | 2 |

1. **Course pre-requisites** : NIL

2. **Course learning objectives** :
   i. Be exposed to problem solving techniques and to generate drafts using modern tools
   ii. Be exposed to Engineering drawing and drafting using Autocad tool.

3. **Expected Level of Output** : **Practical**

4. **Department Offered** : Mechatronics Engineering

5. **Nature of the Course** : Group E - Practical

**Continuous Internal Assessment (CIA)** : **40 Marks**
**Semester End Examination (SEE)** : **60 Marks**

6. **List of Exercises**

**PART-A (2D)**

1. Commands in CAD software.
2. Creation of simple figures like polygon and general multi-line drawings.
3. Construct a 2D complex shape with actual dimensions.
4. Drawing of engineering curves: Ellipse, Archimedean spiral and Circular involute.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves.)
6. Draw and develop the lateral surface of the simple solid objects: Prism and Pyramids.

**PART-B (3D)**

7. Commands in Solidworks/Creo.
8. Modeling of parts using Solidworks/Creo.
9. Modeling of simple machine components using Solidworks/Creo.
10. Detailing of Components using Solidworks/Creo.

**Software Packages: AutoCAD, DWG editor, Solidworks and PTC Creo.**

**Note: Plotting of drawings must be made for each exercise and attached to the records written by students.**

# SEMESTER II

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UH102 | COMMUNICATION SKILLS II (Common to all B.E./B.Tech. and I MCA) | 2 | 0 | 2 | 3 |

**1. Course pre-requisites** : 15UH101 Communication Skills I

**2. Course learning objectives** :

i. To develop the prominence of listening and reading practices using authentic business vocabulary.

ii. To instill analytical thinking and logical reasoning to use LSRW skills in Business related situations.

iii. To urge the need of effective communication in corporate sector with Business English.

**3. Expected Level of Output** : Conceptual Level

**4. Department Offered** : Science & Humanities (English)

**5. Nature of the Course** : 80% Descriptive and 20% Analytical

**Continuous Internal Assessment (CIA)** : **40 Marks**

**Semester End Examination (SEE)** : **60 Marks**

**6. Course Input** :

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **Creative Communication** | | | | | | | | |
| | Introduction- Talking about teamwork- Making Arrangements- Improving Communication in spoken Language | A | 1,1a, | 3 | U,R | 9 | 5 | 5 | 4 |
| | Taking and Leaving Voice mail messages (Present Tenses, Past Tense and Present Perfect)-Talking about Business Hotel ( Speaking Activity) | A | 1b,2 a | 2 | U,Ap,A R | | 4 | 3 | 1 |
| | Talking about Corporate Hospitality – Formal and Informal Language- | A | 2b | 2 | A,U,Ap | | 4 | 3 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Making accepting and declining invitations (Auxiliary Verbs, Countable or Uncountable Nouns) | | | | | | | | |
| | Focus on language –Definitions- Extended Definitions | B | 11 | 2 | R,Ap | | 4 | 3 | 3 |
| **II** | **Interpersonal Communication** | | | | | | | | |
| | Talking about orders – Clarity in Written Language- Phone and Letter Phrases. | A | 3a | 2 | A,Ap,E, R | 11 | 5 | 4 | 2 |
| | Talking about Company Finances- Conditional 1 and 2- Managing Cash Flow (Intention and arrangements Conditional 1 and 2)- Talking about Brands and Marketing – Ethical Banking | A | 3b,4 a | 3 | U,A,Ap | | 4 | 3 | 3 |
| | Talking about Public Relations – Organizing a PR Event- Describing Duties and Responsibilities<br>( Future Tense and Articles) | A | 4b | 2 | A,U | | 5 | 4 | 3 |
| | Reported speech-Modal verbs | B | 42,2 2 | 2 | R,Ap | | 5 | 3 | 0 |
| | Active and Passive, impersonal passive voice | B | 9 | 2 | R,U,Ap | | 5 | 3 | 0 |
| **III** | **Public Speaking / Presentation Skills** | | | | | | | | |
| | Talking about relocation- Report Phrases- Talking about Similarity and Difference | A | 5a | 2 | U,A,Ap, R | 9 | 4 | 3 | 2 |
| | Giving Directions – Asking for Information and Making Suggestions- Talking about Location(Comparatives and Superlatives, Participles)- Talking about Company Performance- Describing Trends- Describing Cause and Effect | A | 5b,6 a | 3 | R,Ap,A, E | | 5 | 4 | 2 |
| | Talking about Environmental Impact- Discussing Green Issues- Language of Presentations (Adjectives and Adverbs, Determiners) | A | 6b | 2 | U,A,E | | 5 | 3 | 3 |
| | Homophones- Homonyms- Acronyms- Abbreviations- British and American words | B | 48 | 2 | R,Ap | | 4 | 3 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **IV** | **Corporate Communication** | | | | | | | | |
| | Talking About Health and Safety- Expressing Obligation- Discussing Regulations | A | 7a | 2 | U,Ap,E, C | 8 | 4 | 3 | 2 |
| | Talking about personnel Problems- Passives- Talking about Problem at Work ( Modal Verbs , Passives) | A | 7b | 2 | R,A,Ap | | 3 | 2 | 1 |
| | Talking about Expenses Claims- Talking about Air Travel (Relative Pronouns , Indirect Questions) | A | 8a,8 b | 2 | U,R,A, E | | 5 | 4 | 2 |
| | Transcoding | B | 33 | 2 | U,Ap | | 4 | 3 | 4 |
| **V** | **Career Planning** | | | | | | | | |
| | Talking about Staff Benefits- Talking about Appraisal Systems (Gerunds and Infinitives , Reported Speech) | A | 9a,9 b | 2 | U,R,Ap ,A | 8 | 4 | 3 | 1 |
| | Talking about Marketing Disasters- Expressing hypothetical Situations- Talking about entering Foreign Markets(Conditional 3 , Grammar review) | A | 10a, 10b | 2 | R,U,Ap | | 5 | 4 | 3 |
| | Letter for calling quotations, Replying for quotations- Placing an order and complaint. | B | 34 | 4 | U,R,Ap | | 5 | 3 | 2 |
| | **Total Hours** | **45** | | | | | | | |

**Bloom's Legends:**

**R-**Remembering **U-**Understanding **AP-** Applying
**A-**Analyzing **C-**Creating **E –** Evaluating

## 7. TEXT BOOKS


**A.** Wood, Ian,Paul Sanderson, Anne Williams with Marjorie Rosenberg, Pass Cambridge BECVantage, Cengage learning. Second Edition. 2014.

**B.** Dr Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited, 2005.

**REFERENCE BOOKS:**


**C.** Whitby, Norman. Cambridge University Press- Students Book. 2013.

**D.** Jawahar, Jewelcy, Rathna P, English Work book, VRB Publications Pvt Ltd, 2006.

**E.** Gunasekaran S, 'A Text and Workbook of Technical English I", United Global Publishers, June 2010.


**8. Assessing Level of Bloom's Taxonomy in Numbers:**

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 3 | 3 | 3 | 2 | 0 | 0 | 11 |
| **UNIT II** | 3 | 3 | 4 | 3 | 1 | 0 | 14 |
| **UNIT III** | 3 | 2 | 3 | 3 | 2 | 0 | 13 |
| **UNIT IV** | 2 | 3 | 3 | 2 | 2 | 1 | 13 |
| **UNIT V** | 3 | 3 | 3 | 1 | 0 | 0 | 10 |
| | | | | | | **TOTAL** | **61** |

**9. Weightage of Bloom's Taxonomy in the Syllabus**

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT 1** | 4.91 | 4.91 | 4.91 | 3.27 | 0 | 0 | 18 |
| **UNIT 2** | 4.91 | 4.91 | 6.51 | 4.91 | 1.63 | 0 | 22.87 |
| **UNIT 3** | 4.91 | 3.27 | 4.91 | 4.91 | 3.27 | 0 | 21.27 |
| **UNIT 4** | 3.27 | 4.91 | 4.91 | 3.27 | 3.27 | 1.63 | 21.26 |
| **UNIT 5** | 4.91 | 4.91 | 4.91 | 1.63 | 0 | 0 | 16.36 |
| **TOTAL** | 22.91 | 22.91 | 26.15 | 17.99 | 8.17 | 1.63 | 100 |
| **Lower Order Thinking** | | | | **71** | | | |
| **Higher Order Thinking** | | | | **29** | | | |

**10. Expected outcome of the course:**

Upon successful completion of this course, the student will be able to:

**CO1:** Understand and gain proficiency with business vocabulary.

**CO2:** Apply Task- Based activity to enhance an effective communication.

**CO3:** Remember LSRW skills and employ cross-cultural communication in business related situations.

**CO4:** Analyze and apply Business English in working environment.

**11. Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | Ap | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √ | √√ | | √ | | |
| **CO2** | | √ | √√ | | | |
| **CO3** | √ | | √√ | | | |
| **CO4** | | | √√ | √ | | |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | | | | | | | | | | | |
| **CO2** | √√ | | | | | | | | | | | |
| **CO3** | √√ | | | | | | | | | | | |
| **CO4** | √√ | | | | | | | | | | | |

**13. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √√ | | | | | | | | | |
| **CO2** | √√ | √√ | | | | | | | | | |
| **CO3** | √√ | √√ | | | | | | | | | |
| **CO4** | √√ | √√ | | | | | | | | | |

**14. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| **CO1** | √√ | √ | | | |
| **CO2** | √√ | √ | | | |
| **CO3** | √√ | √ | | | |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UH301 | MATERIAL SCIENCE (Common to all B.E./B.Tech.) | 3 | 0 | 0 | 3 |

**1. Course pre-requisites** : NIL

**2. Course learning objectives** :

i. To give the fundamental knowledge of materials which is related for engineering programme.
ii. To impart the knowledge on electrical and superconducting properties of materials.
iii. To get exposure on crystal structure and nanomaterials.

**3. Expected Level of Output** : Conceptual Level

**4. Department Offered** : Science & Humanities (Physics)

**5. Nature of the Course** : Group C –75% Descriptive & 25% Analytical

**Continuous Internal Assessment (CIA)** : **40 Marks**
**Semester End Examination (SEE)** : **60 Marks**

**6. Course Input** :

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **CRYSTALLOGRAPHY** | | | | | | | | |
| | Crystalline and amorphous solids - lattice and unit cell, seven crystal system and Bravais lattices | A | 4 | 2 | R | 9 | 2 | 2 | 2 |
| | Atomic radius, coordination number, packing factor calculation for SC, BCC, FCC, HCP. | A | 4 | 3 | U | | 1 | 1 | 2 |
| | Special crystal structures: Diamond, ZnS, NaCl | A | 4 | 1 | U | | 1 | 1 | 1 |
| | Miller Indices, d-Spacing | A | 4 | 1 | AP | | 3 | 2 | 2 |
| | Bragg's law of X-ray diffraction – Laue Method – powder crystal method: Crystal structure analysis-De-bye scherrer method. | B | 3 | 2 | AP | | 3 | 1 | 2 |
| II | **CONDUCTING MATERIALS** | | | | | | | | |
| | Classical free electron theory of metals | A | 6 | 1 | R | 9 | 2 | 1 | 1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Expression for electrical and thermal conductivity, Wiedemann-Franz law, merits and demerits of classical free electron theory. | A | 6 | 3 | AP | | 1 | 1 | 1 |
| | Band theory of Solids and classification of solids into conductors, semiconductor and Insulator | A | 6 | 1 | U | | 2 | 2 | 2 |
| | Factors affecting resistivity of conductors: Temperature and impurities. | A | 6 | 1 | AP | | 1 | 1 | 2 |
| | Fermi distribution function – Density of energy states, carrier concentration in metals. | B | 8 | 3 | AP | | 2 | 2 | 1 |
| **III** | **SEMICONDUCTING MATERIALS** | | | | | | | | |
| | Intrinsic semiconductor, carrier concentration for intrinsic semiconductor | A | 10 | 2 | AP | 9 | 2 | 1 | 1 |
| | Extrinsic semiconductor – n-type semiconductor, carrier concentration for n-type semiconductor | A | 10 | 2 | AP | | 2 | 1 | 2 |
| | P-type semiconductor, carrier concentration for p-type semiconductor, variation of Fermi level with respect to temperature and impurities. | A | 10 | 2 | AP | | 2 | 1 | 1 |
| | Hall Effect, derivation for Hall co-efficient, applications of Hall effect | A | 10 | 2 | AP | | 3 | 2 | 3 |
| | Solar cell | A | 10 | 1 | AP | | 2 | 2 | 1 |
| **IV** | **MAGNETIC MATERIALS AND SUPERCONDUCTING MATERIALS** | | | | | | | | |
| | Magnetic materials: Dia, para, ferro, antiferro and ferri magnetic materials – Properties - Heisenberg and domain theory of ferromagnetism – Hysteresis | A | 9 | 3 | U | 9 | 2 | 1 | 2 |
| | Ferrites: Structure, preparation and its applications | A | 9 | 1 | U | | 2 | 1 | 2 |
| | Principle of magneto recording- Floppy disk. | B | 11 | 1 | U | | 1 | 1 | 1 |
| | Superconductors: Properties of superconductor - Meissner effect, isotope effect, types of superconductors - High Tc Superconductors - BCS theory. | A | 8 | 2 | R | | 2 | 2 | 2 |
| | Application of Superconductors – SQUID, Cryotron, Magnetic levitation. | B | 12 | 2 | AP | | 2 | 1 | 2 |
| **V** | **NANOMATERIALS** | | | | | | | | |
| | Nano materials: Synthesis | E | 6 | 1 | R | 9 | 2 | 1 | 2 |
| | Ball milling method, chemical vapor deposition, plasma arc method and Sol-gel Technique - Properties of Nano materials and applications. | E | 6 | 3 | U | | 1 | 1 | 1 |
| | Carbon nano tube (CNT) - Single walled CNT and Multi walled CNT; structure-Armchair, Zig-zag and Chiral. | E | 6 | 1 | R | | 1 | 1 | 2 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Preparation: Carbon arc method, pulsed laser method and chemical vapour deposition | E | 6 | 2 | U | | 2 | 1 | 1 |
| | Properties and Applications of CNT. | E | 6 | 2 | AP | | 2 | 1 | 1 |

**Bloom's Legends:**

**R-**Remembering **U-**Understanding **AP-** Applying
**A-**Analyzing **C-**Creating **E-**Evaluating

## 7. TEXT BOOKS

**A.** S.O.Pillai "Solid State Physics" New Age International Publishers, New Delhi – 2011

B. Rajendran V and Marikani A "Materials Science" Tata McGraw-Hill Education" New Delhi - 2010.

**REFERENCE BOOKS**

**C.** William D Callister, Jr "Material Science and Engineering" John wiley and Sons, New York, 2014.

**D.** Raghavan, V. "Materials Science and Engineering – A First Course" Prentice Hall of India, New Delhi 2011.

**E.** Dr. G. Senthilkumar "Engineering Physics – II" VRB publishers Pvt Ltd., 2013

## 8. Assessing Level of Bloom's Taxonomy in Numbers:

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 1 | 2 | 2 | **0** | 0 | 0 | **5** |
| **UNIT II** | 1 | 1 | 3 | **0** | 0 | 0 | **5** |
| **UNIT III** | **0** | **0** | **5** | **0** | 0 | 0 | **5** |
| **UNIT IV** | 1 | 3 | 1 | **0** | 0 | 0 | **5** |
| **UNIT V** | 2 | 2 | 1 | **0** | 0 | 0 | **5** |
| | | | | | | **TOTAL** | **25** |

## 9. Weightage of Bloom's Taxonomy in the Syllabus

| | R | U | AP | A | E | C | TOTAL ( %) |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 4 | 8 | 8 | 0 | 0 | 0 | 20 |
| **UNIT II** | 4 | 4 | 12 | | 0 | 0 | 20 |
| **UNIT III** | 0 | 0 | 20 | | | | 20 |
| **UNIT IV** | 4 | 12 | 4 | | | | 20 |
| **UNIT V** | 8 | 8 | 4 | | | | 20 |
| **TOTAL** | 20 | 32 | 48 | | | | 100 |
| **Lower Order Thinking (%)** | | | | 100 | | | |
| **Higher Order Thinking (%)** | | | | NIL | | | |

## 10. Expected outcome of the course:

***Upon successful completion of this course, the student will be able to:***

**CO1**. Obtain necessary input about the materials science needed for their programme

**CO2**. Gained the knowledge about the electrical and magnetic properties of the materials

**CO3**. Acquire knowledge about the crystal structure and nano materials

**11. Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | AP | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √ | | | | | |
| **CO2** | | √√ | | | | |
| **CO3** | | | √√ | | | |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √ | √ | √ | √ | | | | √ | | | |
| **CO2** | √√ | √ | √ | √ | √ | | | | √ | | | |
| **CO3** | √√ | √ | √ | √ | √ | | | | √ | | | |

**10. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √√ | | | | | | | | | |
| **CO2** | √√ | √√ | | | | | | | | | |
| **CO3** | √√ | √√ | | | | | | | | | |
| **CO4** | √√ | √√ | | | | | | | | | |

**11. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| **CO1** | √√ | √ | | | |
| **CO2** | √√ | √ | | | |
| **CO3** | √√ | √ | | | |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UH204 | MATHEMATICS-II (Common to all B.E./B.Tech.) | 2 | 2 | 0 | 3 |

**1. Course pre-requisites** **:** Vector Algebra, Complex Numbers, Differential and Integral Calculus

**2. Course learning objectives** **:**

i. To understand the concept of Differential and Integral calculus for Vector valued and Complex valued functions and its applications.
ii. To understand Laplace transforms techniques.
iii. To understand various Numerical techniques for solving Transcendental and Algebraic equations.

**3. Expected Level of Output** **:** Conceptual Level

**4. Department Offered** **:** Science & Humanities (Mathematics)

**5. Nature of the Course** **:** Group B – 100% Analytical
**Continuous Internal Assessment (CIA)** **:** **40 Marks**
**Semester End Examination (SEE)** **:** **60 Marks**

**6. Course Input** **:**

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **ORDINARY DIFFERENTIAL EQUATIONS** | | | | | | | | |
| | Higher order linear differential equations with constant coefficients | A | 9 | 3 | U | 1 2 | 5 | 2 | 5 |
| | Cauchy's and Legendre's linear equations. | A | 9 | 2 | R,U | | 4 | 2 | 5 |
| | Finite difference solution of second order ordinary differential equations by Euler and Modified Euler's methods | A | 33 | 4 | U | | 5 | 2 | 5 |
| | Fourth order Runge-Kutta methods for solving first order differential equations. | A | 33 | 3 | R,U | | 5 | 2 | 5 |
| II | **VECTOR CALCULUS** | | | | | | | | |
| | Gradient of a scalar point function– Angle between the surfaces | A | 15 | 2 | R,U | 1 2 | 3 | 1 | 3 |
| | Directional derivatives – Divergence and Curl of a vector point functions | A | 15 | 2 | R,U | | 3 | 1 | 2 |
| | Irrotational and Solenoidal vector fields | A | 15 | 2 | R,U | | 2 | 1 | 2 |
| | Green's theorem in a plane | A | 16 | 2 | R,U | | 4 | 1 | 4 |
| | Gauss divergence theorem | A | 16 | 2 | R,U | | 4 | 1 | 4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Stoke's theorem | A | 16 | 2 | R,U | | 4 | 1 | 4 |
| III | **COMPLEX VARIABLES** | | | | | | | | |
| | Functions of complex variable – Analytic functions- Necessary and Sufficient conditions | A | 2 | 3 | R,U | 12 | 2 | 2 | 0 |
| | Harmonic Function –Construction of Analytic functions by Milne-Thomson method | A | 22 | 3 | R,U | | 2 | 1 | 0 |
| | Laurent's Series and Singularities | A | 23 | 1 | R | | 2 | 1 | 1 |
| | Cauchy's theorem – Cauchy's integral formula (concept only) | A | 24 | 1 | R | | 1 | 1 | 2 |
| | Residues – Calculus of Residues – Cauchy Residue theorem | A | 24 | 4 | R,U | | 4 | 2 | 2 |
| IV | **LAPLACE TRANSFORM** | | | | | | | | |
| | Laplace transform – Conditions for existence - Transform of elementary functions | A | 12 | 3 | R | 12 | 2 | 1 | 4 |
| | First shifting theorem – Laplace transform of $tf(t) and\ \frac{f(t)}{t}$ | A | 12 | 3 | R,U | | 2 | 1 | 4 |
| | Transform of derivatives and integrals | A | 12 | 1 | R,U | | 2 | 1 | 2 |
| | Inverse Laplace transforms by Method of partial fractions | A | 12 | 2 | U | | 4 | 1 | 4 |
| | Inverse Laplace transforms by Convolution Method | A | 12 | 1 | R,U | | 4 | 1 | 4 |
| | Laplace transforms of periodic functions | A | 12 | 2 | R,U | | 5 | 1 | 5 |
| V | **NUMERICAL SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS** | | | | | | | | |
| | Solution of non linear equations by Regula-Falsi Method | B | 22 | 2 | R,U | 12 | 5 | 2 | 5 |
| | Newton-Raphson method | B | 22 | 2 | R,U | | 5 | 1 | 5 |
| | Solution of linear systems of equations by direct methods - Gauss Elimination and Gauss-Jordan Methods | B | 22 | 2 | R,U | | 3 | 1 | 5 |
| | Indirect method - Gauss-Seidal Method | B | 22 | 2 | U | | 4 | 1 | 5 |
| | Eigen Values by Power Method | A | 32 | 2 | U | | 4 | 1 | 3 |
| | Jacobi Method | B | 22 | 2 | U | | 3 | 1 | 3 |

**Bloom's Legends:**

**R-**Remembering **U-**Understanding **AP-**Applying
**A-**Analyzing **C-**Creating **E –** Evaluating

## 7. TEXT BOOKS


A. Ramana B.V, 'Higher Engineering Mathematics', Tata McGraw Hill Publishing Company, New Delhi, 2011.
B. N.P.Bali,Dr.ManishGoyal, 'Engineering Mathematics' Eighth Edition, Laxmi Publications (P) Ltd,2011.

**REFERENCE BOOKS**


C. Grewal, B. S., ' Higher Engineering Mathematics',39th Edition, Khanna Publishers, New Delhi, 2006.

D. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India,2006.

E. Jain, M.K., Iyengar, S.R.K and Jain R.K., 'Numerical Methods for Scientific and Engineering Computation', New Age international Publishers, New Delhi, 2012.


**8. Assessing Level of Bloom's Taxonomy in Numbers:**

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 2 | 4 | 0 | 0 | 0 | 0 | 6 |
| **UNIT II** | 6 | 6 | 0 | 0 | 0 | 0 | 12 |
| **UNIT III** | 5 | 3 | 0 | 0 | 0 | 0 | 8 |
| **UNIT IV** | 5 | 5 | 0 | 0 | 0 | 0 | 10 |
| **UNIT V** | 3 | 6 | 0 | 0 | 0 | 0 | 9 |
| | | | | | | **TOTAL** | **45** |

**9. Weightage of Bloom's Taxonomy in the Syllabus**

| | R | U | AP | A | E | C | TOTAL ( %) |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 4.4 | 8.9 | 0 | 0 | 0 | 0 | 13.3 |
| **UNIT II** | 13.3 | 13.3 | 0 | 0 | 0 | 0 | 26.7 |
| **UNIT III** | 11.1 | 6.7 | 0 | 0 | 0 | 0 | 17.8 |
| **UNIT IV** | 11.1 | 11.1 | 0 | 0 | 0 | 0 | 22.2 |
| **UNIT V** | 6.7 | 13.3 | 0 | 0 | 0 | 0 | 20.0 |
| **TOTAL** | 46.6 | 53.3 | 0 | 0 | 0 | 0 | 100 |
| **Lower Order Thinking (%)** | | | | **100 %** | | | |
| **Higher Order Thinking (%)** | | | | **NIL** | | | |

**10. Expected outcome of the course:**

***Upon successful completion of this course, the student will be able to***:

**CO1**. Solve Ordinary Differential Equations analytically and numerically, which are very useful in wave and heat equations, fluid flow problems in Engineering.

**CO2**. Apply the concept of Green's, Gauss and Stokes's theorems which arise in Fluid mechanics, Thermal Engineering and Aerodynamics.

**CO3.**Apply problem solving techniques in differential calculus, which come across in wide range of Engineering and Scientific problems.

**CO4.**Apply Laplace transform as a tool for solving Engineering problems.

**11. Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | AP | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √ | √ | √√ | | | |
| **CO2** | √ | √ | √ | | | |
| **CO3** | | √ | √√ | | | |
| **CO4** | | √ | √√ | | | |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | | | | | | | | | | | |
| **CO2** | √√ | | | | | | | | | | | |
| **CO3** | √√ | | | | | | | | | | | |
| **CO4** | √√ | | | | | | | | | | | |

**13. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √√ | | | | | | | | | |
| **CO2** | √√ | √√ | | | | | | | | | |
| **CO3** | √√ | √√ | | | | | | | | | |
| **CO4** | √√ | √√ | | | | | | | | | |

**14. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| **CO1** | √√ | √ | | | |
| **CO2** | √√ | √ | | | |
| **CO3** | √√ | √ | | | |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UE303 | STATICS AND DYNAMICS | 2 | 2 | 0 | 3 |

**1. Course pre-requisites** : Basic mathematics and principles of Physics.

**2. Course learning objectives** :

i) To develop skills of students in applying the scalar and vector analytical techniques for determining forces in multi-force member structures

ii) To prepare the students for applying the center of gravity concept and predict the behaviour of particles and rigid bodies under motion.

**3. Expected Level of Output** : Conceptual Level through solving application problems

**4. Department Offered** : **Mechatronics Engineering**

**5. Nature of the Course** : Group B – 100% Analytical

**Continuous Internal Assessment (CIA)** : **40 Marks**

**Semester End Examination (SEE)** : **60 Marks**

**6. Course Input** :

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **Basics and Statics of particles** | | | | | | | | |
| | Introduction-UnitsandDimensions-LawsofMechanics– vector operations of forces –Parallelogram law, triangle rule and polygon ruleofforces - principle of transmissibility | A,B | 2,3 | 3 | U | 9 | 5 | 4 | 5 |
| | Resolution andCompositionofforces | A,B | 2 | 2 | E | | 5 | 5 | 4 |
| | CoplanarForces -Equilibrium ofaparticle | A,B | 2 | 2 | E | | 5 | 5 | 4 |
| | Forcesinspace-Equilibriumofaparticleinspace | A,B | 2 | 2 | E | | 5 | 5 | 5 |
| II | **Statics of rigid bodies and Friction** | | | | | | | | |
| | Moment of a force about a point and an axis – Varignon's theorem – Equivalent force-couple system – resultant of a force system | A,B | 3 | 2 | AP | 9 | 5 | 5 | 5 |
| | Free body diagram- types of supports – action and reaction forces - Distributed loads on beams, Equilibrium of rigid bodies in two dimensions | A,B | 4 | 2 | E | | 5 | 5 | 5 |
| | Analysis of a frame | A | 6 | 1 | E | | 4 | 4 | 4 |
| | Friction force - Laws of Coulomb friction | A,B | 8 | 1 | A | | 5 | 5 | 5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| II | – simple contact friction problems | | | | | | | | |
| | Belt Friction | A,B | 8,6 | 1 | E | | 5 | 5 | 4 |
| | Screw Jack | B | 6 | 1 | E | | 5 | 3 | 4 |
| | Theory of rolling friction | A | 8 | 1 | E | | 4 | 3 | 3 |
| III | **Center of gravity and moments of inertia** | | | | | | | | |
| | Centroids of common shapes of Areas -rectangle, triangle, circle and semi-circle – T section, I section, Angle section, Hollow section by using Standard formula | A | 5 | 3 | E | 9 | 5 | 5 | 4 |
| | Second moments of plane area – Rectangle, triangle, circle and semi-circle -T section, I section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia. Theorem of Pappus | A,B | 9, 7 | 3 | E | | 5 | 5 | 4 |
| | Center of gravity of three dimensional composite bodies using standard formula Mass moment of inertia for prismatic, cylindrical and spherical solids (formulae only) – Relation to area moments of inertia | A | 5 | 3 | E | | 5 | 5 | 5 |
| IV | **Dynamics of Particles** | | | | | | | | |
| | Displacements, Velocity and acceleration, their relationship in rectilinear motion | A | 11 | 1 | AP | 9 | 4 | 5 | 0 |
| | Motion of several particles | A | 11 | 1 | E | | 5 | 4 | 5 |
| | Curvilinear motion – Cartesian coordinates-application to projectile motion, tangential and normal coordinates- simple problems | A | 11 | 2 | E | | 5 | 5 | 5 |
| | Newton's second law of motion | A | 12 | 1 | AP | | 5 | 5 | 3 |
| | Work Energy Equation– Impulse and Momentum | A,B | 13,11 | 2 | AP | | 5 | 5 | 4 |
| | Direct central impact of elastic bodies | A | 13 | 2 | E | | 5 | 5 | 4 |
| V | **Elements of Rigid body Dynamics** | | | | | | | | |
| | Translation and Rotation of Rigid Bodies – Fixed axis rotation- Velocity and acceleration | A,B | 15,13 | 3 | E | 9 | 5 | 5 | 4 |
| | General Plane motion of slider crank mechanism – velocity and acceleration | A | 15 | 2 | E | | 5 | 4 | 4 |
| | Equations of motion and angular momentum of a rigid body in plane motion. Eulerian angles (qualitative treatment only) | A | 16,18 | 4 | AP | | 5 | 4 | 4 |

| | |
|---|---|
| **Statics** | **Unit- I, II, III** |
| **Dynamics** | **Unit –IV, V** |

**Bloom's Legends:**

**R-**Remembering **U-**Understanding **AP-**Applying
**A-**Analyzing **E –** Evaluating **C-**Creating

## 7. TEXT BOOKS

**A.** F.P.BeerandJr.E.RJohnston, "VectorMechanicsforEngineers–StaticsandDynamics", 9th edition, Tata McGrawHillPublishingCompany,NewDelhi,2009.

**B.** IrvingH.Shames and Krishna MohanaRao G, "EngineeringMechanics – Staticsand Dynamics", Fourth edition, Eighth impression, PearsonEducation, AsiaPvt.Ltd.,2011.

**Reference Book**

**C.** Hibbler R.C. and Ashok Gupta, "Engineering Mechanics: Statics and dynamics", 11th edition, Pearson Education, 2010

**D.** J. L. Meriam and Kraige L.G. , "Engineering Mechanics: statics and dynamics", 7th edition, John Willey and Son's publication, 2011

**E.** Kumar K.L., "Engineering Mechanics", S.K. Kataria& Sons Publications, 2010

## 8. Assessing Level of Bloom's Taxonomy in Numbers:

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 0 | 1 | 0 | 0 | 3 | 0 | 4 |
| **UNIT II** | 0 | 0 | 1 | 1 | 5 | 0 | 7 |
| **UNIT III** | 0 | 0 | 0 | 0 | 3 | 0 | 3 |
| **UNIT IV** | 0 | 0 | 3 | 0 | 3 | 0 | 6 |
| **UNIT V** | 0 | 0 | 1 | 0 | 2 | 0 | 3 |
| **TOTAL** | | | | | | | **23** |

## 9. Weightage of Bloom's Taxonomy in the Syllabus

| | R | U | AP | A | E | C | TOTAL ( %) |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 0 | 4.35 | 0 | 0 | 13.05 | 0 | 17.4 |
| **UNIT II** | 0 | 0 | 4.35 | 4.35 | 21.75 | 0 | 30.44 |
| **UNIT III** | 0 | 0 | 0 | 0 | 13.05 | 0 | 13.05 |
| **UNIT IV** | 0 | 0 | 13.00 | 0 | 13.05 | 0 | 26.05 |
| **UNIT V** | 0 | 0 | 4.35 | 0 | 8.70 | 0 | 13.05 |
| **TOTAL** | 0 | 4.35 | 21.70 | 4.35 | 69.6 | 0 | 100 |
| **Lower Order Thinking (%)** | | | | **26.05 %** | | | |
| **Higher Order Thinking (%)** | | | | **73.95 %** | | | |

## 10. Expected outcome of the course:

Upon successful completion of this course, the student will be able to:

CO1 Define the law of mechanics and various theorems.
CO2 Understand the importance of centre of gravity and various moment of inertia
CO3 Apply the fundamental concepts of kinematics and kinetics of particles and rigid bodies along with equilibrium condition in solving engineering problems
CO4 Analyze forces in any structures and rigid body subjected to dynamic forces

**11. Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | AP | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √ | | √ | √ | | |
| **CO2** | | √ | | | √ | |
| **CO3** | | | | √√ | | |
| **CO4** | | | | | √ | |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | | | | √ | | | | | √ | | √ |
| **CO2** | √√ | | √√ | | √ | | √ | √ | | √ | √ | √ |
| **CO3** | √√ | | | | | √ | √ | √ | | | √ | |
| **CO4** | √√ | | √ | √√ | | | | | | | | |

**13. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √√ | √ | | √ | √ | | √ | √ | √ | |
| **CO2** | √√ | | | | √ | √ | | | | √ | |
| **CO3** | √√ | | | | | √ | √ | | | √ | √ |
| **CO4** | | √√ | | √ | √ | | √ | | | | √ |

**14. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| **CO1** | √√ | √ | | √ | |
| **CO2** | √√ | √ | | | √ |
| **CO3** | √√ | √ | √ | | √ |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UE304 | PRODUCTION TECHNOLOGY | 3 | 0 | 0 | 3 |

1. **Course pre-requisites:** 15UC101 TECHNICAL DRAWING
   15UH203 ENGINEERING CHEMISTRY

2. **Course learning objectives :**

   i. To understand the fundamentals and various methods of manufacturing process.
   ii. To develop the knowledge about the working principles of machines.
   iii. To understand the modern manufacturing operations, including their capabilities, limitations, and how to design for lower cost.
   iv. To learn how to analyze products and be able to improve their manufacturability and lower cost.
   v. To understand the relationship between customer desires, functional requirements, product materials, product design, and manufacturing process selection.

3. **Expected Level of Output** **:** Conceptual Level

4. **Department Offered** **:** Mechatronics Engineering

5. **Nature of the Course** **:** Group C – 80% Descriptive & 20% Analytical

**Continuous Internal Assessment (CIA)** **: 40 Marks**
**Semester End Examination (SEE)** **: 60 Marks**

6. **Course Input** **:**

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **METAL CASTING PROCESSES** | | | | | | | | |
| | Introduction to casting and Patterns | A | I - 11 | 2 | U | 9 | 4 | 2 | 4 |
| | Moulding and Moulding sand | A | I - 11 | 1 | R | | 4 | 2 | 2 |
| | Cores & Core making | A | I - 11 | 1 | R | | 4 | 2 | 4 |
| | Melting Furnaces | A | I - 11 | 1 | AP | | 4 | 2 | 2 |
| | Special casting process, shell mould casting | A | I - 11 | 2 | U | | 4 | 2 | 4 |
| | Die casting, Investment casting and Centrifugal casting | A | I - 11 | 1 | U | | 4 | 2 | 4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Casting Defects | A | I - 11 | 1 | E | | 4 | 2 | 4 |
| II | **METAL FORMING PROCESSES** | | | | | | | | |
| | Hot and cold working rolling | A | I - 7 | 1 | R | 9 | 4 | 3 | 4 |
| | Rolling mills and Rolling operations | A | I - 7 | 2 | U | | 4 | 3 | 3 |
| | Production of seamless tubing and pipe | A | I - 7 | 1 | U | | 4 | 3 | 3 |
| | Forging: Related Forging Operations and Drop forging | A | I - 8 | 1 | U | | 4 | 3 | 4 |
| | Extrusion and types | A | I - 8 | 1 | A | | 4 | 2 | 4 |
| | Drawing process | A | I - 8 | 1 | A | | 4 | 2 | 4 |
| | Sheet metal operations | B | 16 | 2 | C | | 4 | 3 | 4 |
| III | **METAL JOINING PROCESSES** | | | | | | | | |
| | Welding Equipments, power requirement - Electrode Types – Specification | A | I - 9 | 1 | A | 9 | 4 | 3 | 4 |
| | Gas welding, basic arc welding processes | A | I - 9 | 2 | A | | 4 | 3 | 5 |
| | Thermit welding | A | I - 9 | 1 | U | | 3 | 3 | 3 |
| | Laser, electron beam welding Plasma Arc | A | I - 9 | 1 | U | | 4 | 3 | 3 |
| | Ultrasonic, Friction welding | A | I - 9 | 1 | U | | 3 | 3 | 4 |
| | Welding Defects - welding inspection and testing | A | I - 9 | 1 | A | | 3 | 3 | 3 |
| | Soldering & Brazing. | A | I - 9 | 2 | E | | 5 | 3 | 5 |
| IV | **CONVENTIONAL METAL REMOVAL PROCESSES** | | | | | | | | |
| | Lathe and lathe operations | A | II - 3 | 2 | U | 9 | 4 | 3 | 4 |
| | Lathe process parameters | A | II - 3 | 1 | AP | | 4 | 3 | 2 |
| | Drilling and drilling machines | A | II - 5 | 2 | U | | 3 | 3 | 2 |
| | Drilling process parameters | A | II - 5 | 1 | AP | | 4 | 3 | 3 |
| | Reaming and Tapping | A | II - 5 | 1 | U | | 2 | 3 | 3 |
| | Shaping | A | II - 7 | 1 | AP | | 3 | 3 | 4 |
| | Planning | A | II - 8 | 1 | AP | | 3 | 3 | 4 |
| V | **SPECIALIZED METAL REMOVAL PROCESSES** | | | | | | | | |
| | Milling and milling operations | A | II - 11 | 2 | AP | 9 | 4 | 3 | 4 |
| | Broaching | A | II - 15 | 1 | U | | 4 | 3 | 3 |
| | Gear hobbing | A | II - 12 | 1 | U | | 3 | 3 | 3 |
| | Grinding process – abrasives | A | II - 10 | 1 | AP | | 4 | 3 | 4 |
| | Grinding Wheel types and Specifications | A | II - 10 | 1 | AP | | 4 | 3 | 2 |
| | Selection of Grinding wheel for different applications | A | II - 10 | 1 | A | | 4 | 3 | 3 |
| | Finishing operations-lapping, honing and burnishing | A | II - 16 | 2 | U | | 3 | 3 | 4 |

**Bloom's Legends:**

**R-**Remembering **U-**Understanding **AP-**Applying

**A-**Analyzing **E –** Evaluating **C-**Creating

## 7. TEXT BOOKS

A. HajraChoudhury, “Elements of Workshop Technology”, Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2012.

B. Kalpakjian, “Manufacturing Engineering and Technology”, 4th edition, Addison Wesley CongmenPvt. Ltd., Singapore, 2013.

**REFERENCE BOOKS**

C. Jain.R.K, “Production Technology: Manufacturing Processes, Technology and Automation”, 17th Edition, Khanna Publishers, 2011.

D. Sharma.P.C, “Production Technology: Manufacturing Processes”, 7th Edition, S. Chand Publisher, 2008.

E. Chapman.W.A.J, “Workshop Technology Vol. I and II”, Arnold Publisher, New Delhi, 2001.

**WEB RESOURCES**

a. https://www.youtube.com/watch?v=oxMdDsud5vg

b. https://www.youtube.com/watch?v=ayg2vt25XiY

c. http://www.mechindia.com/BurnishingProcess.html

## 8. Assessing Level of Bloom’s Taxonomy in Numbers:

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 2 | 3 | 1 | 0 | 1 | - | 7 |
| **UNIT II** | 1 | 3 | - | 2 | - | 1 | 7 |
| **UNIT III** | - | 3 | - | 3 | 1 | - | 7 |
| **UNIT IV** | - | 3 | 4 | - | - | - | 7 |
| **UNIT V** | - | 3 | 3 | 1 | - | - | 7 |
| | | | | | | **TOTAL** | **35** |

## 9. Weightage of Bloom’s Taxonomy in the Syllabus

| | R | U | AP | A | E | C | TOTAL ( %) |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 5.71 | 8.57 | 2.86 | 0 | 2.86 | 0 | 20 |
| **UNIT II** | 2.86 | 8.57 | 0 | 5.71 | 0 | 2.86 | 20 |
| **UNIT III** | 0 | 8.57 | 0 | 8.57 | 2.86 | 0 | 20 |
| **UNIT IV** | 0 | 8.57 | 11.43 | 0 | 0 | 0 | 20 |
| **UNIT V** | 0 | 8.57 | 8.57 | 2.86 | 0 | 0 | 20 |
| **TOTAL** | 8.57 | 42.85 | 22.86 | 17.14 | 5.72 | 2.86 | 100 |
| **Lower Order Thinking (%)** | | | | **74.28 %** | | | |
| **Higher Order Thinking (%)** | | | | **25.72 %** | | | |

## 10. Expected outcome of the course:

Upon successful completion of this course, the student will be able to:

**CO1:** Justify the most appropriate manufacturing process and material for a given product.

**C02 :** Interpret how a machine works.

**C03 :**Perform a range of manufacturing processes.

**C04 :** Design the process parameters for different manufacturing processes.

**11. Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | AP | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √ | √ | √ | | | |
| **CO2** | √ | √ | √ | √ | | |
| **CO3** | | √ | √ | √ | √ | |
| **CO4** | | | | √ | √ | √ |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | | √√ | √√ | √√ | | √ | | √ | | √ | √√ |
| **CO2** | √√ | √√ | √√ | √ | √√ | | | | √ | | | √√ |
| **CO3** | √√ | √√ | √√ | √√ | | √ | √ | √ | √ | √ | | √ |
| **CO4** | √√ | √√ | √√ | | | √ | √ | | | | | √√ |

**13. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √ | √√ | √√ | √√ | √√ | √ | | √ | √√ | | √√ |
| **CO2** | √√ | √√ | √√ | √√ | √√ | | | | √√ | | √√ |
| **CO3** | √√ | √√ | √√ | √√ | √√ | | | | √√ | | √√ |
| **CO4** | √√ | √√ | √√ | √√ | √√ | √ | √ | √ | √ | √ | √√ |

**14. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| **CO1** | √√ | √√ | √ | √ | √ |
| **CO2** | √√ | √√ | | | |
| **CO3** | √√ | √√ | | √ | |
| **CO4** | √√ | √√ | | √ | |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UE305 | FUNDAMENTALS OF ELECTRICAL CIRCUITS AND ELECTRON DEVICES | 3 | 0 | 0 | 3 |

1. **Course pre-requisites** : NIL

2. **Course learning objectives** :

The subject is intended to

a. Familiarize the mechatronics engineering students with the basic concepts of AC and DC circuits and its associated theorems.
b. Provide the concepts, characteristics and applications of various semiconductor devices, operational amplifiers and oscillators.

3. **Expected Level of Output** : Conceptual Level

4. **Department Offered** : Mechatronics Engineering

5. **Nature of the Course** : Group C – 80 % Descriptive & 20 % Analytical

**Continuous Internal Assessment (CIA)** : **40 Marks**
**Semester End Examination (SEE)** : **60 Marks**

6. **Course Input** :

| Unit No | Name Of The Topic | Text / Ref Books | Chapter No | Instructional Hours | Level of Bloom's Taxonomy | Course Assessment Factors | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | F1 | F2 | F3 | F4 |
| I | **CIRCUIT ANALYSIS TECHNIQUES** | | | | | | | | |
| | Passive and active elements, Ohm's law | A | 2 | 1 | U | 9 | 4 | 5 | 3 |
| | Kirchhoff's laws, Circuit elements in series and parallel, Voltage division, Current division | A | 3 | 2 | A | | 4 | 5 | 3 |
| | Star-delta conversion, Branch current method, Mesh current method, Node voltage Method, | D | 8 | 3 | A | | 4 | 5 | 3 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Network theorems: Thevenin, Norton, Superposition, Maximum power transfer and duality. | A | 4 | 3 | E | | 3 | 4 | 3 |
| II | **TRANSIENTS AND RESONANCE IN RLC CIRCUITS** | | | | | | | | |
| | Step response of RL, RC and RLC circuits | A | 7 | 2 | E | 9 | 3 | 3 | 2 |
| | Fundamentals of A. C. | A | 10 | 2 | U | | 5 | 3 | 3 |
| | Concept of phasor - L, C, RL, RC, RLC circuits excited by A. C | A | 9 | 3 | U | | 5 | 3 | 3 |
| | Parallel and series resonance and their applications. | A | 12 | 2 | E | | 4 | 4 | 3 |
| III | **SEMICONDUCTOR DEVICES** | | | | | | | | |
| | PN junction diode - Volt-ampere characteristics- | B | 6 | 1 | E | | 5 | 3 | 4 |
| | Zener diode and its characteristics. | B | 6 | 1 | U | | 5 | 4 | 4 |
| | PNP and NPN transistors - Principle of operation - CE, CC and CB configurations | B | 9 | 2 | E | 9 | 5 | 4 | 4 |
| | JFET - Principle of operation - N-channel and P-channel types | B | 14 | 2 | E | | 4 | 3 | 2 |
| | MOSFET - Principle of operation - Enhancement and depletion types | B | 14 | 2 | E | | 4 | 4 | 4 |
| | Comparison of BJT with MOSFET. | B | 14 | 1 | E | | 4 | 4 | 4 |
| IV | **SPECIAL SEMICONDUCTOR DEVICES** | | | | | | | | |
| | SCR - Two-transistor equivalent model - Volt-ampere characteristics - DIAC – TRIAC | E | 8 | 5 | E | 9 | 4 | 3 | 3 |
| | UJT-Light-emitting diode, Photo diode, Phototransistor | B | 14 | 1 | U | | 3 | 3 | 3 |
| | Photoconductive cell, Photo voltaic cell-Half wave and Full wave Rectifiers using Diode. | B,C | 19,18 | 3 | U | | 5 | 3 | 3 |
| V | **OPERATIONAL AMPLIFIERS & OSCILLATORS** | | | | | | | | |
| | Basics of Integrated Circuits-Advantages of IC's over discrete components | C | 7 | 2 | E | 9 | 3 | 3 | 2 |
| | IC 741 Op-amp-Block diagram-Characteristics -Inverting and Non-inverting amplifier | C | 10 | 3 | U | | 5 | 3 | 3 |
| | A general form of Oscillator circuit, - Phase shift Oscillator, LC oscillators | C | 9 | 2 | U | | 5 | 3 | 3 |
| | Resonant Circuit Oscillator- Crystal Oscillators. | C | 12 | 2 | E | | 4 | 4 | 3 |

**Bloom's Legends:**

**R-**Remembering **U-**Understanding **AP-**Applying

**A-**Analyzing **E –** Evaluating **C-**Creating

## 7. TEXT BOOKS

A. Joseph A. Edminister, Mahmood, Nahri, “Electric Circuits” – Schaum series, Tata McGraw Hill, 5th edition, 2010

B. J. Millman&Halkins, SatyebrantaJit, “Electronic Devices & Circuits”, Tata McGraw Hill, 3rd Edition, 2010.

C. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, “Electronic Devices and Circuits”, Tata McGraw Hill, 2nd edition, 2008.

### REFERENCE BOOKS

D. David A. Bell, “Electronic Device and Circuits”, Oxford University Press, 3rd edition, 2012.

E. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis theory and Practice”, Delmar Publishers, 5th edition, 2013.

### WEB RESOURCES

1. **Video Lectures 1-40**
   http://nptel.ac.in/video.php?subjectId=108108076

2. **Video Lectures modules 1-5**
   http://nptel.ac.in/video.php?subjectId=117103063

## 8. Assessing Level of Bloom’s Taxonomy in Numbers:

| | R | U | AP | A | E | C | TOTAL |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 0 | 1 | 0 | 2 | 1 | 0 | 4 |
| **UNIT II** | 0 | 2 | 0 | 0 | 2 | 0 | 4 |
| **UNIT III** | 0 | 1 | 0 | 0 | 2 | 0 | 3 |
| **UNIT IV** | 0 | 0 | 0 | 0 | 4 | 0 | 4 |
| **UNIT V** | 0 | 2 | 0 | 0 | 1 | 0 | 3 |
| | | | | | | **TOTAL** | **18** |

## 9. Weight age of Bloom’s Taxonomy in the Syllabus

| | R | U | AP | A | E | C | TOTAL ( %) |
|---|---|---|---|---|---|---|---|
| **UNIT I** | 0.00 | 5.56 | 0.00 | 11.11 | 5.56 | 0.00 | 22.22 |
| **UNIT II** | 0.00 | 11.11 | 0.00 | 0.00 | 11.11 | 0.00 | 22.22 |
| **UNIT III** | 0.00 | 5.56 | 0.00 | 0.00 | 11.11 | 0.00 | 16.67 |
| **UNIT IV** | 0.00 | 0 | 0.00 | 0.00 | 22.22 | 0.00 | 22.22 |
| **UNIT V** | 0.00 | 11.11 | 0.00 | 0.00 | 5.56 | 0.00 | 16.67 |
| **TOTAL** | 0.00 | 33.34 | 0.00 | 11.11 | 55.55 | 0.00 | 100 |
| **Lower Order Thinking (%)** | | | | 33.34 % | | | |
| **Higher Order Thinking (%)** | | | | 66.67 % | | | |

## 10. Expected outcome of the course:

Upon successful completion of this course, the student will be able to:

**CO1**. Define the basic laws of Electric circuits

**CO2**. Explain, analyze and apply the various theorems and concepts of electric circuits

**CO3**. Explain the fundamentals of semiconductor devices

**CO4**. Explain the operation of operational amplifier and different types of oscillators

**11. Mapping course outcome with Bloom's Taxonomy LOT and HOT:**

| | R | U | AP | A | E | C |
|---|---|---|---|---|---|---|
| **CO1** | √ | | | | | |
| **CO2** | | √ | √ | | | |
| **CO3** | | √ | | | | |
| **CO4** | | √ | | √ | √ | |

**12. Mapping Course outcome with graduate attributes:**

| | GA1 | GA2 | GA3 | GA4 | GA5 | GA6 | GA7 | GA8 | GA9 | GA10 | GA11 | GA12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | | √ | | | | | | | | | |
| **CO2** | √√ | √√ | √ | √ | | | | | | | | |
| **CO3** | √√ | | √ | | | √ | | | | | | √ |
| **CO4** | √√ | √ | √ | √ | | | | | | | | √ |

**13. Mapping course outcome with programme outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | √√ | √ | √ | | √ | √ | | | | | √ |
| **CO2** | √√ | √ | √ | | √ | √ | | | | | √ |
| **CO3** | √√ | √ | √ | | √ | √ | | | | | √ |
| **CO4** | √√ | √ | √ | | √ | √ | | | | | √ |

**14. Mapping with Programme Educational Objectives:**

| | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| **CO1** | √√ | √ | √ | | √ |
| **CO2** | √√ | √ | √ | | √ |
| **CO3** | √√ | √ | √ | | √ |
| **CO4** | √√ | √ | √ | | √ |

| | | | |
|---|---|---|---|
| √√ | Strongly agreed | √ | Moderately agreed |

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UH251 | PHYSICAL SCIENCE LABORATORY (Common to all B.E./B.Tech.) | 0 | 0 | 4 | 2 |

1. **Course pre-requisites** : NIL

2. **Course learning objectives** :
   i) To provide exposure to the students with hands-on experience on scientific equipments.
   ii) Enhancement of student in developing analytical skills through instrumental analysis.

3. **Expected Level of Output** : Conceptual Level

4. **Department Offered** : Science & Humanities

5. **Nature of the Course** : Group E – Practical

**Continuous Internal Assessment (CIA) : 40 Marks**
**Semester End Examination (SEE) : 60 Marks**

6. **List of Experiments:**

**Part – A (Physics Laboratory)**

1. i.Determination of laser parameters – Wavelength and angle of divergence
   ii.Particle size determination using diode laser.
   iii. Determination of acceptance angle in an optical fiber
2. Determination of Band gap of a Semi conducting material.
3. Determination wavelength of mercury spectrum - spectrometer
4. Determination of thermal conductivity of a bad conductor – Lee's disc method.
5. Determination of coefficient of viscosity of liquid – Poiseuille's Method
6. Determination of Young's modulus by cantilever method
7. Determination the specific resistance of the given coil – Carey Foster Bridge.
8. Determination of efficiency of a solar cell.
9. Determination of Young's modulus of the materials – Uniform bending
10. Determination of lattice constant X-ray powder photograph.
11. Determination of Rigidity modulus of a wire - Torsion Pendulum
12. Determination the dispersive power of a prism – Spectrometer.

**Part – B (Chemistry Laboratory)**

1. Determination of strength of given acid by pH meter.
2. Conductometric titration of strong acid with strong base.
3. Determination of strength of acids in a mixture (HCl&CH3COOH) using conductivity meter.
4. Potentiometric titration of Ferrous ion using Potassium dichromate.
5. Determination of Single Electrode Potential of an electrode.
6. Estimation of Iron (II) content by Spectrophotometer.

7. Determination of hardness of water by EDTA method
8. Estimation of Calcium ions and Magnesium ions by EDTA method.
9. Estimation of alkalinity of water sample.
10. Determination of Chloride in water by Argent metric method.
11. Determination of Dissolved Oxygen in waste water using Winkler's titrimetry method.
12. Estimation of Copper content of the given solution by EDTA method.

***ANY TEN EXPERIMENTS SHALL BE OFFERED OUT OF TWELVE IN PHYSICS AND CHEMISTRY LABORATORY***

**7. Expected outcome of the course:**

The student will be able to,

**CO1:** Conversant with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

**CO2**: Operate physics instruments like spectrometer, travelling microscope and solar cell

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UE352 | BASIC ENGINEERING LABORATORY | 0 | 0 | 2 | 1 |

1. **Course pre-requisites** **:** NIL

2. **Course learning objectives** **:**

   - To provide fundamental knowledge and hands on experience to the students on various basic engineering practices in Mechanical, Electrical and Electronics Engineering

3. **Expected Level of Output** **: Practical**

4. **Department Offered** **:** Mechatronics Engineering

5. **Nature of the Course** **:** Group E - Practical

**Continuous Internal Assessment (CIA)** **: 40 Marks**
**Semester End Examination (SEE)** **: 60 Marks**

6. **List of Experiments:**

**GROUP A (MECHANICAL)**

**MECHANICAL ENGINEERING PRACTICE**

**Sheet Metal:**

1. Study of tools, equipments and safety precautions.
2. Different types of joints - knocked up, double grooving joints.
3. Model making –Tray, Dust pan and Funnel.

**Welding:**

4. Study of tools, equipments and safety precautions.
5. Arc welding practice - butt joint, lap joints and tee joints.
6. Demonstration of gas welding.

**Foundry:**

7. Introduction to casting.
8. Study of tools.
9. Study of furnace.
10. Demonstration of moulding.

## GROUP B (ELECTRICAL & ELECTRONICS)

### ELECTRICAL ENGINEERING PRACTICE

I. Study of symbols & Safety aspects of electrical wiring.
2. Basic household wiring using switches, fuse, indicator - lamp, etc.
3. Preparation of wiring diagrams - Staircase wiring &Fluorescent lamp wiring
4. Measurement of energy using single phase energy meter
5. Measurement of electrical quantities voltage, current, power and energy in a RLC circuit
6. Verification of Thevenin theorem and ohms law
7. Study of iron box, fan with regulator.

### ELECTRONICSENGINEERING PRACTICE

1. Study of rating of Resistors with colour coding; Study of capacitors and inductors.
2. Diode and Zener diode characteristics.
3. SCR as an amplifier and switch.
4. Transistor characteristics (CE configuration).
5. Electronic circuit design using PSPICE software:
    a. Half wave Rectifier
    b. Full wave Rectifier
    c. RC,LC Oscillator circuit

**Examination Pattern:** The Examination is to be conducted for both groups A & B, allotting 1½ hours for each group.

**7. Expected outcome of the course:**

The student will be able to,

**CO1:** Perform various basic engineering practices.

**CO2:**Select appropriate tools for solving a given problem.

**CO3:** Apply the practical knowledge to design simple mechanical and simple Electrical wiring circuit.

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15UE151 | CRITICAL AND CREATIVE THINKING | 0 | 0 | 2 | 1 |

1. **Course pre-requisites** **:** NIL

2. **Course learning objectives** **:**

Ability to

i. Analyze complex issues and make informed decisions;
ii. Synthesize information in order to arrive at reasoned conclusions;
iii. Evaluate the logic, validity, and relevance of data;
iv. Solve challenging problems; and
v. Use knowledge and understanding in order to generate and explore new creativity exercises.

3. **Expected Level of Output** **: Practical**

4. **Department Offered** **:** Mechatronics Engineering

5. **Nature of the Course** **:** Group H 100% Internal Mode

**Continuous Internal Assessment (CIA) : 100 Marks**

**Methodology:**

1. Students work in teams as assigned by instructor
2. Teams are presented with an exercise that includes an open ended problem to be solved.
3. Students determine the question to be answered and what information is needed.
4. Students gather the necessary information by team brainstorming
5. As a team, they discuss the information collected, suggest solutions, evaluate solutions, and present the team's conclusion.

**Note:** Students will be given roughly a week for each exercise

6. **List of Exercises:**

1. Solutions required for problems faced in chemical process industries.
   - Waste disposal schemes
   - Flow measurement techniques
   - Piping size calculations
   - Measurement of fluid properties

- Improving the energy economy of the process

2. Solutions required in Engineering processes
   - Carpentry
   - Fitting
   - Plumbing, etc.,
3. Solutions for societal needs/problems
4. Solutions required in automation and robotics
5. Solutions required in Mechatronics systems

A **case study on Mechatronics system** is to be submitted by each team at the end of the semester. Evaluation will be based on formal report detailing and documenting the solution to the project.

**7. Expected outcome of the course:**

**CO1:** Make the reason through given information and identify a solution approach to the problem

**CO2:** Solve an unseen problem

**CO3:** Create a brief project statement

**CO4:** Apply team-based skills to produce a solution to a project idea

**CO5:** Produce a formal report detailing their thought processes and documenting their solution

# SEMESTER III

**15MA103 FOURIER ANALYSIS AND STATISTICAL QUALITY CONTROL 3/2/0/4**

**PREREQUISITES:**

1. 15UH201- Mathematics I
2. 15UH204- Mathematics II

**COURSE OBJECTIVES**

1. To study the concept of mathematical formation of certain practical problems in terms of partial differential equations and solving for physical interpretation.
2. To understand the different possible forms of Fourier series and also the frequently needed practical harmonic analysis that an engineer may have to make from discrete data
3. To understand the concepts of Fourier transform and its inverse, their properties and the possible special cases with attention to their applications
4. To study the concept of fitting a curve of best fit to the given numerical data and to calculate the deviation of the expected value from the observed value

**COURSE OUTCOMES**

Upon successful completion of the course, students shall have ability to

1. Solve the engineering problems using PDE
2. Find Fourier series solution to the engineering problems
3. Fit a curve to the given numerical data

**UNIT 1 PARTIAL DIFFERENTIAL EQUATIONS 9**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions.

Lagrange's linear equations. Linear homogeneous partial differential equations of second and higher order with constant coefficients.

**UNIT 2 FOURIER SERIES 9**

Dirichlet's conditions - General Fourier Series – Odd and Even Functions. Half range sine series- Half range cosine series – Change of Interval .Parseval's Identity- Harmonic analysis.

**UNIT 3 FOURIER TRANSFORM 9**

Complex form of Fourier Transform –Properties. Fourier sine and cosine transforms-Properties. Transforms of simple functions. Convolution theorem and Parseval's Identity (excluding proof) Evaluation of integrals using Parseval's Identity.

**UNIT 4 CURVE FITTING AND REGRESSION ANALYSIS 9**

Empirical laws and curve fitting – linear law– principle of Least squares. Method of group averages-fitting straight line, fitting parabola and exponential curve. Covariance-Correlation coefficient-properties-Regression lines-properties.

**UNIT 5 STATISTICAL QUALITY CONTROL 9**

Quality control charts -quality variations-Variables and attributes-basics of control charts-warning limits – control charts for variables - $\overline{X} - R$ chart control charts for attributes. C chart - p- chart for fractional defectives. np chart -Advantages of control charts.

**LECTURE HOURS:45 TUTORIALS:15 TOTAL:60HRS**

**TEXT BOOKS:**


1. Grewal. B.S, “Higher Engineering Mathematics”, 43th Edition, Khanna Publications, Delhi, 2014.
2. Gupta, S.C, and Kapur, J.N., “Fundamentals of Applied Statistics”, Sultan Chand, 10th Edition, New Delhi,2000


**REFERENCE BOOKS:**


1. Kreyszig. E, “Advanced Engineering Mathematics”, Eighth Edition, John Wiley and Sons (Asia) Limited, Singapore, 2011.
2. P..Kandasamy, K.Thilagavathy, K.Gunavathy, “Probability, Statistics and Queuing Theory”,2008th edition ,S.Chand publications.


**WEB REFERENCES:**

1. http://nptel.ac.in/video.php?subjectId=122107037
2. http://nptel.ac.in/courses/112106064
3. http://nptel.ac.in/courses/111105042
4. http://nptel.ac.in/courses/110105039/22

**15ME306/ 15MT304** **STRENGTH OF MATERIALS** **2/2/0/3**

**Prerequisites:** 15UE303 – Statics and Dynamics, 15UE302 - Basic Mechatronics Engineering

**Course Objectives**

1. To impart knowledge on simple stresses, strains and deformation in components due to different loads.
2. To understand the concepts of beam , column and shafts
3. To understand the importance of Principal stresses
4. To get the basic knowledge of design courses.

**Course Outcomes**

1. Apply the concepts of mechanics of deformable solids in different applications.
2. Solve solid mechanics related engineering problems in systematic methods.
3. Determine mechanical properties of materials and structural elements by experiments and analyze/synthesize test results.

**UNIT 1 STRESS, STRAIN AND DEFORMATION OF SOLIDS 12**

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses and Strains; Tensile, Compressive and Shear – Hooke's law – Stress-strain diagram for ductile and brittle materials – Deformation of simple and compound bars under axial load – Thermal stress. Poisson's ratio – Elastic constants – relationship between elastic constants and Poisson's ratio.

**UNIT 2 BEAMS – LOADS AND STRESSES 12**

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams due to Point and Uniformly Distributed loads – Stresses in beams – Theory of simple bending. Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams.

**UNIT 3 TORSION 12**

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts. Torsion of non – circular members –Thin walled hollow shafts.

**UNIT 4 BEAM DEFLECTION AND COLUMNS 12**

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method and Macaulay Method – Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

**UNIT 5 STRAIN ENERGY AND BIAXIAL STRESSES 12**

Strain energy and unit strain energy – Strain energy in uniaxial loads. Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principle planes and stresses – Mohr's circle for biaxial stresses – Maximum shear stress.

**SELF STUDY:** Torsion of square shaft

**TOTAL: 60**

**TEXT BOOKS:**


1. Beer F. P. and Johnston R, “Mechanics of Materials”, McGraw-Hill Education, 7th Edition, 2014.
2. R.K.Bansal, “Strength of Materials”, Laxmi Publication, 6th Edition, 2015.


**REFERENCE BOOKS:**


1. Nash W.A, “Theory and problems in Strength of Materials”, Schaum Outline Series, McGraw-Hill Education, New York, 2005.
2. Kazimi S.M.A, “Solid Mechanics”, Tata McGraw-Hill Publishing Co, New Delhi, 2001
3. Popov E.P, “Engineering Mechanics of Solids”, Prentice-Hall of India, New Delhi, 2007.


**WEB REFERENCES:**

1. nptel.ac.in/courses/112107147/
2. ocw.mit.edu/courses/mechanical-engineering/2-001-mechanics-materials-i-fall-2006

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15MT305 | THERMAL AND FLUID ENGINEERING | 3 | 1 | 0 | 4 |

**Course pre-requisite** 15UH204 - Mathematics – II

**Course Objectives**

1. To understand the properties of the fluid and appreciate the complexities involved in solving the fluid flow problems.
2. To understand the laws and principles of thermodynamics and heat transfer,
3. To evaluate the performance of refrigeration and air conditioning system.

**Course Outcomes**

Upon successful completion of this course, the student will be able to:

1. Describe the basic properties, principles and applications fluids and force developed by flowing fluids.
2. Calculate the fluid flow and head loss in pipes, determine operational aspects of a pump in a system and describe the basic types of fluid machinery.
3. Use thermodynamic tables and diagrams to solve simple problems in refrigeration and air conditioning.
4. Calculate efficiencies of simple power and refrigeration cycle.

**UNIT 1 INTRODUCTION TO FLUID STATICS AND FLUID KINEMATICS 12**

Fluid – Units and dimensions - Properties of fluids - fluid static pressure - pressure measurements by manometer - Fluid Kinematics -Types of flow- Velocity field and acceleration - Continuity equation (one, two and three dimensional differential forms)

**UNIT 2 FLUID DYNAMICS, INCOMPRESSIBLE FLUID FLOW 12**

Fluid dynamics - Bernoulli's and energy equations- Venturi meter, Orifice meter and Pitot tube - Laminar flow and turbulent flow (qualitative treatment only)- Flow through pipes - Darcy - Weisbac's equation - Minor losses – flow through pipes in series and in parallel.

**UNIT 3 BASICS OF THERMODYNAMICS 12**

Basic concepts - First law of thermodynamics for open and closed systems - Steady Flow Energy Equation - Second law of thermodynamics- Heat engines- Carnot cycle, Carnot theorem - Concept of entropy- Principle of increase of entropy

**UNIT 4 REFRIGERATION AND AIR-CONDITIONING 12**

Principles of refrigeration- Refrigerator and heat pump - Vapour compression refrigeration systems- Coefficient of performance Vapour absorption systems - Principle of air conditioning- types - Psychometric chart, humidification and dehumidification

**UNIT 5 HEAT TRANSFER 12**

Modes of heat transfer - Fourier’s law of conduction in plane- Radial and composite walls - Principles of Convective heat transfer - Radiative heat transfer- Black body and white body- Stefan Boltzmann law.

**SELF STUDY:** Cooling towers

**Total hours: 60 hours**

**TEXT BOOKS:**

1. R.K.Bansal, A Textbook of Fluid Mechanics, Laxmi Publications, Second edition, 2016.
2. Mahesh M.Rathore, Thermal engineering, Tata McGraw Hill education pvt. Ltd, New Delhi, 2010.

**REFERENCE BOOKS:**

1. Frank M.White, Fluid mechanics, McGraw Hill education India pvt. Ltd. eighth edition, 2015.
2. Yunus A. Cengel, Michael A. Boles, Thermodynamics an engineering approach, McGraw Hill education India pvt. Ltd. $7^{th}$ edition, 2015.
3. R.C.Sachdeva, Fundamentals of engineering heat and mass transfer, New age internationalpublishers, fourth edition,2010

**WEB REFERENCES:**

1. nptel.ac.in/courses/105101082/ Fluid Mechanics
2. nptel.ac.in/courses/112105128/ Refrigeration And Air Conditioning

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15MT306 | ELECTRICAL ENGINEERING | 3 | 0 | 0 | 3 |

**Course pre-requisite**

15UE305 - Fundamentals of Electrical Circuits and Electron Devices

**Course Objectives**

1. Constructional details, principle of operation, performance, starters and testing of DC machines and AC Machines.
2. Constructional details, principle of operation and performance of transformers.

**Course Outcomes**

Upon successful completion of the course, students shall have ability to

1. Identify the various electrical machines and components of Electric Power systems.
2. Observe and understand the working of practical electrical machines and generation, transmission and distribution systems.
3. Troubleshoot and identify faults occurring in Electrical machines and Transmission and distribution networks.
4. Choose appropriate electrical machines suitable for a specific application based on their characteristics.

**UNIT 1 DC MACHINES** **12**

DC Generators: Construction - EMF equation DC Generators - Types Concept of Armature reaction – Characteristics - DC motors: Types Characteristics - Speed control - DC motor starters

**UNIT 2 TRANSFORMERS** **12**

Types - Ideal transformer - EMF equation - Voltage Transformation Ratio - Practical Transformer - Equivalent Circuit - Voltage Regulation

**UNIT 3 INDUCTION MOTORS** **12**

Three phase induction motors: Construction, Principle of operation - Slip, Rotor parameters - Equivalent circuit Torque - Slip Characteristics – Introduction to Single Phase induction motors - Equivalent circuit - Torque - Slip Characteristics - Introduction to Single Phase induction motors

**UNIT 4 SYNCHRONOUS AND SPECIAL MACHINES** **12**

Alternators: Construction, Principle of operation - EMF equation Armature reaction for R, L, C loads, Synchronous Reactance - Synchronous motors: Construction - Principle of operation Applications - Special Machines: Stepper motors - DC and AC Servo motors
BLDC motor (Qualitative treatment only)

**UNIT 5 BASICS OF ELECTRIC POWER SYSTEMS** **12**

Basic structure of electrical power system - Insulators and Cables - High voltage DC transmission - FACTS concepts - Substations

**SELF STUDY:** Corona and Radio Interference

**TOTAL HOURS:45**

**TEXT BOOKS:**

1. V.K.Mehta and R.Mehta, “Principles of Electrical Machines”, S.Chand& Company, 2013
2. S.N.Singh, “Electric Power Generation, Transmission and Distribution”, PHI Learning, 2011

**REFERENCE BOOKS:**

1. Nagrath I.J. and D. P. Kothari, “Electric Machines”, 4/e, Tata McGraw Hill, 2010
2. Leonard L. Grigsby, “Electric Power Generation, Transmission, And Distribution”, 3/e, CRC press, 2012
3. B. S. Guru and H. R. Hiziroglu, “Electrical Machinery and Transformers”, 3/e, Oxford University Press Pvt. Ltd., New Delhi, India, 2008.

**WEB REFERENCES:**

1. http://www.learnengineering.org/
2. http://nptel.ac.in/courses/108105053/

**15CS206 OBJECT ORIENTED PROGRAMMING 3/0/2/4**

**PREREQUISITES:** 15UC301Fundamentals of Computing and C Programming

**COURSE OBJECTIVES**

1. To understand Object Oriented programming concepts like data abstraction, encapsulation
2. To analyze different kinds of constructor, Inheritance and polymorphism
3. To understand and apply streams and File concepts
4. To implement collection frame work and strings in solving real world problems

**COURSE OUTCOMES**

Upon successful completion of the course, students shall have ability to:

1. Evaluate the concepts of friend function and virtual functions
2. Create C++ programs using Object Oriented concepts
3. Design, write and debug Package, multithreading and interface concepts using java programs
4. Implement I/O functionality to read and write files.

**UNIT I INTRODUCTION 9**

Introduction: Object Oriented Programming features - Merits and demerits of object oriented methodology- An overview of C++ - Data types- variables –Constants -operators –expressions -selection statements –Iteration statements –Jump statements –Functions – Function Arguments – Recursion – Function prototype

Arrays – single dimensional arrays –Passing single dimensional arrays to functions –Two dimensional arrays –Multidimensional arrays- pointers – pointer variables – pointer expressions

**UNIT II PROGRAMMING IN C++ 9**

Classes and objects –Friend Functions –Friend class - constructor –Default constructor-parameterized constructor –copy constructor – destructors.-operator overloading –unary-Binary – Operator overloading using friend function-Inheritance –single-multilevel-multiple-hierarchical – Virtual base class - virtual functions- pure virtual functions – Abstract classes.

**UNIT III C++ STREAMS AND FILE HANDLING 9**

C++ Streams – Stream classes – Formatted I/O -File –File classes - Opening and Closing of files-Reading and writing a Text file -Unformatted and Binary I/O –Characters vs Bytes –put() and get() –read() and write()-getline() –Detecting EOF –Random Access File- File pointers

**UNIT IV JAVA PROGRAMMING 9**

The Byte code – Java Features –Simple java program –Java Keywords -Data types, variables, Literals and arrays- operators- control statements -classes-objects-methods –constructor – overloaded constructor-Object as Arguments –Returning objects-Inheritance-Basics – Super keyword-Method overriding

**UNIT V PACKAGES, INTERFACE ,COLLECTION FRAMEWORK 9**

Packages – Defining a package – Access protection –importing a packages – Interfaces-Defining an interface-implementing interface - applying an interface - Extending an interface -. Multithreaded programming – Java Thread Model – creating a thread – implementing a thread – extending thread-Collection framework - collection –List -Set –Queue-Dequeue.

**SELF- STUDY:** String- String Buffer- operations

**TOTAL LECTURE HOURS:45**

**LABORATORY EXPERIMENTS**

**C++**

1. Simple C++ Programs to Implement Various Control Structures.
    a. If statement
    b. Switch case statement and do while loop
    c. For loop
    d. While loop
2. Program to understand Inline Functions & Function overloading
3. Programs to implement Constructors & Destructors.
4. Programs to Implement Inheritance and Function Overriding.
    a. Multiple inheritance –Access Specifiers
    b. Hierarchical inheritance – Function Overriding/Virtual Function
5. Programs to Overload Unary & Binary Operators as Member Function & Non Member Function.
    a. Unary operator as member function
    b. Binary operator as non member function
6. Programs to Understand Friend Function & Friend Class.
    a. Friend Function
    b. Friend class

**JAVA**

7. Simple Java applications using
    a. Data types
    b. Class & object
    c. Constructor
8. Implementation of Inheritance concepts
    a. Single inheritance using super keyword
    b. Multilevel inheritance
9. Creation of simple package and access
10. Developing user-defined interfaces and implementation

**TEXT BOOKS:**

1. Herbert Schildt." *The Complete Reference C++", Fourth* Edition, McGraw Hill, 2016 .(Unit –I Chapter 2,3,4,5,6 Unit –II Chapters 12,14,15,16,17 Unit III Chapters 20,21)
2. Herbert Schildt, "Java : The Complete Reference", Ninth edition, McGraw Hill, 2014.Unit –IV Chapter 1-8), Unit –V Chapter 9,11,16,17)

**REFERENCE BOOKS:**

1. K.R.Venugopal, RajkumarBuyya, T.Ravishankar, "Mastering C++", McGraw Hill, 2003
2. BjarneStroustrup, "The C++ programming language" Addison Wesley, fourth edition 2000
3. John R.Hubbard, "Progranning with C++", Schaums outline series, McGraw Hill, Third Edition 2003
4. H.M.Deitel, P.J.Deitel, "Java : How to program", Ninth edition, PHI private limited. 2000

**WEB REFERENCES:**

1. http://www.nptel.ac.in
2. http://www.javaworld.com
3. http://www.ocw.mit.edu

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15MT301 | MECHATRONICS DRAWING LABORATORY | 3 | 0 | 0 | 3 |

**PREREQUISITES:** 15UE351 - Mechatronics Drawing Laboratory – I

**COURSE OBJECTIVES**

1. To establish the relationship between traditional drafting technique and CG.
2. To develop the ability of 3D modelling using design softwares.

**COURSE OUTCOMES**

Upon successful completion of this course, the student will be able to:

**CO1:** Draw part and assembly drawing of all machine components using CAD software.
**CO2:** Model various machine components using 3D CAD modelling techniques.
**CO3:** Apply 3D modelling for industrial applications.
**CO4:** Simulate the models with CAD software.

**LIST OF EXPERIMENTS**

**Part- I (Using Solid works – DWG editor software)**

1. Part and Assembly drawing of Plummer block.
2. Part and Assembly drawing of Flanged coupling.
3. Part and Assembly drawing of IC engine connecting rod.
4. Part and Assembly drawing of Lathe tailstock.
5. Part and Assembly drawing of Simple eccentric.
6. Assembly drawing of power transmission shaft with bearings, gears, keys and couplings.

**Part – II (Using Pro-E software)**

7. 3D modelling of a simple machine part.
8. 3D modelling of Machine vice.
9. 3D modelling of a Coupling.
10. 3D modelling of Universal coupling.
11. 3D modelling of Stuffing box.
12. 3D modelling of Screw jack.

**REFERENCES:**


1. K.C.John, “Text book of machine drawing”, PHI learning pvt. Ltd, New Delhi, 2010.
2. K. L. Narayana, K. Venkata Reddy, “Machine Drawing” New age international, 2009.

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15MT307 | THERMAL AND FLUID ENGINEERING LABORATORY | 0 | 0 | 3 | 2 |

**PREREQUISITES:** Nil

**COURSE OBJECTIVES**

1. To understand the basic working concepts in Thermal and Fluid engineering
2. To impart knowledge on the principle of various thermal and fluid machineries

**COURSE OUTCOMES**

Upon successful completion of this course, the student will be able to:

**CO1:** Understand the working of thermo fluid components.
**CO2:** Apply theoretical concepts developed in course work of fluid mechanics to hands-on experiments
**CO3:** Conduct thermodynamics experiments and analyse experimental data.
**CO4:** Apply thermal fluid theories to analyse the functions of major components

**LIST OF EXPERIMENTS**

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Verification of Bernoulli's theorem.
6. Performance test on four stroke twin cylinder diesel engine with electric dynamometer.
7. Performance test on air compressor
8. Heat conduction test on composite wall
9. Natural convection apparatus.
10. Performance test on Refrigeration test rig
11. Performance test on air condition test rig.

**REFERENCES:**


1. A.YunusCengel, M.JohnCimbala. "Fluid Mechanics: Fundamentals and applications", McGraw Hill education India pvt. Ltd. Third edition, 2015.
2. M.MaheshRathore, "Thermal engineering", Tata McGraw Hill education pvt. Ltd, 2010

| Course Code | Course Name | Contact Hours | | | |
|---|---|---|---|---|---|
| | | L | T | P | C |
| 15MT308 | ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY | 0 | 0 | 3 | 2 |

**PREREQUISITES:** Nil

**COURSE OBJECTIVES**

1. To expose the students to the basic operation of electrical machines, op-amps and logic gates.

**COURSE OUTCOMES**

Upon successful completion of this course, the student will be able to:

**CO1:** Explain the principles of various electrical machines and integrated circuits.
**CO2:** Choose electrical machines, analogue and digital IC's for various applications.
**CO3:** Justify their ratings and performance.
**CO4:** Create applications based on their knowledge of Electrical and Electronics

**LIST OF EXPERIMENTS**

PART-I

1. Load test on D.C. shunt generator.
2. Load test on D.C. series generator.
3. Load test on D.C. shunt motor.
4. Load test on D.C. series motor.
5. Swinburne's test and speed control of D.C. shunt motor.
6. Load test on single phase transformer
7. Load test on three-phase induction motor.
8. Load test on single-phase induction motor.
9. O. C. and S. C. test on single phase transformer
10. Study of D.C. motor and induction motor starters.

PART-II

1. Study of Logic gates.
2. Design and implementation of Adder and Subtractor using logic gates.
3. Design and implementation of code converter using logic gates
4. Design and implementation of 2 bit magnitude comparator using logic gates
5. Design and implementation of multiplexer and de-multiplexer using logic gates
6. Design and implementation of encoder and decoder using logic gates
7. Design and implementation of BCD to 7 segment decoder circuit
8. Construction and verification of 4 bit ripple counter
9. Implementation of shift register using flip- flops
10. Inverting,non-inverting and differential amplifiers using op-amp

**REFERENCES:**


1. V. K. Mehta and Rohit Mehta, “Principles of Electrical Machines”, S. Chand and Company, 2013
2. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, “Electronic Devices and Circuits”, Tata McGraw Hill, 2nd edition, 2008.

# SEMESTER IV

**15MA107 THEORY OF PROBABILITY AND MATHEMATICAL STATISTICS** **3/2/0/4**

**Nature of Course** J (Problem analytical)
**Pre requisites** Basic Probability concepts

**Course Objectives:**

1 To study the basic probability concepts
2 To acquire skills in handling situations involving more than one random variable
3 To understand and have a well – founded knowledge of standard distributions which can be used to describe real life phenomena
4 To analyze data, interpret results and write technical reports
5 To learn the concept of testing of hypothesis using statistical analysis

**Course Outcomes:**
**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C107.1 | Recall basic probability and integration concepts | [R] |
| C107.2 | Understand to handle situations involving single random variable | [U] |
| C107.3 | Use distribution in cluster analysis of similar binary variables | [AP] |
| C107.4 | Derive the inference for engineering problems using testing of hypothesis | [AP] |
| C107.5 | Design and conduct an experiment. | [AP] |

**Course Contents:**

**Probability** - Probability concepts-Addition and Multiplication law of probability – Conditional probability - Total probability theorem, Bayes theorem(statement) – Problems-**Random Variables**- One dimensional random variable - Probability mass function - Probability density function – Discrete and continuous random variables – **Standard distributions**-Discrete distributions - Binomial – Poisson – Geometric – Continuous distributions - Uniform – Exponential - Normal distributions – MGF- Simple problems- **Testing ofHypothesis** –Large sample - Z test-Test of significance - Proportions- Mean - Standard deviation- Small sample test – t test and F test for single mean–difference of means and variance - Chi-square test for goodness of fit and independence of attributes- **Design of Experiments**- Analysis of variance - One way and two way classifications -Completely randomized design -Randomized block design.

**Total Hours: 60**

**Text Books:**


1 Peebles Jr. P.Z., —Probability Random Variables and Random Signal Principles, Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2010
2 Palaniammal, S., —Probability and Random Processes, Prentice hall of India, New Delhi, 2014,Reprint 2015.
3 Grewal. B.S, “Higher Engineering Mathematics”, 43rd edition, Khanna Publications, Delhi, 2014.
4 Gupta, S.C., &Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & sons, 2000,Reprint 2014.

**Reference Books:**


1 Ross, S., —A First Course in Probability, Sixth edition, Pearson Education, Delhi, 2014.
2 Henry Stark and John W. Woods —Probability and Random Processes with Applications to Signal Processing, Pearson Education, Fourth Edition, Delhi, 2011
3 Veerarajan., T —Probability, Statistics and Random Processes, Tata McGraw-Hill, Second Edition, New Delhi, 2010.
4 N.P.Bali and Dr.ManishGoyal,"A Text book of Engineering Mathematics Sem-III/IV" 4th edition Laxmi publications ltd, reprint 2012.


**Web References:**

1 http://nptel.ac.in/courses/111104079/
2 http://www.nptelvideos.in/2012/12/probability-random-variables.html
3 http://freevideolectures.com/Course/3028/Econometric-Modelling/22
4 http://freevideolectures.com/Course/2311/Digital-Communication/4
5 http://nptel.ac.in/syllabus/111105041/

**Online Resources:**

1 https://www.coursera.org/learn/probability-intro
2 https://ocw.mit.edu/courses/.../18-440-probability-and-random-variables-spring-2014/
3 https://www.coursera.org/learn/wharton-introduction-spreadsheets-models/lecture/Y3bCF/3-1-random-variables-and-probability-distributions
4 http://nptel.ac.in/upcoming_courses.php

**Assessment Methods & Levels (based on Blooms'Taxonomy)**

**Formative assessment based on Capstone Model (Max. Marks:20)**

| Course Outcome | Bloom's Level | Assessment Component | Marks |
|---|---|---|---|
| C107.1 | Remember | Classroom or Online Quiz | 2 |
| C107.2 | Understand | Class Presentation/Power point presentation | 4 |
| C107.3 | Apply | Group Assignment | 7 |
| C107.4 & C107.5 | Apply | Group activities | 7 |

**Summative assessment based on Continuous and End Semester Examination**

| Bloom's Level | Continuous Assessment | | | End Semester Examination |
|---|---|---|---|---|
| | CIA1 | CIA2 | Term End Assessment | |
| Remember | 20 | 20 | 20 | 20 |
| Understand | 30 | 30 | 30 | 30 |
| Apply | 50 | 50 | 50 | 50 |
| Analyse | - | - | - | - |
| Evaluate | - | - | - | - |
| Create | - | - | - | - |

**15MT309 MICROCONTROLLER AND ITS APPLICATIONS 3/0/0/3**

**Nature of Course** : F (Theory Programming)

**Pre requisites** : 15UE305 Fundamentals of Electrical Circuits and Electron Devices

**Course Objectives:**

1 To introduce the 8085 architecture and 8051 architecture.
2 To enable the students to understand the programming concepts of microprocessor and microcontroller
3 To enable the students to understand the hardware interfacing units of microprocessor and microcontroller.
4 To enable the students to understand the PIC microcontroller concepts
5 To enable the students to understand the architecture of ARM Processor.
6 To enable students to choose the appropriate micro controller for specific applications.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

C309.1 Explore their acquired knowledge on recalling the architecture of microprocessor and microcontroller. [R]
C309.2 Understand the instruction sets and programming concepts of microprocessor and microcontroller with examples. [U]
C309.3 Apply the programming concepts to interface the hardware units with microprocessor and microcontroller [AP]
C309.4 Analyse the architecture of PIC, ARM Processor and choose the appropriate micro controller for specific applications. [AN]

**Course Contents:**

8085 Architecture - Addressing modes, instructions, memory mapping & Programming of 8085;Interfacing keyboards and LED displays, Programmable peripheral interface (8255), 8253 timer, programmable interrupt controller (8259), DMA controller; 8051 microcontroller architecture, Memory organization, Interrupts and interrupt handling, 8051 addressing modes, instructions; Interfacing 8051 timer, ADC, DAC, and sensors interfacing; PIC16C61 Micro-controllers, CPU architecture, Register file structure and addressing modes , Introduction of ARM processor – Architecture- pipelining - applications.

**Total Hours: 45**

**Text Books:**

1 Krishna Kant “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice – Hall of India, New Delhi , 2012

2 Ramesh S.Goankar, ’Microprocessor Architecture: Programming and Applications with 8085’, Fourth edition, Penram International, 2010.

**Reference Books:**

1 Han Way,Huang,” PIC Microcontrollers- An Introduction to Software and Hardware Interfacing”, 2013

2 T.R.Padmanaban, “Introduction to Microcontrollers and their Applications”, Narosa Publishing House, 2012

**Web References:**

1 http://nptel.ac.in/courses/Webcourse-contents.

2 http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR.

**Online Resources:**

1 **https://www.edx.org/course/computer-system-design-advanced microprocessor-concepts**

| **Assessment Methods & Levels (based on Bloom’s Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom’s Level** | **Assessment Component** | **Marks** |
| C309.1 | Remember | Quiz | **5** |
| C309.2 | Understand | Group Mini Project | **5** |
| C309.3 | Apply | Simulation Exercises | **5** |
| C309.4 | Analyse | Group Activities | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom’s Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 20 | 10 | 10 |
| Understand | 80 | 20 | 20 | 20 |
| Apply | - | 30 | 30 | 30 |
| Analyse | - | 30 | 40 | 40 |
| Evaluate | - | - | - | - |
| Create | - | - | - | - |

**15MT310/ 17MT309** **THEORY OF MACHINES** **3/1/0/4**

**Nature of Course** :(G)Theory Analytical

**Pre requisites** : 15UE303 Statics and Dynamics

**Course Objectives:**

1. To develop competency in understanding of theory of all types of mechanisms
2. To understand the analysis of kinematics, force analysis, balancing and vibration
3. To make the student conversant with friction drives and mechanism for control
4. To develop competency in drawing the cam profile for its follower motion.

**Course Outcomes:**

Upon completion of the course, students shall have ability to

| | | |
|---|---|---|
| C310.1 | Understand all types of mechanism concepts | [U] |
| C310.2 | Apply kinematics to draw the velocity and acceleration diagrams | [AP] |
| C310.3 | Analyze the friction drives, vibration and working principle of mechanisms for control | [A] |
| C310.4 | Design the cam profile and analyze the dynamic force in engine components | [C] |

**Course Contents:**

Mechanism Terminology - Kinematic Diagrams – Mobility- Kutzbach criterion- Grashoff's law - Kinematic Inversions of four bar and slider crank chains - pantograph, straight line mechanism - Parallel mechanism, toggle mechanism, Ackermann steering gear – Geneva mechanism. Displacement, velocity and acceleration- Graphical Method (Relative velocity method) - Coriolis Acceleration. CAM: Displacement diagrams-parabolic, Simple harmonic and Cycloidal motions - Layout of plate cam profiles (Inline and offset of knife edge and roller follower only) Law of gearing and gear trains. Inertia force and Inertia torque – D' Alemberts principle - Dynamic Analysis of slider crank mechanism. Force analysis in Reciprocating engines (Analytical method) - Turning moment diagrams and Fly wheels

Static and dynamic balancing - Balancing of several masses in different planes - Balancing of V engine and radial engines. VIBRATION: Free damped vibration- logarithmic decrement- Dunkerley's method and critical speed of shafts - Theory of Watt governor – types of brakes - Band and block brake- Effect of braking in vehicles – tensions and power transmission in belt and chain drives - Gyroscopic effect on Naval ships and Automobiles

**Total Hours: 60**

**Text Books:**


1. S.S. Rattan, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2015
2. H. David Myszka, "Machines and Mechanism – Applied Kinematic analysis", Pearson Prentice Hall, 2010


**Reference Books:**


1. Robert Norton, "Design of machinery" McGraw-Hill, 2013.
2. J.E. Shigley and J.J. Uicker, "Theory of Machines and Mechanisms", Oxford University Press India, 2014

**Web References:**

1. Electronic Speed Control (ESC) governor
2. Theory of machine study material www.pearsoned.co.in

**Online Resources:**

1. https://india.oup.com/orcs/9780199454167/
2. https://india.oup.com/.../**theory-of-machines**-and-mechanisms-97801994

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C310.1 | Understand | Quiz / Class Notes | **5** |
| C310.2 | Apply | Assignment | **5** |
| C310.3 | Analyse | Simulation Exercises | **5** |
| C310.4 | Create | Mini Project | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 10 | 10 | 10 | 10 |
| Understand | 20 | 10 | 10 | 10 |
| Apply | 40 | 20 | 30 | 30 |
| Analyse | 40 | 30 | 30 | 30 |
| Evaluate | - | 10 | 10 | 10 |
| Create | - | 20 | 10 | 10 |

**15MT311 THEORY OF CONTROL SYSTEMS 3/1/0/4**

**Nature of Course** : G (Theory analytical)

**Pre requisites** : 15MA103 - Fourier Analysis and Statistical Quality Control

**Course Objectives:**

1 To impart the basic concepts of control systems components and its feedback control
2 To Interpret various time domain and frequency domain tools for analysis and design of linear control systems
3 To analyze the stability of systems from transfer function forms
4 To describe the methods of designing compensators

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C311.1 | Impart the knowledge on basic components of control systems, various time domain, frequency domain specifications, basic controllers and Characteristics equation of asystemfor stability | [R] |
| C311.2 | Interpret various time domain and frequency domain tools for analysis and design of linear control systems | [U] |
| C311.3 | Apply the various techniques for determining transfer function of a system and to design compensators | [AP] |
| C311.4 | Analyze the stability of systems from transfer function forms | [A] |
| C311.5 | Evaluate the steady state error of various type and order of a system | [E] |

**Course Contents:**

**Systems representation and Modeling**: Mathematical modeling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs. **Transient and Steady-state analysis of linear time invariant systems:** Types of test input -First and second order system response, Time domain specifications, Error coefficients, Generalized error series, Steady state error, Effect of P, PI, PID controllers. **Frequency response:**Frequency domain specifications, Bode plots,Polar Plot, Correlation between frequency domain and time domain specifications.**Stability of systems :** Characteristics equation , Location of roots in S plane for stability ,Routh-Hurwitz, Nyquist criteria, Root loci. **Compensator design and state space analysis :** Performance criteria - Lag, lead and lag-lead networks and Compensator design using bode plot**,** State space model, State transition matrix.

**Total Hours: 45**

**Text Books:**


1 A.J. Nagrath and M. Gopal, Control System Engineering, New Age International Publisher, New Delhi, 2011
2 D.SmarajitGhosh, Control Systems: Theory and Applications, Pearson Education, India, 2012.

**Reference Books:**


1 B.M. Gopal, Control System Principles and Design, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2014.
2 C.S. Palani, Control System Engineering, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2009.
3 Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Learning Ltd., New Delhi, 2010


**Web References:**

1 nptel.ac.in/courses/108103008/PDF/module1/m1_lec1.pdf
2 http://nptel.ac.in/courses/108101037
3 http://nptel.ac.in/courses/ElectricalEngineering/controlsystem/IITDelhi/webcourse-contents

**Online Resources:**

1 https://www.edx.org/course/introduction-control-system-design-first-mitx-6-302-0x
2 https://www.edx.org/course/introduction-state-space-control-mitx-6-302-1x
3 https://www.mooc-list.com/course/control-system-analysis-and-design-uninettuno

**Assessment Methods & Levels (based on Bloom's Taxonomy)**

**Formative assessment based on Capstone Model (Max. Marks:20)**

| Course Outcome | Bloom's Level | Assessment Component | Marks |
|---|---|---|---|
| C311.1 | Remember | Surprise Test | **3** |
| C311.2 | Understand | Online Quiz | **5** |
| C311.3 | Apply | Assignment | **5** |
| C311.4 | Analyze | Test | **5** |
| C311.5 | Evaluate | Group Assignment | **2** |

**Summative assessment based on Continuous and End Semester Examination**

| Bloom's Level | Continuous Assessment | | | End Semester Examination [60 marks] |
|---|---|---|---|---|
| | CIA-I [6 marks] | CIA-II [6 marks] | Term End Examination [8 marks] | |
| Remember | 20 | 40 | 24 | 24 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 0 | 24 | 24 |
| Analyse | 0 | 20 | 16 | 16 |
| Evaluate | 0 | 20 | 6 | 6 |
| Create | 0 | 0 | 0 | 0 |

**15MT312 THEORY OF MACHINES LABORATORY 0/0/3/2**

**Nature of Course** :[M] Practical Application

**Co requisites** : 15MA103 - Fourier Analysis and Statistical Quality Control

**Course Objectives:**

1.To develop competency in understanding of theory of all types of mechanisms
2.To understand the analysis of kinematics, force analysis and balancing
3.To make the student conversant with friction and mechanism for control
4.To develop competency in drawing the cam profile and understand the follower motion.

**Course Outcomes:**

Upon completion of the course, students shall have ability to

| | | |
|---|---|---|
| C312.1 | Analyze the various mechanisms. | [A] |
| C312.2 | Examine the working of universal Governors and balancing of vibrating systems. | [E] |
| C312.3 | Determine the natural frequency of bodies using various vibration experiments. | [E] |
| C312.4 | Determine the moment of inertia of bodies using various systems | [E] |

**Course Contents:**

1. Measure and Comment on mechanical advantage, Transmission angle, joints and type of given mechanisms.
2. Fabricate a four bar mechanism.
3. Compare the characteristics for Watt and Proell governors.
4. Determinations of critical speed of shaft and analyze it.
5. Balancing of reciprocating masses and interpret.
6. Balance the given rotating masses and apply it to balance the cycle wheel.
7. Determination of mass moment of inertia of the disc using Motorised Gyroscope.
8. Determine the mass moment of inertia of the object using compound pendulum setup experimentally. Verify the answer theoretically.
9. Determination of mass moment of inertia of flywheel axle system.
10. Determination of transverse frequency of beam and compare it theoretically.
11. Determination of natural frequency of given spring mass system in free longitudinal vibrations.
12. Tension, Impact and hardness test on Mild Steel, Copper and Brass.
13. Find the maximum deflection in the beams and verify it analytically.

**Total Hours: 45**

**Reference Books:**


1. L.Robert Norton, “Design of machinery” McGraw-Hill, 2013.
2. J.E.Shigley and J.J.Uicker, "Theory of Machines and Mechanisms", Oxford University Press India, 2014


**Web References:**

1. Electronic Speed Control (ESC) governor
2. Theory of machine study material www.pearsoned.co.in.

**Online Resources:**

1. https://india.oup.com/orcs/9780199454167/
2. https://india.oup.com/.../**theory-of-machines**-and-mechanisms-97801994

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | |
|---|---|---|
| **Summative assessment based on Continuous and End Semester Examination** | | |
| **Bloom's Level** | **Rubric based Continuous Assessment[60 marks] (in %)** | **End Semester Examination [40 marks] (in %)** |
| Remember | - | - |
| Understand | 20 | 20 |
| Apply | 30 | 30 |
| Analyse | 30 | 30 |
| Evaluate | 10 | 10 |
| Create | 10 | 10 |

**15MT313 MICROCONTROLLER LABORATORY 0/0/3/2**

**Nature of Course** : K (Problem Programming)

**Co requisites** : 15MT309 - Microcontroller and its applications

**Course Objectives:**

1 To assemble the microprocessor and microcontroller kit.
2 To provide the practical understanding and programming concept of microprocessor and microcontrollers
3 To provide the programming concept of interfacing hardware units.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

C313.1 Assemble the microprocessor and microcontroller kit by applying the theoretical knowledge gained in microprocessor and microcontroller. [AP]

C313.2 Analyse the instruction set and programming concepts by executing simple example . [A]

C313.3 Observe and analyse the programming concepts of hardware interfacing units. [A]

C313.4 Create simple applications using ARM Processor and evaluate the obtained results [C]

**Course Contents:**

1. Study of Assembly details in 8085 Microprocessor Kit.
2. Programming for arithmetic operations: 8 and 16 bit addition & subtraction, 8 bit multiplication, 8 bit division
3. Program with 8085 control instruction to find minimum and maximum number
4. Interfacing experiments of A/D and D/A using 8085/8051
5. Interfacing and programming of stepper motor using 8085/8051
6. Study of Assembly details in 8051 Micro controller.
7. Simple programs of 8051
8. Program and verify Timer in 8051/8085.
9. Interfacing and programming of seven segment display using 8085/ 8051
10. Write C program to interface ARM processor with LED Display and Stepper motor
11. Study of Interfacing of sensors using 8051 Microprocessor Kit.

Note: A mini project using either microprocessor or microcontroller

**Total Hours: 45**

**Reference Books:**


1 Krishna Kant “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice – Hall of India, New Delhi , 2012

2 Ramesh S.Goankar, ’Microprocessor Architecture: Programming and Applications with 8085’, Fourth edition, Penram International, 2010

3 Raj Kamal, “Embedded Systems Architecture, Programming and Design” Tata McGraw-Hill, New Delhi ,2010.

**Web resources:**

1. www.electrical4u.com/microprocessor and microcontroller.html

**Online Resources:**

1. http://nptel.ac.in/courses

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | |
|---|---|---|
| **Summative assessment based on Continuous and End Semester Examination** | | |
| **Bloom's Level** | **Rubric based Continuous Assessment [60 marks] (in %)** | **End Semester Examination [40 marks] (in %)** |
| Remember | - | - |
| Understand | 20 | 20 |
| Apply | 30 | 30 |
| Analyse | 30 | 30 |
| Evaluate | 10 | 10 |
| Create | 10 | 10 |

**15MT314 PRODUCTION TECHNOLOGY LABORATORY 0/0/3/2**
**(Project Based Laboratory)**

**Nature of Course** : L (Problem experimental)

**Co requisites** : Production Technology

**Course Objectives:**

1 To familiarize students with the basic concepts of manufacturing processes
2 To expose hands-on training to the students by various experiments using machines like lathe, Shaper, Milling, drilling and grinding machines.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C314.1 | Perform various turning operations on a given component using Lathe | [AP] |
| C314.2 | Produce flat surface on the given component using milling, shaper and slotting machines | [AP] |
| C314.3 | Improve surface finish in the given components using grinding machines | [A] |
| C314.4 | Apply and fabricate related mini projects. | [C] |

**Course Contents:**

1. Introduction- lathe machine, plain turning, Step turning & grooving (Including lathe mechanisms, simple problems)
2. Make a Taper turning using compound rest method for the given diagram (Different degree of taper for each student)
3. Do an external threading in a lathe and mate it with the given nut (The pitch will vary for each student)
4. Make an internal and external dovetail using shaping machine and mate both.
5. Perform a Grinding (Cylindrical /Surface) and study the parameters that affects the surface finish.
6. Produce spur gears using Milling machine for different module.
7. Perform a drilling operation to make the shaft fit into the hole.
8. Mini Project work- Application oriented products using above experiments

**Note:** Calculation of Production cost – Sum of raw material cost, machining cost, labor cost, Power cost and Overhead charges, for all the above experiments

**Total Hours: 45**

**Reference Books:**


1 Kalpakjian, S., “Manufacturing Engineering and Technology”, Pearson education India, 4th edition,2012

2 HajraChoudhury, S.K., and HajraChoudhury, A.K., “Elements of Workshop Technology”, Volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 2011.


**Web References:**

1 www.allaboutcircuits.com
2 www.circuitstoday.com

**Online Resources:**

1 http://iitb.vlab.co.in/?sub=43&brch=2211
2 http://vlab.amrita.edu/?sub=1&brch=282

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | |
|---|---|---|
| **Summative assessment based on Continuous and End Semester Examination** | | |
| **Bloom's Level** | **Rubric based Continuous Assessment [60 marks] (in %)** | **End Semester Examination [40 marks] (in %)** |
| Remember | - | - |
| Understand | - | - |
| Apply | 50 | 50 |
| Analyse | 30 | 30 |
| Evaluate | - | - |
| Create | 20 | 20 |

**15MT702** **ENVIRONMENTAL SCIENCE** **2/0/0/1**

**Nature of Course** :C (Theory Concept)

**Pre requisites** :NIL

**Course Objectives:**

1. To learn the integrated themes on natural resources.
2. To acquire knowledge about the various aspects of ecosystem and biodiversity.
3. To gain knowledge on the type of pollution and its control methods.
4. To have an awareness about the current environmental issues and the social problems.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C702.1 | Recall and play an important role in transferring a healthy environment for future generation. | [R] |
| C702.2 | Understand the importance of Natural resources and conservation of biodiversity. | [U] |
| C702.3 | Understand and analyze the impact of engineering solutions in a global and societal context. | [U] |
| C702.4 | Apply the gained knowledge to overcome pollution problems. | [AP] |
| C702.5 | Apply the gained knowledge in various environmental issues and sustainable development. | [AP] |

**Course Contents:**

**Natural Resources:** Concept of Resources - Forest, water, mineral, food, energy – **Biodiversity:** Hot-spots of biodiversity – threats to biodiversity- conservation of biodiversity. **Pollution –** causes, effects and control measures – air, water, noise, solid waste. **Social Issues & Green approaches:** Sustainable development - water conservation, rain water harvesting-environmental ethics – 12 principles of green chemistry- emission standards – ISO14001 standard- human rights – Value education - Role of IT in environment and Human health.

**Total Hours: 15**

**Text Books:**

1. AnubhaKaushik and C P Kaushik ‘Perspectives in Environmental Studies” 4th Edition, Newage International (P) Limited, Publisher Reprint 2014. New Delhi
2. Rajagopalan, R, ‘Environmental Studies-From Crisis to Cure’, Oxford University Press 2015.

**Reference Books:**

1. Tyler Miller, Jr., ‘Environmental Science, Brooks/Cole a part of Cengage Learning, 2014.
2. William Cunningham and Mary Cunningham ,”Environmental Science”,13th Edition, McGraw Hill,2015.
3. Gilbert M. Masters, ‘Introduction to Environmental Engineering and Science’, Third Edition, Pearson Education, 2014.

**Web References:**

1 http://nptel.ac.in/courses/104103020/20
2 http://nptel.ac.in/courses/120108002
3 http://nptel.ac.in/courses/122106030
4 http://nptel.ac.in/courses/120108004/
5 http://nptel.ac.in/courses/122102006/20

**Online Resources:**

1 https://www.edx.org/course/subject/environmental-studies
2 www.environmentalscience.org

| **Assessment Methods & Levels (based on Bloom'sTaxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C702.1 | Remember | Quiz | **5** |
| C702.2 | Understand | Writing Skills | **5** |
| C702.3 | Understand | Class Presentation | **5** |
| C702.4 & C702.5 | Apply | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | |
|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | |
| | **CIA-I(project) [10 marks]** | **CIA-II(short film) [10 marks]** | **Model Examination [60 marks]** |
| Remember | 20 | 40 | 20 |
| Understand | 80 | 60 | 40 |
| Apply | - | - | 40 |
| Analyse | - | - | - |
| Evaluate | - | - | - |
| Create | - | - | - |

**15MT601** **MINI PROJECT** **2 Credits**

## Guidelines for MINI PROJECT

| Week | SOP |
|---|---|
| 1 | Students may form a group of maximum of 4 members. They shall identify a problem of societal importance and do Mechatronics Engineering oriented project or Re-engineer any of the automated systems. |
| 2 | Students shall fix guide who is appropriate to their field of interest and discuss with the guide to fix the title of the project |
| 3 | Literature review pertaining to problem identified shall be done by the students |
| 4 | |
| 5 | Students shall make the block diagram of the project and tentative budget of the project. |
| 6 | ZEROTH REVIEW – To verify the literature review and the feasibility of the project. |
| 7 | Students shall do design calculation and find the methodology to execute the project |
| 8 | Students shall collect the hardware components required for the project. |
| 9 | FIRST REVIEW – To verify Design and bill of materials of the project |
| 10 | Fabrication of the proposed project shall be accomplished by the students preferably at our college premises. |
| 11 | |
| 12 | |
| 13 | Students shall present a paper on their project in symposium/ conference organized by premier institutions |
| 14 | Students shall do the documentation to prepare a report of the project |
| 15 | SECOND REVIEW -Students shall submit and demonstrate their projects |
| 16 | End Semester Project VIVA-VOCE Examination |

| Assessment Components | | |
|---|---|---|
| **S.No.** | **Category** | **Marks** |
| 1 | Zeroth Review | **10** |
| 2 | First Review | **15** |
| 3 | Second Review | **15** |
| 4 | Final Review | **60** |

# SEMESTER V

**15MT315/ 16MT313/ 17MT313** **HYDRAULICS AND PNEUMATICS** **3/0/0/3**

**Nature of Course :** D (Theory Application)

**Pre requisites :** Nil

**Course Objectives:**

1. To understand the concepts of fluid power.
2. To understand the Hydraulic and Pneumatic Systems.
3. To understand the design of Hydraulic and Pneumatic circuits applied in industries

**Course Outcomes:**

Upon completion of the course, students shall have ability to

| | | |
|---|---|---|
| C315.1 | Draw symbols used in hydraulic and pneumatic systems. | [R] |
| C315.2 | Select appropriate components for hydraulic and pneumatic circuits. | [U] |
| C315.3 | Troubleshoot the pneumatic and hydraulic systems. | [AP] |
| C315.4 | Design simple pneumatic and hydraulic circuits | [A] |

**Course Contents:**

**Hydraulics –** Fluid power properties, Advantages & Disadvantages - Principles of oil hydraulics - Hydraulic Pumps – Classification, Performance & Selection- Symbols of hydraulic components - Hydraulic Actuators - Hydraulic motors –Torque, Power & flow rate calculation - Hydrostatic transmissions - Cylinders - Types - Cushioning mechanism - Force, velocity and power calculations – Direction, Pressure and Flow control valve – Accumulators - Intensifiers – Hydraulic power pack.

Hydraulic circuits - Regenerative circuits, Speed control circuits - Synchronizing circuits – Air over oil circuit- Safety circuits. **Pneumatics** – Gas laws - Air Compressor - Filter – Pressure regulator - Lubricator – Muffler – Air control valves – Actuators – Symbols of Pneumatic components - Principle of Vacuum - Vacuum systems.

Introduction to Electro Hydraulic & Pneumatics- PLC applications in fluid power control - Limit switches Pneumatic circuits - Cascade – Step counter method - Installation and Maintenance of fluid power system, Fault finding - Case studies: Car barrier system – Aircraft landing system.

**TOTAL HOURS : 45 HOURS**

**Text Books:**


1 Anthony Esposito, “Fluid Power with Applications”, Pearson Education, South Asia, 2014.
2 Majumdar S.R., “Oil Hydraulics”, Tata McGraw-Hill, 2010


**Reference Books:**


1 Pinches, “Industrial Fluid Power”, Prentice hall, New Delhi, 2008.
2 J.Michael, Pinches and G.John Ashby, "Power Hydraulics", Prentice Hall, New Delhi,2013.
3 S.R.Majumdar, “Pneumatic System Principle and Maintenance” Tata McGraw-hill. New Delhi,2006
4 Anthony Lal, “Oil hydraulics in the service of industry”, Allied publishers, New Delhi 2002.

**Web References:**

1 http://nptel.ac.in/courses/112106175/Module%201/Lecture%201.pdf
2 http://nptel.ac.in/courses/112106175/Module%201/Lecture%207.pdf
3 http://nptel.ac.in/courses/112106175/Module%203/Lecture%2024.pdf
4 http://nptel.ac.in/courses/112105046/m9L35.pdf
5 http://nptel.ac.in/courses/112106175/Module%204/Lecture%2042.pdf

**Online Resources:**

1 http://www.itclearning.com/products/online-courses/hydraulic-power.html

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C315.1 | Remember | Test (Definition) | **5** |
| C315.2 | Understand | Online Quiz | **5** |
| C315.3 | Apply | Circuit construction | **5** |
| C315.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 40 | 20 | 20 | 20 |
| Understand | 30 | 30 | 30 | 30 |
| Apply | 20 | 30 | 20 | 20 |
| Analyse | 10 | 20 | 30 | 30 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT316/ 3/0/0/3**
**16MT314/ EMBEDDED SYSTEM**
**17MT314**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** 15EU305-Fundamentals of Electrical circuits and Electron Devices.

**Course Objectives:**

1. To understand the basic concept of Embedded system.
2. To know about the working principles of buses and devices for Embedded networking.
3. To study the concept of Real time operating systems.
4. To explain the Real Time operating system tools and its real time applications.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C316.1 | Define the Embedded system hardware and its software. | [R] |
| C316.2 | Describe Devices and Buses used in Embedded networking. | [U] |
| C316.3 | Implement various real time operating systems concept. | [AP] |
| C316.4 | Examine the real time operating system tools with examples. | [A] |

**Course Contents:**

Introduction to embedded systems, Architecture of advanced processors, Hardware and software components, System on Chip- I/O Devices, Communication Buses, Device drivers and interrupt service Mechanism.

Introduction to Embedded C Programming- meeting real time constraints- Emulators, debuggers- Real time operating systems basics- Processes, Tasks, Threads and their synchronization using Inter Process communication, priority inversion.

Real time operating system Programming: MicroC / OS-II , MUCOS, VxWorks Case study: Coding for an Automatic Chocolate Vending Machine , Embedded system for an Adaptive Cruise Control Systems in a Car, Embedded Systems for a Smart Card.
UART Driver, CAN BUS, Lin BUS (Quanlitative Analysis)

**Total Hours: 45**

**Text Books:**


1 Rajkamal, “Embedded Systems Architecture, Programming and Design”, TATA McGraw-Hill, Fifth reprint, 2016.
2 James K .Peckol, Embedded Systems Contemporary Design Tools, John Wiley & Sons 3rd Reprint, 2013.


**Reference Books:**


1 David E.Simon, “An Embedded Software Primer”, Pearson Education Asia, First Indian Reprint 2011.
2 K.V.K.K.Prasad “Embedded /Real-Time Systems: Concepts, Design and Programming”, Dream tech, Wiley, 2013.
3 Wayne Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufmann, 2 edition, 2008.

**Web References:**

1.www.nptel/ElectricalEngineering/EmbeddedSystems/IITDelhi

2.www.nptel/ElectricalEngineering/EmbeddedSystems/IITkarahpur

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C316.1 | Remember | Test | **5** |
| C316.2 | Understand | Online Quiz | **5** |
| C316.3 | Apply | Case study | **5** |
| C316.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 15 | 20 |
| Understand | 40 | 30 | 30 | 25 |
| Apply | 40 | 30 | 35 | 30 |
| Analyse | 0 | 30 | 20 | 25 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT317/ 16MT315/ 17MT315** **POWER ELECTRONICS AND ELECTRICAL DRIVES** **3/0/3/4**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** 15EU305-Fundamentals of Electrical circuits and Electron Devices.
15UE352-Basic Engineering Laboratory,
15MT306- Electrical Engineering,
15MT308- Electrical and Electronics Engineering Laboratory

**Course Objectives:**

1 To learn the operation and characteristics of power semiconductor devices.
2 To design protection circuits and converters using power semiconductor devices for various applications
3 To understand the basics of electrical drives with different loads.
4 To learn the implementation of power semiconductor devices in industrial drives applications.
5 To familiarize the students by introducing MATLAB simulation and help them to simulate and analyse different converters
6 To enable the student to study and simulate drives circuits using Matlab.
7 To apply the power electronics and drives concepts for real time applications

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

C317.1 Compare the principles of operations of power semi-conductor devices. [U]
C317.2 Differentiate various single phase and three phase power converter circuits [AP]
C317.3 Acquire the knowledge about fundamental of electrical drives and its control [AP]
C317.4 Identify the electrical drives for various control applications [A]
C317.5 Design and simulate converter, chopper & inverter circuits for drives applications [C]

**Course Contents:**

Power diodes, power transistors, SCRs, TRIAC, GTO, power MOSFETs, IGBTs-Principles of operation, characteristics, protection of thyristors against over voltage,over current, dv/dt and di/dt. Uncontrolled and Controlled converters- single phase and three phase half controlled and fully controlled rectifiers – Single phase dual converters- Effect of source Inductance - Thyristor triggering circuits.

Principle of chopper operations-control strategies – Step up and step down chopper – Quadrant operation-Buck and boost switched mode regulators. DC-AC converters-1-phase/3- phase (both 120 degree and 180 degree), VSI, CSI, PWM techniques-sinusoidal PWM, modified sinusoidal PWM-multiple PWM-Single phase ac voltage controller-On-off control and phase control.

Basic Elements – Types of Electric Drives –selection of motor, feedback control of drives, Induction motor drive –stator voltage control and V/f control methods-stepper motor drives and servo motor drives applications.

**Lab Component:**

1 To Obtain the SCR, MOSFET & IGBT V-I characteristics. [U]
2 To conduct the operation of SCR and TRIAC phase control circuit [C]
3 To design the Single phase half controlled converters and obtain the wave forms across R, RL load. [C]
4. To design the Single phase fully controlled converters and obtain the wave forms across R, RL load. [C]
5. To conduct the operation of Series inverter and Parallel inverter. [C]
6. To design the step up and step down chopper and compare its voltage results. [C]
7. To analyse the performance of voltage and current commutated chopper. [C]

8. To conduct speed control of converter fed DC motor by using Matlab simulation. [C]
9. To conduct speed control of chopper fed DC motor by using Matlab simulation. [C]
10. Design and simulate the 180 degree/120 degree mode of Three phase inverter with RLE load. [C]

**Total Hours: 90**

**Text Books:**

1 Singh. M.D &Khanchandani, K.B, “Power Electronics”, Tata McGraw Hill Publishing Co. Ltd., NewDelhi, 2008
2 Muhammad H. Rashid, “Power Electronics – Circuits, Devices & Applications”, Prentice Hall of India, New Delhi, 2013
3. Ned Mohan,T.M.Undeland and W.P Robbin, “Power Electronics: Converters, Application and Design” John Wiley and sons, 2006

**Reference Books:**

1 A.Bhimbra. Dr.P.S., “Power Electronics”, Khanna Publishers, New Delhi, 2012.
2 Gopal K Dubey, "Fundamentals of Electrical Drives”, Alpha Science International Limited, 2006.

**Web References:**

1 http://nptel.iitm.ac.in/courses/Webcoursecontents/IITKharagpur/PowerElectronics/

**Online Resources:**

1 *https://www.coursera.org/course/fundamentals-power electronic converters*

| **Assessment Methods & Levels (based on Blooms’ Taxonomy)** | | | | | |
|---|---|---|---|---|---|
| **Summative assessment based on Continuous and End Semester Examination** | | | | | |
| **Bloom’s Level** | **Continuous Assessment** | | | | **End Semester Examination (Theory) [40 marks]** |
| | **Theory** | | | **Practical** | |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | **Rubric based CIA [40 Marks]** | |
| Remember | 20 | 20 | 10 | - | 10 |
| Understand | 60 | 40 | 30 | 20 | 20 |
| Apply | 20 | 40 | 40 | 40 | 30 |
| Analyse | - | - | - | - | - |
| Evaluate | - | - | - | - | - |
| Create | - | - | 20 | 40 | 40 |

**15MT318/ 16MT316/ 17MT316** **MACHINE DESIGN** **3/2/0/4**

**Nature of Course :** J (Problem analytical)

**Pre requisites :** 15UE303–Statics and Dynamics
15MT304–Strength of materials

**Course Objectives:**

1. To formulate and analyse stresses and strains in machine elements and structures subjected to various loads.
2. To design and analyse various joints, power transmission shafts carrying various elements with geometrical features.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C318.1 | Understand, identify and quantify failure modes of mechanical parts. | [U] |
| C318.2 | Analyse the stress and strain on mechanical components. | [A] |
| C318.3 | Evaluate the stress developed in various joints. | [E] |
| C318.4 | Design and dimensioning various mechanical power transmission elements. | [C] |

**Course Contents:**

Design Process - Mechanical properties of materials - Types of loads - Stresses - Static, varying, thermal, impact and residual - Factors of safety - Theories of failure – Stress concentration factors, Limits system- Fits – types, Tolerances- types.Welded Joints- types- Design of Transverse, parallel fillet and Butt welded joints – Design of Threaded joints and Power screws .

Design of helical and leaf springs.Design of Solid and Hollow shafts – Based on strength and rigidity– Design of flanged coupling and Bushed pin coupling - Design of Journal Bearings – selection of ball bearings.Design and selection of V belts, timing belts- wire ropes - pulleys.

Selection and design of Transmission chains and Sprockets - Gear classification - Gear tooth forces – Component design of spur, helical, bevel and worm gears based on Lewis equation.

Direct shifting gear box (DSG) (qualitative treatment only)

**Total hours: 60**

**Text Books:**

1. Bhandari V.B, “Design of Machine Elements”, third edition, Tata McGraw-Hill education, 2010.
2. Joseph Edward Shigley and Charles R.Mischke, “Mechanical Engineering Design”, tenth edition, McGraw-Hill International Edition, 2016.

**Reference Books:**

1. Norton R.L, “Design of Machinery”, Tata McGraw-Hill Book Co, Ebook fifth edition, 2011.
2. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, fifth Edition, Wiley, 2015

**Web References:**

1. http://nptel.ac.in/downloads/112105125/
2. http://www.uptu.ac.in/pdf/sub_eme_501_30sep14.pdf

**Online Resources:**

1. https://ocw.mit.edu/courses/mechanical-engineering
2. https://www.coursera.org/browse/physical-science-and.../mechanical-engineering

| **Assessment Methods & Levels (based on Bloom’s Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom’s Level** | **Assessment Component** | **Marks** |
| C318.1 | Understand | Online Quiz | **5** |
| C318.2 | Analyse | Group Assignment | **5** |
| C318.3 | Evaluate | Problem Solving | **5** |
| C318.4 | Create | Time line component reengineering | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom’s Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 0 | 0 | 0 | 0 |
| Understand | 20 | 20 | 20 | 20 |
| Apply | 0 | 0 | 0 | 0 |
| Analyse | 40 | 30 | 30 | 30 |
| Evaluate | 40 | 30 | 40 | 40 |
| Create | 0 | 20 | 10 | 10 |

**15MT319/ 16MT317/ 17MT317** **SENSOR, MEASUREMENTS AND INSTRUMENTATION** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To Understand the basic concepts of sensor and instruments
2. To Select appropriate instruments for various applications
3. To Familiarize students in handling various types of sensors

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C319.1 | Compare the different types of sensors and transducers. | [R] |
| C319.2 | Classify the need of sensors for various processes | [U] |
| C319.3 | Design a measuring system. | [AP] |
| C319.4 | Rectify errors in sensors. | [A] |

**Course Contents:**

Sensors –Classification of sensors - Fiber optic, Chemical, semiconductor, Bio, Pop up, Blind Spot, Millimeter, smart, Micro sensors - Linear measuring instruments: VernierCaliper and Micrometer - Comparators- Mechanical, Pneumatic and Electric. Types-Terms in Surface Evaluation - Tomlinson surface meter Characteristics of instruments, Errors in instruments, GD&T.

Electronic Voltmeter and their advantages Electronic multimeter and ohmmeter – Current measurement - Power measurement Microprocessor based DMM with auto ranging and self-diagnostic features -Vibrometer and Accelerometer – Densitometer.

Angular velocity: Tachometers, Tacho generators, Digital tachometers and Stroboscopic methods – Encoders, decoders and resolvers. Nano Instrumentation- Biomedical Instrumentation, Analytical Instrumentation.

**Total Hours: 45**

**Text Books:**


1 Patranabis, “Sensors and Transducers”, Prentice Hall India Pvt. Ltd, New Delhi 2014
2 R.K.Jain, “Engineering Metrology ”, Khanna publishers, New Delhi 2010.


**Reference Books:**


1 D. V. S. Murthy, “Transducers and Instrumentation”, Prentice Hall of India Pvt. Ltd., New Delhi, 2009
2 A.K.Sawhney, “A Course in Mechanical Measurements and Instrumentation”, DhanpatiRai& Sons, New Delhi, 2014.


**Web References:**

1 http://nptel.ac.in/course.php?disciplineId=108
2 http://www.instrumentationworld.com/instrumentation_guide.htm

**Online Resources:**

1 https://www.edx.org/course?search_query=sensor%2C+measurements+and+instrumentation
2 https://www.coursera.org/courses?languages=en&query=measurements+and+instrumentation

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C319.1 | Remember | Test (Definition) | **5** |
| C319.2 | Understand | Online Quiz | **5** |
| C319.3 | Apply | Problem Solving | **5** |
| C319.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 20 | 20 | 15 |
| Understand | 30 | 30 | 30 | 30 |
| Apply | 30 | .30 | 30 | 40 |
| Analyse | 20 | 20 | 10 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT320/ 16MT318/ 17MT318** **HYDRAULICS AND PNEUMATICS LABORATORY** **0/0/3/2**

**Nature of Course :** M (Practical application)

**Co Requisites :** 15MT313- Hydraulics and Pneumatics

**Course Objectives:**

1. To design and test Hydraulic circuits
2. To design and test Pneumatic circuits
3. To simulate circuits using Fluid Sim and Automation Studio

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

C320.1 Understand the hydraulic symbols and Pneumatic symbols. [U]
C320.2 Analyse the Industrial Hydraulic and Pneumatic circuits. [A]
C320.3Design Hydraulic and Pneumatic circuits. [Ap,E]

**Course Contents:**

1. Study of pneumatic and hydraulic components
2. Simulation and Actuation of Hydraulic Linear & Rotary actuator
3. Speed Control of Hydraulic Actuator
4. Simulation and Actuation of an Accumulator Circuit
5. Simulation and Actuation of Counter Balancing Circuit
6. Simulation and Actuation of Regenerative Circuit and safety circuit
7. Simulation and Actuation of Single and Double Acting Cylinder, parallel and series Circuit
8. Simulation and Actuation of logical circuits using Shuttle Valve & two pressure valve
9. Simulation and Actuation of Metering In and Metering Out Circuit
10. Simulation and Actuation of Sequential Circuit (2 & 3 Cylinder circuit)
11. Simulation and Actuation of Sequential Circuit Using Cascading Method (2 & 3 Cylinder circuit )
12. Simulation and Actuation of Electro Pneumatic circuits

**Total Hours 45**

**Reference Books:**


1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education, 2014.
2. MajumdarS.R.,“Pneumatic systems – Principles & Maintenance”, Tata McGraw Hill, 2010
3. Festo Basic Pneumatic, Electro pneumatic, Hydraulic text and work books, 2015.
4. John Pippenger, Fluid Power Controls, Literary Licensing LLC, 2012.


**Web References:**

1. http://nptel.ac.in/courses/112106175/Module%203/Lecture%2024.pdf
2. http://nptel.ac.in/courses/112106175/Module%204/Lecture%2041.pdf
3. http://hydraulicspneumatics.com/fluid-power-basics/circuits

**Online Resources:**

1. http://www.itclearning.com/products/online-courses/hydraulic-power.html

| Assessment Methods & Levels (based on Bloom's Taxonomy) | | |
|---|---|---|
| **Summative assessment based on Continuous and End Semester Examination** | | |
| **Bloom's Level** | **Rubric based Continuous Assessment [60 marks] (in %)** | **End Semester Examination [40 marks] (in %)** |
| Remember | - | - |
| Understand | 20 | 20 |
| Apply | 20 | 20 |
| Analyse | 30 | 30 |
| Evaluate | 30 | 30 |
| Create | - | - |

**15MT321/ 16MT319/ 17MT319** **SENSOR AND INSTRUMENTATION LABORATORY** **0/0/3/2**

**Nature of Course :** M (Practical application)

**Co requisites :** 15MT319-Sensor, Measurements and Instrumentation

**Course Objectives:**

1. To understand the working principle of various sensors
2. To select appropriate sensor for specified application
3. To Familiarize students in handling various types of sensors

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C321.1 | Apply the basic knowledge of science. | [Ap] |
| C321.2 | Design a simple measurement system. | [Ap] |
| C321.3 | Proper selection of sensors for various processes. | [A] |
| C321.4 | Calibrate the instruments. | [U] |

**Course Contents:**

1. Measurement of linear displacement using inductive sensor.
2. Liquid level measurement using capacitive sensor
3. Measurement of light intensity using optical sensor
4. Piezo Electric accelerometer for vibration measurement
5. Measurement of pressure using Bourdon Gauge
6. Measurement of temperature using Thermocouple, RTD sensor
7. Measure the torque developed using torque sensor
8. Measure and control the speed of motor using stroboscope
9. Measurement of flow using Rotameter.
10. Measure the strain applied in the cantilever beam using strain sensor
11. Measurement of speed using proximity sensor
12. Digital shaft angle using Encoder Decoder.

**Total Hours: 45**

**Reference Books:**


1 Sawhney, A. K., “A Course in Mechanical Measurements and Instrumentation, DhanpatRai& Sons”, New Delhi, 2014

2 J. P. Bentley, “Principles of Measurement Systems”, Addison Wesley Longman Ltd., UK, 2010.


**Web References:**

1 http://nptel.ac.in/course.php?disciplineId=108

2 http://www.instrumentationworld.com/instrumentation_guide.htm

| Assessment Methods & Levels (based on Bloom's Taxonomy) | | |
|---|---|---|
| **Summative assessment based on Continuous and End Semester Examination** | | |
| **Bloom's Level** | **Rubric based Continuous Assessment [60 marks] (in %)** | **End Semester Examination [40 marks] (in %)** |
| Remember | - | - |
| Understand | 10 | 10 |
| Apply | 40 | 40 |
| Analyse | 10 | 10 |
| Evaluate | 40 | 40 |
| Create | 0 | 0 |

# SEMESTER VI

**15MT322/ 16MT320/ 17MT320** **COMPUTER INTEGRATED MANUFACTURING** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** 15UE304-Production Technology

**Course Objectives:**

1. To study about CNC machines and its constructional features
2. To learn basics of manufacturing automation
3. To study the need of automated material handling system.
4. To learn basics of computer aided inspection

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C322.1 | Get clear understanding of NC/CNC machines and its various elements of CNC machines. | [U] |
| C322.2 | Learn the different types of FMS layouts, material handling storage and retrieval Systems | [U] |
| C322.3 | Get an insight of automation in manufacturing and to demonstrate knowledge of their understanding of drives, controls and modeling in automation. | [AP] |
| C322.4 | Simulate and apply modeling methods with their impact on the designed systems. | [A] |

**Course Contents:**

CIM Definition - CIM wheel - CIM components, Evolution of CIM - needs of CIM - Benefits of CIM -components of NC system - NC motion control system - applications of NC - advantages and disadvantages of NC -computer Numerical control - advantages of CNC - functions of CNC - DNC systems.

Manufacturing Automation - Manufacturing Support Systems - Types of Automation- Computerized manufacturing Support System - Automated material Handling and storage systems. Group Technology - Cell design - Flexible Manufacturing Systems- Process Planning – MRP - MRP II – JIT - Types of production monitoring system.

process control & strategies - direct digital control - Supervisory computer control- computer aided quality control - QC and CIM – contact and non-contact inspection methods - CMM and Flexible Inspection systems - Integration of CAQC with CIM

**TOTAL HOURS : 45**

**Text Books:**


1 Mikell P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India Private Ltd., New Delhi, 2016
2 P. Radhakrishnan, “CAD / CAM / CIM”, New age international, 2016


**Reference Books:**


1 Kant Vajpayee. S., “Principles of Computer Integrated Manufacturing”, Prentice Hall of India, 2010
2 YoremKoren, “Computer Control of Manufacturing System”, McGraw Hill, 2011

**Web References:**

1 http://www-personal.umich.edu/~ykoren/uploads/
2 http://vigyanpariyojana.weebly.com/uploads/2/4/2/5/24253861/cad_cam.pdf

**Online Resources:**

1 www1.rmit.edu.au/courses/015034
2 nptel.ac.in/courses/112102011/

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C322.1 | Understand | Test (Definition) | **5** |
| C322.2 | Understand | Online Quiz | **5** |
| C322.3 | Apply | Case Study | **5** |
| C322.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 20 | 20 | 20 |
| Understand | 30 | 30 | 15 | 30 |
| Apply | 40 | 30 | 30 | 35 |
| Analyse | 10 | 20 | 35 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT323/ 16MT321/ 17MT321** **VIRTUAL INSTRUMENTATION** **3/0/3/4**

**Nature of Course :** F (Theory programming)

**Pre requisites :** 15MT319-Sensor, Measurements and Instrumentation

**Course Objectives:**

1 To familiarize the basics of Virtual Instruments
2 To differentiate traditional instrumentation and virtual instrumentation
3 To provide practical knowledge and hands on experience on basic concepts of LabVIEW programming
4 To know about the programming structure of the software
5 To understand various bus
6 To implement data acquisition and interfacing
7 To develop applications using LabVIEW

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C323.1 | Understand the basic concepts of Virtual Instruments. | [U] |
| C323.2 | Implement various bus interfaces | [AP] |
| C323.3 | Program and simulate systems using LabVIEW. | [C] |
| C323.4 | Acquire data using DAQ and implement various interfaces. | [AP] |
| C323.5 | Apply LabVIEW for various application | [AP] |

**Course Contents:**

Introduction to Virtual Instrumentation - Block diagram & architecture of Virtual Instrumentation - graphical programming in data flow, comparison with conventional programming - Introduction to LabVIEW – Programming techniques.

DAQ Hardware Configuration - Selecting and configuring a Data Acquisition device - components of computer based measurement system - Bus Interfaces: USB, RS 232C, RS422, RS485, GPIB, Firewire, Instrument Interfaces: PCI, PCI Express, PXI, PCMCIA, VXI, SCXI, LXI, Ethernet control of PXI, VISA and IVI.

Instrument control- Hardware in the Loop (HIL) - Image acquisition and processing- Motion control – LabVIEW based Robot Control System

**Lab Component:**

1. Programming Exercises for performing arithmetic operations. [U]
2. Programming exercises for verification of half adder and full adder. [AP]
3. Programming to find Addition of First n natural numbers using for and while loop [AP]
4. Programming to create a sine wave using formula node. [AP]
5. Programming to control Traffic light. [AP]
6. Programming exercises on case and sequence structures, file Input / Output. [AP]
7. Programming to develop voltmeter and ammeter using DAQ cards. [C]
8. Programming to plot VI characteristics of a diode [C]
9. Programming for implementing half wave and full wave rectifier using DAQ [C]
10. Programming for implementing Seven Segment Display using DAQ. [C]
11. Programming to perform temperature measurement using DAQ. [C]
12. Programming for simple fire detection and alarm [C]

**Total Hours: 90**

**Text Books:**


1 Jovitha Jerome, "Virtual Instrumentation using LabVIEW", PHI Learning Private Limited, 2012.

2 S. Sumathi and P. Surekha, "LabVIEW based Advanced Instrumentation Systems" Springer-Verlag Berlin Heidelberg, 2011.

3 John Essick, "Hands-On Introduction to LabVIEW for Scientists and Engineers", Second edition, Oxford University press, 2013.


**Reference Books:**


1 Sanjay Gupta, Joseph John, "Virtual Instrumentation using LabVIEW – Principles and Practices of Graphical Programming", Second Edition, Tata McGraw Hill Education Private Limited, 2011.

2 Jim Kring, Jeffrey Travis, "LabVIEW for Everyone: Graphical Programming Made Easy and Fun", 3rd Edition, Pearson Education, 2011.

3 John Essick, "Hands-On Introduction to LabVIEW for Scientists and Engineers" Oxford University Press, 2nd Edition, 2013.


**Web References:**

1 http://www.ni.com

2 http://k12lab-support-pages.s3.amazonaws.com/lvbasichome1.html

**Online Resources:**

1 *www.nptel.ac.in/syllabus/112106152/*

2 *nptel.ac.in/courses/108105062/10*

| **Assessment Methods & Levels (based on Blooms' Taxonomy)** | | | | | |
|---|---|---|---|---|---|
| **Summative assessment based on Continuous and End Semester Examination** | | | | | |
| **Bloom's Level** | **Continuous Assessment** | | | | **End Semester Examination (Theory) [40 marks]** |
| | **Theory** | | | **Practical** | |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | **Rubric based CIA [40 Marks]** | |
| Remember | 20 | 20 | 10 | - | 10 |
| Understand | 60 | 40 | 30 | 20 | 20 |
| Apply | 20 | 40 | 40 | 40 | 30 |
| Analyse | - | - | - | - | - |
| Evaluate | - | - | - | - | - |
| Create | - | - | 20 | 40 | 40 |

**15MT324/ 16MT322/ 17MT322** **INDUSTRIAL AUTOMATION** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To understand the various types of Automation processes.
2. To study about the hardware and software involved in a PLC.
3. To provide the control functions involved in DCS and SCADA.
4. To give adequate information in the interfaces used in HMI.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C324.1 | Relate the significance of control in automation. | [U] |
| C324.2 | Connect the PLC peripherals with the ladder programming. | [AP] |
| C324.3 | Summarize the working of various elements of DCS and SCADA. | [U] |
| C324.4 | Identify and interpret the processes in HMI. | [AP] |

**Course Contents:**

Introduction to Industrial Automation, Requirements of Industrial Automation, Types of Automation-Localized Process-Distributed process-supervisory and data acquisition, Components of Industrial Automation, Advantages of industrial automation.
PLC architecture, Parts of PLC, CPU and Memory, Input/output modules, power supplies, relays, switches, Relay logic, PLC programming languages, Ladder logic, Timers and Counters, selection of PLC based on input and output.

Distributed Control System (DCS) architecture, Database organization in DCS, System elements of DCS-Field station-Intermediate station-Central computer station, Reliability parameters of DCS, Classifications of Alarms in DCS. Introduction, Application areas of SCADA, Major elements of SCADA systems, Comparison of SCADA, DCS and PLC, Considerations and benefits of SCADA system.Introduction to field-programmable gate array (FPGA).

HMI –Automation system structure, Instrumentation subsystem, control subsystem, Human interface subsystem-operator panel-construction of the panel-Interfacing with control sub system-Types of Mimic panels, Advance HMI system-Intelligent operator panel-operator station- Data logging station.
Case studies: Loading and unloading, Material Transfer application.

**Total Hours: 45**

**Text Books:**


1 Frank D Petruzella, “Programmable Logic Controllers”, Tata McGraw Hill Publications, 2016
2 DobrivojePopovic and Vijay Bhatkar, “Distributed control for Industrial Automation”, Marcel Dekker Inc, 2012.

**Reference Books:**


1 Michael P.Lukas, “Distributed Control system”, Van Nostrand Reinhold co, Canada, 2012.

2 Stuart A Boyer, “SCADA-supervisory control and data acquisition”, International Society of automation, 3rd edition,2011.


**Web References:**

1 http://nptel.ac.in/courses/webcourse-contents/IITKharagpur/Industrial

2 http://nptel.ac.in/courses/112102011/

**Online Resources:**

1 https://www.control.com

2 https://www.ourinstrumentationgroup.com

| **Assessment Methods & Levels (based on Bloom’s Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom’s Level** | **Assessment Component** | **Marks** |
| C324.1 | Remember | Test (Definition) | **5** |
| C324.2 | Understand | Online Quiz | **5** |
| C324.3 | Apply | Programming | **5** |
| C324.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom’s Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 10 | 10 |
| Understand | 40 | 40 | 50 | 50 |
| Apply | 40 | 50 | 40 | 40 |
| Analyse | 0 | 0 | 0 | 0 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT325** **CAE LABORATORY** **0/0/3/2**

**Nature of Course :** M (Practical application)

**Pre requisites :** 15MT301 - Mechatronics Drawing Laboratory

**Course Objectives:**

1. To understand the types of element used, type of analysis done, interpretation of results, method of solving and analyzing a given problem
2. To Create a computer aided manufacturing (CAM) model and generate the machining codes automatically using the CAM software
3. To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C325.1 | Understand and analyse the given component. | [U] |
| C325.2 | Apply appropriate commands for simple shapes and complex figures in ANSYS | [A] |
| C325.3 | Generate automated tool paths for a given engineering component. | [AP] |
| C325.4 | Develop G and M codes for turning and milling components. | [C] |

**Course Contents:**

1. Study of ANSYS software.
2. Stress analysis of beam -cantilever beam with point load
3. Stress analysis of beam-simply support beam with distributed loads
4. Stress analysis of beam-fixed beam with varying load
5. Stress analysis of a corner angle bracket
6. Thermal analysis
7. CNC programming for turned components using FANUC Controller
8. CNC programming for milled components using FANUC Controller
9. Automated CNC Tool path & G-Code generation using Master CAM
10. Demo on FDM Rapid Prototyping machine

**Total Hours: 45**

**Reference Books:**


1 Daryl L Logan, Thomason, “A first course in the Finite element method”, Third Edition, 2014.
2 Radhakrishnan P, “Computer Numerical Control Machines”, New Central Book Agency, 2012.


**Web References:**

1 https://caeai.com/ansys-e-learning-series
2 http://nptel.ac.in/courses/112102103/9

| Assessment Methods & Levels (based on Bloom's Taxonomy) | | |
|---|---|---|
| **Summative assessment based on Continuous and End Semester Examination** | | |
| **Bloom's Level** | **Rubric based Continuous Assessment [60 marks] (in %)** | **End Semester Examination [40 marks] (in %)** |
| Remember | 10 | 10 |
| Understand | 20 | 20 |
| Apply | 20 | 20 |
| Analyse | 30 | 30 |
| Evaluate | 0 | 0 |
| Create | 20 | 20 |

**15MT326/ 16MT324/ 17MT324** **INDUSTRIAL AUTOMATION LABORATORY** **0/0/3/2**

**Nature of Course :** M (Practical application)

**Co requisites :** 15MT324-Industrial Automation

**Course Objectives:**

1. To Analyze the input and output interfaces of the PLC system.
2. To Develop programs on PLC using timer and counter instructions.
3. To Identify the HMI operations on an automation environment.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C326.1 | Identify basic components of a PLC and describe their functions. | [U] |
| C326.2 | Read and understand simple ladder logic programs. Effectively write basic and intermediate level PLC programs. | [Ap] |
| C326.3 | Perform simple debugging of programs. | [Ap] |
| C326.4 | Identify and interpret the processes in HMI. | [U] |

**Course Contents:**

1. To study the block diagram and input and output modules interfaces of Programmable Logic Controller.
2. Introduction to ladder programming and to implement basic logic gates.
3. Water level control with PLC programming.
4. Water level control with HMI.
5. Temperature control with PLC programming.
6. Temperature control with HMI.
7. Belt conveyor control with PLC programming.
8. Belt conveyor control with HMI.
9. Stepper motor control for linear applications using PLC programming.
10. Stepper motor control for linear applications using HMI.
11. Stepper motor control for Rotary applications using PLC programming.
12. Stepper motor control for Rotary applications using HMI.
13. Create a New SCADA for Temperature control application.
14. Create a New SCADA for Water level control application.

**Total Hours:45**

**Reference Books:**


1 Frank D Petruzella, “PLC”, Tata McGraw Hill Publications, 2016.

2 Webb, John W, “Programmable Logic Controllers - Principles and applications”, PHI Publication,5th edition,2016.

**Web References:**

1 http://nptel.ac.in/courses/112102011/

2 www.plcs.net

| Assessment Methods & Levels (based on Bloom's Taxonomy) | | |
|---|---|---|
| **Summative assessment based on Continuous and End Semester Examination** | | |
| **Bloom's Level** | **Rubric based Continuous Assessment [60 marks] (in %)** | **End Semester Examination [40 marks] (in %)** |
| Remember | - | - |
| Understand | 30 | 30 |
| Apply | 50 | 50 |
| Analyse | 0 | 0 |
| Evaluate | 0 | 0 |
| Create | 20 | 20 |

**15MT602/ 16MT602/ 17MT602** **Industrial Field Training** **2 Credits**

## SOP for Industrial Field Training

1. A minimum of 15 days in-plant training has to be undergone by the student in the fifth semester vacation.

2. Students have to undergo practical training in Mechatronics engineering related industry/ project site or design / planning office so that they become aware of the practical application of theoretical concepts studied in the class rooms.

3. The student has to decide the company and period of training in the mid of fifth semester. The information of the company has to be intimated to their respective tutors.

4. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made.

5. The report should contain the details of the Company layout, organizational structure, work flow, etc. At the end of the training student will submit a report as per the prescribed format to the department.

6. A certificate from company stating that the student has undergone the training successfully, has to be produced after the training.

| **Assessment Components** | | |
|---|---|---|
| **S.No.** | **Category** | **Marks** |
| 1 | Fixing Industry | **10** |
| 2 | Certificate | **10** |
| 3 | Power point Presentation | **40** |
| 4 | Report | **40** |
| **Total** | | **100** |

# SEMESTER VII

**15MT327/ 16MT325/ 17MT325** **ROBOTICS AND MACHINE VISION SYSTEM** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** 15MT315 - Hydraulics and Pneumatics
15MT309 - Microcontroller and Its Applications
15MT310 - Theory of Machines

**Course Objectives:**

**The objective of this course is to**

1. Introduce the principles of robotics.
2. Familiarize the concepts and techniques in robot manipulator control and robot dynamics.
3. Understand the design and implementation of robot applications and their relationship to other automated technologies.
4. Understand the basis of machine vision & its application in robotics.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C327.1 | Understand the basic concepts of Robotics & Robot component | [R] |
| C327.2 | Apply the concept of sensors used in robotics application & basic robot programming techniques | [AP] |
| C327.3 | Apply the concept of image processing & it's real time application in robotics | [AP] |
| C327.4 | Analyse the robot kinematic position & dynamic actuator force. | [A] |

**Course Contents:**

Basic components of robot-Laws of robotics- classification and application of robots -work space- accuracy-resolution –repeatability of robot. Rotary to rotary motion, Rotary to linear motion, Harmonics drives. Robot kinematics: Introduction- Matrix representation- Rigid motion & homogeneous transformation- forward & inverse kinematics (DH – Parameter) - trajectory planning.

Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation – Basics of Trajectory Planning. Robot End effectors: Introduction- types of End effectors- Mechanical gripper- types of gripper mechanism- special purpose grippers- Lead through Programming.

Machine vision: image acquisition, digital images - sampling and quantization - levels of computation Feature extraction - windowing technique- segmentation- Thresholding - edge detection - binary morphology - grey morphology, Feature Extraction and vision sensors and their types. Image resolution – Depth and volume, Colour processing, and Object recognition by features, Depth measurement, and specialized lighting techniques. Segmentation using motion – Tracking. Image Data Compression; Real time Image processing, Application of Vision systems,Case study –Remote Centred Compliance(RCC)

**Total Hours: 45**

**Text Books:**

1 King Sun Fu, Rafael C. González, C. S. George Lee, “Robotics: control, sensing, vision, and intelligence”, Tata Mcgraw-Hill Publication, 2014.
2 M.P.Groover, “Industrial robotics- Technology, programming and Applications”, McGraw-Hill, 2016
3 Saeed B. Niku, “Introduction to Robotics: Analysis, Systems, Applications”, 2nd edition, Pearson Education India, 2011.

**Reference Books:**

1 SathyaRanjan Deb, “Robotics Technology & flexible Automation”, Sixth edition, Tata Mcgraw-Hill Publication, 2011
2 John.J.Craig, “Introduction to Robotics: Mechanics & control”, Second edition, 2012.

**Web References:**

1 http://www.gorobotics.net/
2 http://www.robotbooks.com/general-robotics-links.html
3 http://nptel.ac.in/courses/112101099/

**Online Resources:**

1 https://www.edx.org/course/robotics-columbiax-csmm-103x
2 https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/lecture-notes/

| **Assessment Methods & Levels (based on Bloom’s Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom’s Level** | **Assessment Component** | **Marks** |
| C327.1 | Remember | Test (Definition) | **5** |
| C327.2 | Apply | Online Quiz | **5** |
| C327.3 | Apply | Problem Solving | **5** |
| C327.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom’s Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 15 | 15 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 40 | 40 | 40 |
| Analyse | 0 | 30 | 15 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT328/ 16MT326/ 17MT326** **DESIGN AND MODELING OF MECHATRONICS SYSTEM** **3/2/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To provide the mechatronic system design and their structure, ergonomic and safety
2. To learn the design of mechatronics products.
3. To provide an exposure on carryout mechatronic modeling and design.
4. To reduce the product design and development cost and time through simulation.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C328.1 | Understand the mechatronic system design and their structure. | [U] |
| C328.2 | Create Mechatronic modeling and design | [C] |
| C328.3 | Evaluate and validate the simulation models. | [E] |
| C328.4 | Design of mechatronic products. | [C] |

**Course Contents:**

Introduction to Mechatronics system– Key elements Mechatronics Design process – Traditional and Mechatronics designs- concurrent design- procedure for mechatronics systems, modeling procedure mechanisms and structures: loading conditions, modeling and simulation, industrial design and ergonomics information, transfer and safety.Role of modeling in mechatronics design,modeling as part of design process, goals of modeling.

Bond graphs (BGs) BG terminology basic elements and junctions object oriented modeling Derivation of state space equations Mechatronic design quotient (MDQ) application to Industrial fish cutting machine and kinematic design optimization of Acrobot Mechatronic design quotient (MDQ).

Appropriateness of simulation, Areas of application models and steps in a simulation study, Simulation of manufacturing and material handling systems frequency test, chi-square test; verification and validation of simulation models. Modeling and simulation of semi-active suspension system, Internal combustion engine with drive train, Camera drive, Disk drive - Auto control system for greenhouse temperature, Mechatronics in landmine detection and removal – Validation using MATLAB.

**Total Hours: 45**

**Text Books:**


1 Georg Pelz , “Mechatronic Systems Modelling and Simulation with HDLs”, John Wiley & Sons Ltd, 2013

2 Robert H. Bishop., “The Mechatronics Handbook”, 3rd Edition, CRC press, London, 2012

**Reference Books:**


1 Clarence W. de Silva, “Mechatronic Systems-Devices, design, control, operation and monitoring”, CRC Press, Taylor & Francis group, 2011

2 Banks J., Carson J.S. and Nelson B.L., “Discrete – Event System Simulation”, 3rd Edition, Pearson Education, Inc 2004 (ISBN 81-7808-505-4).


**Web References:**

1 nptel.ac.in/courses/112104158/
2 nptel.ac.in/courses/112104158/lecture1.pdf

**Online Resources:**

1 ieeexplore.ieee.org/document/1411763/
2 mechatronics.colostate.edu/resources.html

| **Assessment Methods & Levels (based on Bloom’s Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom’s Level** | **Assessment Component** | **Marks** |
| C328.1 | Understand | Online quiz | **5** |
| C328.2 | Create | Test | **5** |
| C328.3 | Evaluate | Problem Solving | **5** |
| C328.4 | Create | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom’s Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 10 | 10 |
| Understand | 30 | 20 | 20 | 25 |
| Apply | 40 | 30 | 40 | 25 |
| Analyse | 10 | 20 | 15 | 15 |
| Evaluate | 0 | 20 | 0 | 15 |
| Create | 0 | 0 | 15 | 10 |

**15HS003/ 16HS004/ 17HS003** **INDUSTRIAL MANAGEMENT AND PROFESSIONAL ETHICS** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To familiarize the moral issues in engineering
2. To provide tools for analyzing the issues.
3. To give sufficient experience and confident to resolve the issues in working environment.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C003.1 | Explain the various industrial management principles | [U] |
| C003.2 | Analyse the impact of social environment on individuals and groups | [A] |
| C003.3 | Optimize the resources of an organization and improve productivity | [E] |
| C003.4 | Demonstrate the knowledge of designing plants and controlling Production. | [C] |

**Course Contents:**

Introduction to organizational structure, work study and method study – Time study– Standard data - Method Time Measurement (M-T-M) – Work sampling – Plant location - Factors - Plant layout - Types - Layout design process – Computerized Layout Planning – Construction and Improvement algorithms -ALDEP and CRAFT.

Heuristic methods of grouping by machine matrices product design and plant layout - Types of productions, Production cycle- Forecasting, Loading, Scheduling, Dispatching, Routing- Simple problems.

Ethics-scope-Engineering as social experimentation-commitment to safety- Safety and risk, assessing and reducing risk -work place responsibilities and rights- Team work, confidentiality and conflicts of interest, Rights of Engineers. Case studies-Air bags, containers, TV antenna.

**Text Books:**


1 Buffa E.S, “Modern Production / Operational Management”, John Wiley & Sons, 2013.

2 Mike.W.Martin, Roland Schinzinger, “Ethics in Engineering” Tata McGraw- Hill, fourth edition, 2011.


**Reference Books:**


1 Charles E, Harris.JR, Michael S.Pritchard, Michael J.Rabins, “Engineering ethics” fifth edition, 2013.
2 Nigel Slack, Stuart Chambers, Robert Johnston., “Operation Management”, Pearson Education, sixth edition 2011.
3 R.Panneerselvam, “Production and operation management”, PHI learning Pvt.ltd, Sixth edition, 2014.

**Web References:**

1 http://nptel.ac.in/courses/109104032/
2 http://www.youtube.com/watch?v=vS31o3xfh_0

**Online Resources:**

1 https://www.leeds.ac.uk/arts/info/125162/.../2431/professional_ethics_short_course

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C003.1 | Understand | Online Quiz | **5** |
| C003.2 | Analyse | Group Assignment | **5** |
| C003.3 | Evaluate | Case studies | **5** |
| C003.4 | Create | Online course | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | |
|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | |
| | **CIA-I [30 marks]** | **CIA-II [30 marks]** | **Term End Examination [40 marks]** |
| Remember | 20 | 0 | 10 |
| Understand | 20 | 30 | 20 |
| Apply | 20 | 10 | 20 |
| Analyse | 40 | 30 | 30 |
| Evaluate | 0 | 20 | 10 |
| Create | 0 | 10 | 10 |

**15MT329/ 16MT327/ 17MT327** **ROBOTICS LABORATORY** **0/0/3/2**

**Nature of Course :** M (Practical application)

**Co requisites :** 15MT327-Robotics And Machine Vision System

**Course Objectives:**

1. To familiarize the concepts and techniques in robot, manipulator control via teach pendant.
2. To understand rapid programming and create programs to perform certain tasks.
3. To understand the basics of machine vision using LabVIEW& its application in robotics.

**Course Outcomes:**

**Upon completion of the course, students shall have ability**

| | | |
|---|---|---|
| C329.1 | To understand the basics & classification of robots. | [U] |
| C329.2 | To apply the concept & techniques in robot, manipulator control via Teach pendant. | [Ap] |
| C329.3 | To apply Rapid programming and create programs to perform industrial tasks. | [Ap] |
| C329.4 | To apply the basics of machine vision in robotics. | [AP] |

**Course Contents:**

1. Verifying the work volume of given six robots.
2. Simple rapid programming for Teach pendant.
3. Teach Work object and TCP setting to ABB six axis robot using Teach pendant
4. Teach the ABB six axis robot to identify the given components are Metal or Non - metal using Teach pendant
5. Teach the Machine tending operation of ABB six axis robot using Teach pendant
6. Teach the welding simulation of ABB six axis robot using Teach pendant
7. Teach the painting simulation of ABB six axis robot using Teach pendant
8. Perform the Matrix palletizing operation of ABB six axis robot using Teach pendant with single suction cup
9. Perform the Cartoon palletizing operation of ABB six axis robot using Teach pendant with multi suction cup
10. In ABB six axis robot, identify and sorting the defective and non defective components using Teach pendent and vision system.

**Total Hours: 45**

**Reference Books:**

1 Saeed B. Niku, “Introduction to Robotics: Analysis, Systems, Applications”, 2nd edition, Pearson Education India, 2013.

**Web References:**

1 http://new.abb.com/products/robotics/robotstudio/tutorials

| Assessment Methods & Levels (based on Bloom's Taxonomy) | | |
|---|---|---|
| **Summative assessment based on Continuous and End Semester Examination** | | |
| **Bloom's Level** | **Rubric based Continuous Assessment [60 marks] (in %)** | **End Semester Examination [40 marks] (in %)** |
| Remember | 0 | 0 |
| Understand | 30 | 30 |
| Apply | 0 | 0 |
| Analyse | 50 | 50 |
| Evaluate | 0 | 0 |
| Create | 20 | 20 |

**15MT505/ 16MT505/ 17MT505** | **MOOC Certification** | **1 Credit**

## SOP FOR MOOC Certification

1. The MOOC certification should be on technical domains, either related to their project or placement activities.
2. The Student should complete 2 courses within the same semester.
3. The first course should be completed in the first half of the semester and the second course should be completed in the second half of the semester.
4. The MOOC course should be approved by the Department.
5. The minimum duration should be 4 weeks per course.
6. The student should earn the MOOC certificates individually.
7. The student should prepare the power point of the FIRST course in the middle of the semester and present the same.
8. The student should prepare the power point of the SECOND course at the end of the semester and present the same.
9. The course dates should be updated with the assigned faculty incharges every week.

| **Assessment Components** | | |
|---|---|---|
| **S.No.** | **Category** | **Marks** |
| 1 | MOOC Certification- Course-I | **25** |
| 2 | Power point Presentation of course-I | **25** |
| 3 | MOOC Certification- Course-II | **25** |
| 4 | Power point Presentation of course-II | **25** |
| **Total** | | **100** |

# SEMESTER VIII

**15MT603/ 16MT603/ 17MT603** **INDUSTRIAL PROJECT** **0/0/24/12**

## SOP FOR INDUSTRIAL PROJECT

1. Students must do the project based on their subjective domain.
2. Students can do projects either by individual or group containing maximum of 4 per batches.
3. Students should fix one External guide from Industry and One Internal guide from department based on their field of domain or area of interest.
4. Students have to carry project in the industry for the complete duration of the semester.
5. Students should present all their reviews compulsory as per the fixed schedule.
6. Students must publish a paper in National and International Journals or in National/International conference organized by premier institutions.
7. Students must produce Attendance and Industrial certificates from their project carrying Industry.
8. Students must prepare their documents without any plagiarism.
9. Students should follow all the procedures, formats and instructions in their documentation works as per the guidelines by the institution.

| Week | Guidelines |
|---|---|
| 1 | Permission shall be obtained from the industries for doing project during mid of $7^{th}$ semester |
| | Students shall visit the industries to identify problem for which solution has to be obtained |
| 2 | Students shall fix guide, one internal guide in department and one external guide in industry who is appropriate to their field of interest and fix the title of the project |
| 3 | ZEROTH REVIEW – To verify the level of industrial exposure to the students and project feasibility |
| 4 | Literature review pertaining to problem identified shall be done by the students |
| 5 | Students shall propose a new system with block diagram and tentative budget of the project (Students may submit the project proposal to the funding agencies - Optional) |
| 6 | FIRST REVIEW to verify the literature review and proposed model |
| 7 | Students shall do design calculation and find the methodology to execute the project |
| 8 | Students shall collect the hardware components required for the project/ The simulation required for the project shall be carried out. |
| 9 | SECOND REVIEW – To verify Design and bill of materials of the project |
| 10 | Fabrication of the proposed project shall be accomplished by the student at the concerned industrial premises. |
| 11 | Students shall publish a paper in National and International Journals or in National/ International conference organized by premier institutions |
| 12 | THIRD REVIEW – To evaluate the fabrication of project |
| 13 | Students shall do the documentation to prepare a report of the project |
| 14 | END SEMESTER PROJECT VIVA EXAM |

| Assessment Components | | |
|---|---|---|
| **S.No.** | **Category** | **Marks** |
| 1 | Fixing Industry | **20** |
| 2 | Zeroth Review | **10** |
| 3 | First Review | **10** |
| 4 | Second Review | **10** |
| 5 | Third Review | **10** |
| 6 | Report & Final Viva Voce<br>(Conference – 10,<br>Journal Publication - 10) | **40** |
| **Total** | | **100** |

# OPEN ELECTIVES

**15MT501/ 16MT501/ 17MT501** **RELIABILITY ENGINEERING** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To use statistical tools to characterize the reliability of an item.
2. To select appropriate reliability validation methods.
3. To get the working knowledge for finding the reliability of a system and suggest approaches to enhancing system reliability.
4. To apply engineering knowledge and specialist techniques to prevent or to reduce the frequency of failures**.**

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C501.1 | Know the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment; | [R] |
| C501.2 | Establish maintenance strategies according to system characteristics and design transition programs to implement these strategies | [U] |
| C501.3 | Apply the appropriate methodologies and tools for enhancing the inherent and actual reliability of components and systems, taking into consideration cost aspects | [AP] |
| C501.4 | Analyse the interference between strength and stress, or life data for estimating reliability of the system. | [A] |

**Course Contents:**

Reliability basics, maintainability, availability, quality, cost and system effectiveness, life characteristic phases, modes of failure, areas of reliability, quality and reliability assurance rules, product liability, importance of reliability. Probability distributions -binomial, normal, Poisson, lognormal, Weibull, exponential, standard deviation, variance, skewness coefficient, series, parallel, mixed configuration, k- out of n structure, analysis of complex systems-

Enumeration method, conditional probability method, delta-star method for conditional probability analysis, - types of stand by redundancy Objectives of maintenance, types of maintenance, maintainability, factors affecting maintainability, system down time, availability - inherent, achieved and operational availability, reliability and maintainability trade-off, maintainability tools and specific maintainability design considerations.

Failure mode effects analysis, severity/criticality analysis, FMECA examples, RPN, Ishikawa diagram for failure representation, fault tree construction, basic symbols development of functional reliability block diagram, minimal cut set method, minimal tie set method, Delphi methods, Monte Carlo evaluation.

**Total Hours : 45**

**Text Books:**

1. L.S.Srinath, “Reliability Engineering”, EWPublishers, 3rd Edition, 2012.
2. Alessandro Birolini , “Reliability Engineering Theory and Practice”, Springer,2011.

**Reference Books:**

1. Roy Billinton and Ronald N Allan, “Reliability Evaluation of Engineering Systems”, Springer,2012.
2. S S. Rao, “Reliability Based Design”, McGraw Hill Inc. 2011.
3. E Balagurusamy, “Reliability Engineering”, Tata McGraw-Hill Publishing Company Limited, 2012.

**Web References:**

1 http://nptel.iitm.ac.in/courses/Webcoursecontents/IITKharagpur/Reliability Engineering/

| **Assessment Methods & Levels (based on Bloom’s Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom’s Level** | **Assessment Component** | **Marks** |
| C501.1 | Remember | Test (Definition) | **5** |
| C501.2 | Understand | Online Quiz | **5** |
| C501.3 | Apply | Design a system and estimate the reliability of the system | **5** |
| C501.4 | Analyse | Assignment | **5** |

**Summative assessment based on Continuous and End Semester Examination**

| **Bloom’s Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
|---|---|---|---|---|
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 15 | 15 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 40 | 40 | 40 |
| Analyse | 0 | 30 | 15 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT502/ 16MT502/ 17MT502** **VEHICLE DYNAMICS** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To understand the basic concepts of forces acting on the Vehicles on road.
2. To gain knowledge on acceleration and braking performance of vehicles.
3. To make the students choose appropriate suspension and steering system for vehicles.
4. To design the size and load rating of tires.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C502.1 | Be aware of the basic forces acting on a vehicle during on road | [R] |
| C502.2 | Understand the accelerating and braking performances. | [U] |
| C502.3 | Analyze the suspension and steering system of a vehicle | [A] |
| C502.4 | Compute the size and load ratings of tires. | [AP] |

**Course Contents:**

Introduction to Vehicle Dynamics– Dynamic Axle loads – Static loads on level ground – Low-speed acceleration – Loads on grades. Acceleration Performance: Power limited acceleration and Traction limited acceleration. Braking Performance: Basic Equations of Constant deceleration and Deceleration with Wind resistance. Braking forces: Rolling resistance, Aerodynamic Drag, Driveline Drag and grade. Brake Factor. Tire road friction: Velocity, Inflation pressure and Vertical Loads.

Aerodynamic forces, Drag, Side force and Lift force. Suspension: Solid axles – Hotchkiss, Four link and De Dion – Independent Suspensions, Anti Squad and Anti Pitch Suspension geometry – Anti Dive Suspension Geometry. Active Suspensions.

Steering System: Steering linkages, Steering geometry error, Front wheel geometry, Steering system forces and moments and Steering system Models. Tires: Tire construction, Size and load rating, Terminology and Axis system, Mechanics of force generation. Combined braking and cornering steer– Tire Vibrations.

**Total Hours: 45**

**Text Books:**


1 Thomas D Gillespie, “Fundamentals of Vehicle Dynamics”, SAE, 2013.
2 William F Milliken and Douglas L Milliken, “Race Car Vehicle Dynamics”, SAE, 2008


**Reference Books:**


1 Reza N Jazar, “Vehicle Dynamics”, Springer, 2nd Edition, 2013
2 Giancarlo Genta, “Motor Vehicle Dynamics”, World Scientific Publishers, 2007


**Web References:**

1 http://nptel.ac.in/courses/107106080/
2 http://training.sae.org/seminars/99020/

**Online Resources:**

1 https://iversity.org/en/courses/vehicle-dynamics-i-accelerating-and-braking
2 sae.org/credentialing/certificate/vehicledynamics.htm

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C502.1 | Remember | Test (Definition) | **5** |
| C502.2 | Understand | Online Quiz | **5** |
| C502.3 | Analyse | Problem Solving | **5** |
| C502.4 | Apply | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 30 | 15 | 10 | 15 |
| Understand | 35 | 25 | 25 | 30 |
| Apply | 35 | 35 | 40 | 40 |
| Analyse | 0 | 25 | 25 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT503/ 16MT503/ 17MT503** **MICRO AND NANO ROBOTICS** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To understand scientific concepts underlying engineering and technological applications.
2. To acquire the knowledge of manipulation for advance technology applications
3. To get familiarized with the new concepts of real-time manipulation & assembly

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C503.1 | Explain the basic theory of stiffness, workspace, kinematics and dynamics related to robotics | [R] |
| C503.2 | Understand the Micro/Nano manufacturing techniques | [U] |
| C503.3 | Analyze mechanism's DOF and singularity by scaling laws | [A] |
| C503.4 | Apply the algorithms for controlling. | [AP] |

**Course Contents:**

Introduction to Robotics – Overview of Micro/Nano-robotic systems. Physics of reduced length scales (scaling effects in the physical parameters, surface forces, contact mechanics, and micro/nano-scale dynamical phenomena).

Basics of micro/nano-manufacturing, microfabrication and soft lithography, Biomimetic design strategies for mobile micro-robots, Principle of transduction, material properties and characteristics of actuators (piezoelectric, shape-memory alloy, and a variety of MEMS and polymer actuators).Control requirements and challenges of micro/nano-actuators, sensors for microrobotic applications, manipulation- Fabrication of grippers (scanning probe microscopy, operation principles, designing experiments for nanoscale mechanical characterization of desired samples).

Type design, DOF and singularity analysis, kinematics Modelling, dynamics Modelling, the incidence relation between outputs of end-effector and inputs of actuators, reducible matrix, how to design micro/nano robot using reducible matrix, control algorithm.
Case Study of Micro/Nano Robot.

**Total Hours: 45**

**Text Books:**


1 Ning xi &Guangyoungli, "Introduction to Nanorobotic Manipulation & Assembly" Artech house Press, 2012
2 Yi Guo ,"Selected Topics in Micro/Nano-robotic for Biomedical Applications", Springer media, 2013


**Reference Books:**


1 Klaus D. Sattler, "Hand Book of Nanophysics: Nano medicine &Nanorobotics", CRC Press, 2010.
2 Mustapha Hamdi, Antoine Ferreira, "Design, Modelling and Characterization of Bio-Nanorobotic Systems", Springer, 2011.

**Web References:**

1 http://www.nptel.ac.in/courses/112101098/Robotics1/Lecture
2 http://nptel.ac.in/courses/112101096/

**Online Resources:**

1 https://www.iit-kharagpur-offers-course-in-microrobotics
2 https://www.ieee-ras.org/micro-nano-robotics-and-automation

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C503.1 | Remember | Test (Definition) | **5** |
| C503.2 | Understand | Online Quiz | **5** |
| C503.3 | Analyse | Problem Solving | **5** |
| C503.4 | Apply | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 30 | 15 | 10 | 15 |
| Understand | 35 | 25 | 25 | 30 |
| Apply | 35 | 35 | 40 | 40 |
| Analyse | 0 | 25 | 25 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT504/ 16MT504/ 17MT504** **FIELD AND SERVICE ROBOTICS** **3/0/0/3**

**Nature of course :** H(Theory Technology)

**Pre requisites :**Nil

**Course Objectives:**

1. To understand the various parts of robots .
2. To develop the knowledge of various kinematics and inverse kinematics of robots.
3. To study the control of robots for specific applications.

**Course outcomes:**

**Upon completion of the course, students shall have the ability to**

C504.1Elucidate the basic concepts of robot [R]
C504.2Identify the function of sensors in the robot [U]
C504.3 Inscribe program to use a robot for advanced applications [AP]
C504.4 Use Robots in different applications [A]

**Course contents:**

Field and service robots-Classification, applications, sensing and perception, social and ethical implications of robotics. History of service robotics – Present status and future trends – Need for service robots - applications- examples and Specifications of service and field Robots.

Non conventional Industrial robots. Autonomous Mobile robots: Kinematics, locomotion, perception, motion planning and control, localization and mapping; Intelligent unmanned vehicles.Underwater robot.

Kinematics and dynamics, modeling and simulation, navigation, guidance and control.Planning And Navigation -Introduction-Path planning overview- Road map path planning- Cell decomposition path planning-Potential field path planning-Obstacle avoidance

**TOTAL: 45 hours**

**Text Books:**

1. R Siegwart, I. R. Nourobakhsh, Introduction to Mobile robotics, MIT Press, Cambridge, 2014
2. G. Antonelli: Underwater Robots, 2nd Edition, Springer-Verlag, Berlin Heidelberg, 2011

**References:**

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd.2011.
2. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics", Springer, 2011

**Web References:**

1. http://nptel.ac.in/courses/112101099/
2. http://nptel.ac.in/downloads/112101098/

| Assessment Methods & Levels (based on Bloom's Taxonomy) | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C504.1 | Remember | Test (Definition) | **5** |
| C504.2 | Understand | Online Quiz | **5** |
| C504.3 | Apply | Problem Solving | **5** |
| C504.4 | Analyse | Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 15 | 15 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 40 | 40 | 40 |
| Analyse | 0 | 30 | 15 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

# PROFESSIONAL ELECTIVES

**15MT401/ 16MT401/ 17MT401** **ADVANCED MANUFACTURING PROCESSES** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** 15UE304 -Production Technology

**Course Objectives:**

1. To give a good perspective with adequate depth to understand the unconventional machining processes.
2. To impart the knowledge of relative advantages of advanced manufacturing processes over conventional techniques.
3. To analyse the process parameters of different advanced manufacturing processes.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C401.1 | Detail the fundamentals of advanced manufacturing processes. | [R] |
| C401.2 | Select the appropriate process based on the requirement | [U] |
| C401.3 | Analyse the process parameters of different methods | [A] |
| C401.4 | Analyse and improve manufacturing processes from design stage to manufacturing stage | [A] |

**Course Contents:**

Introduction to Modern machining Processes – Process selection – Abrasive Jet Machining, Water Jet Machining and Ultrasonic Machining: Working Principles – Equipment used – Process parameters – MRR – Variation in techniques used – Applications. Electric Discharge Machining (EDM) - Working Principles – Equipments - Process Parameters – MRR – Tool – Power Circuits – Tool Wear – Dielectric – Flushing . Wire cut EDM: Applications – Electrical Discharge Grinding – Working Principle – Equipment – Process Parameters – Applications.

Chemical machining: Process principle - Process Parameters – Masks – Etchants – Applications. Electro-Chemical machining: Principles – Equipments – MRR - Electrical circuit - Process Parameters – Applications: Electro Chemical Grinding (ECG) and Electro Chemical Honing (ECH). Laser Beam machining (LBM), Plasma Arc machining (PAM) and Electron Beam Machining (EBM): Principles – Equipment – Types – Beam control techniques – Applications.

High Energy Rate Forming (HERF) – Electromagnetic forming - Explosive forming - Electrohydraulic forming. Surface Treatment: Classification – Removal Processes – Conversion Coatings – Thermal Treatments – Metal Coatings – Physical Vapor Deposition (PVD) – Chemical Vapor Deposition (CVD) – Ion Planting – Organic Coatings – Process capabilities and Design Aspects.

**Total Hours: 45**

**Text Books:**


1 Benedict. G.F. “Non-traditional Manufacturing Processes”, Taylor & Francis, New York, 2010.
2 Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2009.

**Reference Books:**

1 John A. Schey, “Introduction to Manufacturing Processes”, McGraw Hill, 2014.
2 McGeough, “Advanced Methods of Machining” Chapman and Hall, London, 2008.

**Web References:**

1 http://www.wisegeek.com/what-is-virtual-manufacturing.htm
2 http://nptel.ac.in/courses/112107144/Metal%20Forming%20&%20Powder%20metallurgy/lecture9/lecture9.htm

**Online Resources:**

1 https://www.edx.org/course/fundamentals-advanced-manufacturing-processes-mitx-2-012x
2 https://www.canvas.net/advancedmanufacturing

| **Assessment Methods & Levels (based on Bloom’s Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom’s Level** | **Assessment Component** | **Marks** |
| C401.1 | Remember | Test (Definition) | **5** |
| C401.2 | Understand | Online Quiz | **5** |
| C401.3 | Apply | Problem Solving | **5** |
| C401.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom’s Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 15 | 15 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 40 | 40 | 40 |
| Analyse | 0 | 30 | 15 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT402/ 16MT402/ 17MT402** **MICRO AND NANO MANUFACTURING** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** 15UE304 - Production Technology

**Course Objectives:**

1. To understand the Micro Nano Fabrication processes.
2. To develop the knowledge about the working principles Laser based Micro Nano fabrications.
3. To made the innovation on present devices.
4. To gain knowledge in Nano design.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C402.1 | Predict the different micro Nano fabrication process. | [R] |
| C402.2 | Determine the laser based Micro & Nano fabrication. | [U] |
| C402.3 | Apply the innovation on present device. | [AP] |
| C402.4 | Design the Nano products using designing software. | [A] |

**Course Contents:**

Nano technology concepts and applications, Micro- and Nanofabrication, Nano technology in India, Scope for micro-fabrication, Rise Nano technology Fields, Commercialization issues of Micro-Nano technology. Mechanical Micromachining, Physical Fabrication Methods, Lithography, Nano Lithography, Precision Micro- and Nano grinding , Use of Spectrometers & Microscopes. Micro pumps and motors.

Laser-Based Micro and Nanofabrication, Pulsed Water Drop Micromachining, Nano Materials, Synthesis of Nano materials, Bio Materials, Nano Composites, Development of Nano Particles. Nano chips, Nano tubes and Nano wires, Integration of chips and microprocessors, Technology Support, Meeting Social Needs.

Computer Aided Nano Design, VLSI product detailing Finite Element Analysis of Microstructures, 3-D Molecular Modeling

**Total Hour : 45**

**Text Books:**


1 Mark J. Jackson, “Micro and nano-manufacturing”, Springer, 2012
2 N. P. Mahalik, “Micro-manufacturing and nanotechnology”, Springer, 2011.


**Reference Books:**


1 Jeremy Ramsden, “Micro &nano technologies”, Elsevier,2016
2 Gabor L. Hornyak, H.F. Tibbals, JoydeepDutta, and John J. Moore, “Introduction to Nano science and Nanotechnology”, CRC Press, 2012.


**Web References:**

1 https://micronanomanufacturing.asmedigitalcollection.asme.org/
2 nptel.ac.in/courses/112108092/module2/lec07.pdf

**Online Resources:**

1 https://www.edx.org/course/micro-nanofabrication-mems-epflx-memsx

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C402.1 | Remember | Test (Definition) | **5** |
| C402.2 | Understand | Online Quiz | **5** |
| C402.3 | Apply | Problem Solving | **5** |
| C402.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 20 | 20 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 40 | 30 | 30 |
| Analyse | 0 | 30 | 20 | 20 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT403/ 16MT403/ 17MT403** **ADDITIVE MANUFACTURING PROCESSES** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** 15UE304 - Production Technology

**Course Objectives:**

1. To design, optimize, manufacture, and validate a physical system component using rapid prototyping methods and computer-aid tools.
2. To familiarize with the various Rapid Prototyping and Tooling (RPT) techniques so as to compare their strengths and limitations.
3. To understand RP data format, applications areas and industrial case studies.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C403.1 | Remember the techniques for processing of CAD models for rapid prototyping | [R] |
| C403.2 | Understand and apply fundamentals of rapid prototyping techniques. | [U] |
| C403.3 | Choose appropriate tooling for rapid prototyping process. | [A] |
| C403.4 | Apply rapid prototyping techniques for reverse engineering. | [A] |

**Course Contents:**

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP. CAD model preparation, Data Requirements, Data formats ( STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation. Stereolithography (SL), SL resin curing process, SL scan patterns, Micro-stereolithography, Applications of Photo-polymerization Processes.

Selective laser Sintering (SLS), Powder fusion mechanism and powder handling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Applications of Powder Bed Fusion Processes.Fused Deposition Modelling (FDM), Principles, Plotting and path control, 3D printing (3DP), Research achievements in printing deposition, Technical challenges in printing, Printing process modelling, Applications of. Printing Processes.

Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications. Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing-structure-properties, relationships, Benefits and drawbacks. Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

**Total Hours: 45**

**Text Books:**

1 Chua C.K. et al., " Rapid Prototyping: principles and applications" Wiley,2013.
2 Pham D.T &Dimov.S.S, "Rapid manufacturing" , Springer-Verlag, London, 2011.

**Reference Books:**

1 Hilton P.D, “Rapid Tooling”, Marcel Dekkar Publishers, 2010.
2 Jacobs P.F, “Stereolithography and other Rapid Prototyping & Manufacturing Technologies”, McGrawHill, New york, 2011.

**Web References:**

1 http://www.stratasys.com/solutions/rapid-prototyping
2 http://www.materialise.com/en/manufacturing/rapid-prototyping

**Online Resources:**

1 http://professional.mit.edu/programs/short-programs/rapid-prototyping-technology
2 https://www.udacity.com/course/rapid-prototyping--ud723

| **Assessment Methods & Levels (based on Bloom’s Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom’s Level** | **Assessment Component** | **Marks** |
| C403.1 | Remember | Test (Definition) | **5** |
| C403.2 | Understand | Online Quiz | **5** |
| C403.3 | Apply | Problem Solving | **5** |
| C403.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom’s Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 15 | 15 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 35 | 40 | 40 |
| Analyse | 0 | 35 | 15 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT404/ 16MT404/ 17MT404** **PRODUCT DESIGN AND MANUFACTURING** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To introduce students to principles and evaluation methods of various aspects of designing components.
2. To study the process capability, tolerance and form design of materials.
3. To develop the students to acquire skills to analyse product design and be able to design products that are easier to manufacture, assemble, service and friendlier to environment.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C404.1 | Understand the design principles for manufacturing processes | [U] |
| C404.2 | To expose the impact of design on environment to achieve eco-friendly component design. | [Ap] |
| C404.3 | Perform economic and break even analysis of various design process. | [E] |
| C404.4 | Demonstrate the knowledge of CAD software for case studies. | [A] |

**Course Contents:**

Product design- factors- morphology of design- role of allowance, process capability and tolerance in assembly- strength consideration in product design- Design for Machinability, accessibility, assembly.

Design for production of metal parts (forging, casting,, powder metallurgy) – Designing with plastics, rubber, ceramics- product value- design for safety, reliability and environmental considerations-economic analysis- break even analysis.

Human engineering consideration in product design-Ergonomics, Aesthetics- Role of computer in product design, manufacturing and management- case studies.

**Neural network in design and manufacturing** (Qualitative treatment only)

**Total hours: 45**

**Text Books:**


1 A.K. Chitale, R.C. Gupta, “Product Design and Manufacturing”, Prentice Hall of India private limited, New Delhi, 6th Revised edition, 2014.
2 Karl T. Ulrich and Steven D. Eppinger. “Product Design and Development” TataMcGraw-Hill Publishing Company Limited, 6th edition, 2015.


**Reference Books:**


1 Boothroyd, G, “Product Design for Manufacture and Assembly”, New York, CRC Press, London, third edition, 2013.
2 Otto, Kevien and Wood, Kristin, “Product Design”. Pearson Publication, New Delhi, 2nd edition, 2011.

**Web References:**

1 nptel.ac.in/courses/112101005/
2 courses.washington.edu/inde494/Design%20for%20X.ppt

**Online Resources:**

1 https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x
2 https://ocw.mit.edu/courses/.../2-007-design-and-manufacturing-i-spring-2009

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C404.1 | Understand | Online Quiz | **5** |
| C404.2 | Applying | Group Assignment | **5** |
| C404.3 | Analyse | Open source course | **5** |
| C404.4 | Evaluate | Problem solving | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 20 | 20 |
| Understand | 40 | 30 | 20 | 20 |
| Apply | 20 | 20 | 20 | 20 |
| Analyse | 20 | 20 | 20 | 20 |
| Evaluate | 0 | 20 | 20 | 20 |
| Create | 0 | 0 | 0 | 0 |

**15MT405/ 16MT405/ 17MT405** **CNC MACHINES AND PROGRAMMING** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To study the features of CNC tools and classify the NC/CNC/DNC
2. To understand the CNC part programming, and apply the knowledge in automated manufacturing.
3. To learn about interpolators and control loop for CNC manufacturing system
4. To learn about computerized numerical control drives

**Course Outcomes:**

**Upon completion of the course, students shall have the ability to**

| | | |
|---|---|---|
| C405.1 | Understand NC,CNC, DNC machines | [U] |
| C405.2 | Understand manual part programming and COMPACT II | [U] |
| C405.3 | Apply the drive concept in selection of various motors. | [AP] |
| C405.4 | Illustrate CNC technology and the control systems of CNC | [A] |

**Course Contents:**

Introduction to NC/CNC/DNC machine tools, Classification, Advantage, disadvantages, Applications, micro computers in CNC –Machine structure, slide- ways, motion transmission element, swarf removal and safety considerations, automatic tool changers, tooling for CNC machines and multiple pallet system, sensors and feedback devices in CNC machines, constructional detail of CNC turning and machining centers, classification of CNC control system. CNC open architecture.

Introduction to NC part program- manual programming, basic concepts, G & M coding for turning and milling- computer aided programming, general information, post processors – APT commands and programming, dialog programming - description of COMPACT – II.

DDA hardware interpolator, linear, circular and complete interpolators - control of point to point system, incremental open loop and closed loop controls, absolute closed loop circuit. Drives , hydraulic system, DC motors, stepping motors- feedback devices- counting devices, CIM – case studies about CNC technology in today's industries, trends of CNC cutting tool, application of developed CNC in AERO shop.

**Total hours: 45**

**Text Books:**


1 Yoramkoren, "Computer Control of Manufacturing System" McGraw Hill Education, 2015
2 Michael Fitzpatrick , " Machining and CNC Technology" McGraw Hill Education, 2011.


**Reference Books:**


1 John Stenerson and Kelly Curran, "Computer Numerical Control: Operation and Programming", PHI, New Delhi, 2012.
2 TC Chang, RA Wysk and HP Wang, "Computer Aided Manufacturing", PHI, New Delhi, 2011.

**Web References:**

1 http://nptel.ac.in/courses/112103174/38
2 http://www.cnccookbook.com/CCCNCGCodeCourse.htm

**Online Resources:**

1 http://millwright.in/freecnc/
2 https://www.coindia.in/training.html

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C405.1 | Understand | Online Quiz | **5** |
| C405.2 | Applying | Group Assignment | **5** |
| C405.3 | Analyse | Open source course | **5** |
| C405.4 | Evaluate | Problem solving | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 20 | 20 |
| Understand | 40 | 30 | 20 | 20 |
| Apply | 20 | 20 | 20 | 20 |
| Analyse | 20 | 20 | 20 | 20 |
| Evaluate | 0 | 20 | 20 | 20 |
| Create | 0 | 0 | 0 | 0 |

**15MT406/ 16MT406/ 17MT406** **MECHANICAL DESIGN FOR ROBOTICS SYSTEM** **3/0/0/3**

**Nature of Course :** C (Theory Concept)

**Pre requisites :** 15MT327- Robotics and Machine vision System

**Course Objectives:**

1. To understand the mechanical components in robots.
2. To Study the types and force analysis of end effectors.
3. To select the appropriate Servo motor.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C406.1 | Predict and apply the appropriate Mechanical linkages | [AP] |
| C406.2 | Determine the Robot joint dimensions | [U] |
| C406.3 | Design of End Effectors | [E] |
| C406.4 | Design complete robot mechanical components for particular application | [E] |

**Course Contents:**

Robotics system and robot anatomy- Specification of robots- Mechanical components of robots – Elementary mechanical concepts – Motion conversion – Robot End Effectors: classification, drive system, mechanical grippers, gripper force analysis and gripper design. Selection procedure for stepper motor.

Design of multiple DOF instrumented robot hand. Kinematics chains – Design of robotic joints and links. Step by step procedure for selecting a servo motor and final consideration.

Complete robot design along with calculation of torques and selection of components for an Egg packing problem.
Case study 1: Autonomous mobile robot design

**Total Hours: 45**

**Text Books:**


1 Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, “Robotics Engineering an Integrated Approach”, PHI Learning, 2011.
2 S.R. Deb and S. Deb, “Robotics Technology and Flexible Automation” , Tata McGraw-Hill, 2012.


**Reference Books:**


1. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, AshishDutta, “Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2012
2 A.Smali, F.Mard, “Mechatronics integrated technologies for intelligent machines”, Oxford Publication, 2015.


**Web References:**

1 https://en.wikibooks.org/wiki/Robotics/Design_Basics/Mechanical_Components
2 www.brighthubengineering.com ›
3 Roboticsieeexplore.ieee.org/document/5669867/

**Online Resources:**

1 *https://www.edx.org/course/robot-mechanics-control-part-i-snux-snu446-345-1x*

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C406.1 | Remember | Test (Definition) | **5** |
| C406.2 | Understand | Online Quiz | **5** |
| C406.3 | Apply | Problem Solving | **5** |
| C406.4 | Apply | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 0 | 0 | 0 | 0 |
| Understand | 50 | 30 | 20 | 20 |
| Apply | 50 | 40 | 60 | 60 |
| Analyse | 0 | 30 | 20 | 20 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT407/ 16MT407/ 17MT407** **THEORY OF AUTOMOBILE ENGINEERING** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To understand the construction and working principle of various parts of an automobile.
2. To have the practice for assembling and dismantling of engine parts and transmission system
3. To evaluate the performance of engine with different alternate fuels
4. To compare the different injection and ignition systems.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C407.1 | Identify the basic Automobile Components | [R] |
| C407.2 | Explain the Construction and Working principle of Front Axle, Rear Axle, Final Drive, Steering System, Brakes and Suspension System. | [U] |
| C407.3 | Conduct experiment in engine with different alternate fuels. | [AP] |
| C407.4 | Compare the different injection and ignition systems available in automobiles | [A] |

**Course Contents:**

Types of automobiles - vehicle construction and different layouts – chassis - frame and body - resistances to vehicle motion - need for a gearbox - components of engine - their forms, functions and materials. Electronically controlled gasoline injection system for SI engines - Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system) - Electronic ignition system - Turbo chargers - Fuel injection system- Engine emission control by three way catalytic converter system.

Introduction to Transmission system. Front axle – Elliot axle – Steering mechanism – Steering ratio – Steering lock – Steering box – Rack and Pinion steering gear – Power steering – Steering geometry – Front wheel alignment. Construction and operation of front suspension – Independent suspension system – Leaf spring – Rear axle suspension – Trailing arm and Shock absorbers – Mac Pherson Strut type suspension.

Purpose of braking – Hand brake system – Disc brakes – Pneumatic and Hydraulic Braking Systems - Antilock Braking System and Traction Control. Use of Natural Gas – Liquefied Petroleum Gas - Bio-diesel - Bio-ethanol - Gasohol and Hydrogen in Automobiles - Engine modifications required – Performance - Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell.

**Total Hours: 45**

**Text Books:**


1 Kirpal Singh, “Automobile Engineering - VOL 1 & 2”, Standard Publishers, Seventh edition 2011, New Delhi.
2 Srinivasan S, “Automotive Mechanics”, McGraw Hill Education, New Delhi, 2015.

**Reference Books:**

1 William H Crouse, Donald L Anglin, “Automotive Mechanics”, McGraw Hill, 2011.
2 Newton, Steeds and Garet, “Motor vehicles”, Butterworth Publishers, 2010.

**Web References:**

1 http://www.autoguide.com/new-cars/2016/audi/a6/3-0t-prestige/4dr-sdn quattro/specs.html
2 http://indiatoday.intoday.in/education/story/automobile-engineering/1/353575.html

**Online Resources:**

1 https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x
2 https://www.canvas.net/manufacturing

| **Assessment Methods & Levels (based on Bloom’s Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom’s Level** | **Assessment Component** | **Marks** |
| C407.1 | Remember | Component Identification | **5** |
| C407.2 | Understand | Online Quiz | **5** |
| C407.3 | Apply | Problem Solving | **5** |
| C407.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom’s Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 15 | 15 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 40 | 40 | 40 |
| Analyse | 0 | 30 | 15 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT408/**
**16MT408/AUTOMOTIVE ELECTRONICS 3/0/0/3**
**17MT408**

**Nature of course :** H (Theory Technology)

**Pre requisites :** 15UE305–Fundamentals of Electrical circuits and Electron Devices

**Course Objectives:**

1. To interpret the basic electronic engine control used in automobiles
2. To select appropriate Sensors and actuators for engines
3. To learn and illustrate Electronic fuel injection, ignition system and advanced control system in automobiles

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C408.1 | Elucidate the role of electronic control in vehicles. | [R] |
| C408.2 | Understand various sensors and actuators in automobiles. | [U] |
| C408.3 | Implement Electronic injection and ignition systems | [AP] |
| C408.4 | Analyse advanced vehicle control system. | [A] |

**Course Contents:**

Basics of automotive electronics-Electronic Engine Control system - Exhaust Catalytic Converters - Electronic Fuel Control System - Analysis of Intake Manifold Pressure - Idle Speed Control - Electronic Ignition-Automotive Control System.

Engine Management System - Automotive Engine Control Actuators -Carburettors - Electronic fuel injection -Safety and Comfort System-Powertrain System-Body Electronics System-Infotainment and Telematics System-Digital Engine Control - EGR Control.

Automatic Transmission Control - Variable Valve timing control - Integrated engine control system - Vehicle motion control-Electronic suspension system - Antilock braking system, Traction control system - Electronic control- system diagnostic - Onboard diagnosis system - Expert Systems in Automotive diagnosis

**Total Hours: 45**

**Text/Reference Books:**


1. B.WilliamRibbens, “Understanding Automotive Electronics”, 7th Edition, Butterworth, Heinemann, Woburn, 2015
2. H.William Crouse, Donald L.Anglin, “Automotive Mechanics*”,* 10th Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2013


**Reference books:**


1. Robert Bosch GmbH, “Bosch Automotive Electrics and Automotive Electronics”, 5th Edition, Springer Views, Germany, 2011.
2. E.WalterBilliet, F.Leslie Goings, “Automotive Electrical Equipment”, 3rd Edition, American Technical Society Ltd., Chicago, 2010.
3. D.JamesHalderman, “Diagnosis and Troubleshooting of Automotive, Electronic, and Computer Systems”, 6th Edition, Prentice Hall, New Delhi, 2012

**WEB RESOURCES:**

1. http://nptel.ac.in/courses/112103174/3
2. http://www.azinet.com/articles/real98.htm
3. www.automotive-electronics.co.uk

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C408.1 | Remember | Test | **5** |
| C408.2 | Understand | Online Quiz | **5** |
| C408.3 | Apply | Assignment | **5** |
| C408.4 | Analyse | Seminar | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 15 | 15 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 40 | 40 | 40 |
| Analyse | 0 | 30 | 15 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT409/ 16MT409/ 17MT409** **AUTONOMOUS VEHICLE GUIDANCE SYSTEM** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To introduce the concepts behind autonomous vehicle guidance and coordination.
2. To design and implement guidance strategies for vehicles incorporating planning, optimizing and reacting elements.
3. To develop the theory behind coordinated swarms of autonomous vehicles.
4. To describe the theory and implementation of motion detection systems.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C409.1 | Understand the basic working principles of Autonomous Vehicle Guidance systems. | [U] |
| C409.2 | Develop path planning systems for autonomous vehicle guidance. | [C] |
| C409.3 | Design and implement obstacle avoidance methods within an autonomous regime. | [C] |
| C409.4 | Implement search algorithms for autonomous vehicle guidance, navigation and control. | [A] |

**Course Contents:**

Introduction to Electric Vehicle- development - system layout - basic system components - Electric battery solar cells - Rapid charging system - Motor drive system - fuel cell Electric vehicle - Hybrid vehicle - Series - Hybrid Vehicle - Parallel Hybrid Vehicle - CNG Electric hybrid vehicle. Autonomous vehicles systems (AVS) **–** Introduction, missions, capabilities, types, configurations and subsystems.

UAVs -unmanned aerial vehicle - ground, surface water & underwater- Remotely operated vehicle (ROV) - levels of autonomy - coordinate systems - equations of motion and transformations for payloads - sensors & actuators - inertial measurement& navigation, Global Positioning System (GPS) **-** PID automatic control – guidance – navigation - vision-based guidance for ground vehicles.

Communication & telemetry systems - mission planning - ground control systems & operator interfaces - estimation of vehicle weight, power, & performance - manual remote control technologies & operations - embedded computer system design **-** Introduction to Vehicle motion control - Adaptive cruise control-Electronic transmission control - Vehicle stabilization system - Antilock braking system - Traction control system- Electronic stability program - low tyre pressure warning system - Onboard diagnosis system

Introduction to vehicle intelligence (Qualitative Treatment Only)

**Total Hours: 45**

**Text Books:**

1 William B. Ribbens, “Understanding Automotive Electronics”, 7th edition Elsevier Science, 2012.
2 Richard Kendall Miller, “Survey On Autonomous Vehicle Guidance Systems”, 2010

**Reference Books:**

1 Ronald K. Jurgen, “Electric and Hybrid-electric vehicles”, SAE, 2012.
2 Ichiro Masaki, “Vision-based Vehicle Guidance”, Springer verlag, New York, 2011.

**Web References:**

1 ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6723936.
2 journals.cambridge.org/article_S0263574700016568.

**Online Resources:**

1 *ieeexplore.ieee.org/document/5262854/*
2 https://github.com/takeitallsource/awesome-autonomous-vehicles

| **Assessment Methods & Levels (based on Bloom’s Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom’s Level** | **Assessment Component** | **Marks** |
| C409.1 | Understand | Online quiz | **5** |
| C409.2 | Create | Class notes | **5** |
| C409.3 | Create | Problem Solving | **5** |
| C409.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom’s Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 10 | 10 |
| Understand | 30 | 20 | 20 | 25 |
| Apply | 40 | 30 | 40 | 25 |
| Analyse | 10 | 20 | 15 | 15 |
| Evaluate | 0 | 20 | 0 | 15 |
| Create | 0 | 0 | 15 | 10 |

**15MT410/ 16MT410/ 17MT410** **AUTOMATED MATERIAL HANDLING SYSTEMS** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To develop skills of analyzing the automation concepts.
2. To design an automated materials handling, storage and assembly system.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C410.1 | Understand the importance of manufacturing unit layout and process flow chart. | [R] |
| C410.2 | Apply the productivity improvements due to the automation of material handling methods & Automated storage system | [AP] |
| C410.3 | Apply automatic transfer lines & automated manufacturing system | [AP] |
| C410.4 | Do the quantitative analysis of automated assembly system | [A] |

**Course Contents:**

Overview of material handling equipment – Considerations in material handling system design – 10 principles of material handling – Automation of material handling – Mechanism of part handling - Industrial trucks – AGV systems – mobile Robots – Mono Rails, manipulators, storage systems, elevators, racks, bins, and other Rail Guided Vehicles.

Conveyors systems – Cranes and Hoists – Analysis of Material transport systems. Storage system performance – storage location strategies – Conventional storage methods and equipment's – Automated storage systems.

Engineering Analysis of Automated storage systems - AS/RS – Quantitative analysis- Carousel storage system. Fundamentals of Automated Assembly systems – Design for Automated Assembly – Bar-code techniques – Robotics in material handling system.

**Total Hours: 45**

**Text Books:**


1 Mikell.P.Groover, "Automation, Production System and Computer integrated manufacturing", Prentice Hall of India Pvt. Ltd., New Delhi, 2013
2 S.Kant. Vajpayee , "Principles of Computer Integrated Manufacturing", Prentice Hall of India Pvt. Ltd., 2016.
3 G.K. Agarwal, "Plant Layout and material handling", Jain Brothers, Delhi, 2011.


**Reference Books:**


1 Mulcahy.D.E. "Material handling hand book", McGraw Hill, New York, 2013
2 Kulwiec R.A." Material Handling Hand book" 2nd Edition, JohnWiely& Sons Inc., New York, 2012.
3 Charles D Reese, "Material Handling Systems", Taylor And Francis, 2011.

**Web References:**

1 http://www.mmh.com/topic/category/automation
2 http://galecia.com/content/automated-materials-handling
3 http://www.cisco-eagle.com/material-handling-systems
4 https://www.bastiansolutions.com/case-studies

**Online Resources:**

1 http://nptel.ac.in/courses/112102011/

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C410.1 | Remember | Test | **5** |
| C410.2 | Apply | Online Quiz | **5** |
| C410.3 | Apply | Current trends in AMHS - report | **5** |
| C410.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 15 | 15 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 40 | 40 | 40 |
| Analyse | 0 | 30 | 15 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT411/ 16MT411/ 17MT411** **MEDICAL MECHATRONICS** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To understand how to measure biochemical parameters and various physiological information.
2. To study the need and technique of electrical safety in Hospitals.
3. To study the use of radiation for diagnostic and therapy.
4. To study about recorders and advanced equipment in medicine

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C411.1 | Explain different measurement techniques used in physiological parameter measurement. | [R] |
| C411.2 | Describe the sensors and signal conditioning circuits used in biomedical engineering. | [U] |
| C411.3 | Comment on various measurement systems used in diagnostics. | [A] |
| C411.4 | Differentiate the working of recorders and explain the advanced systems used in medicine. | [AP] |

**Course Contents:**

Introduction- Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential , source of bioelectric potentials – electrodes for their measurement, ECG, EEG, EMG – machine description – methods of measurement.Basic transducer principles Types –— resistive, inductive, capacitive, fiber-optic, photoelectric, chemical, active and passive transducers and their description and feature applicable for biomedical instrumentation – Bio, Nano sensors and application.

Blood pressure measurement: by ultrasonic method – plethysmography – blood flow measurement by electromagnetic flow meter, cardiac output measurement by dilution method – phonocardiography – vector cardiography. Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – cardiac pacemaker –defibrillator patient safety - electrical shock hazards - Centralized patient monitoring system.

Oscillographic, galvanometric and thermal array recorder, photographic recorder, storage oscilloscopes, electron microscope. Biotelemetry, Diathermy, Audiometers, Dialysers, Lithotripsy.
Case Study:-Hot wire Anemometry for respiratory flow measurements, Surgical robots.

**Total Hours: 45**

**Text Books:**

1 Khandpur, R.S., “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, 2014.
2 Cromwell, Weibell and Pfeiffer, “Biomedical Instrumentation and Measurements”, Prentice Hall of India, 2012.

**Reference Books:**

1 SiamakNajarian, “Mechatronics in Medicine – A Bio medical engineering approach" , Tata McGraw Hill, 2011.
2 Geddes L.A., and Baker, L.E., “Principles of Applied Bio-medical Instrumentation”, John Wiley and Sons, 3rd Edition, 2010.

**Web References:**

1 http://www.nptel.ac.in/courses/ 102106057/
2 http://nptel.ac.in/course.php
3 http://www.davincisolutions.net/Services.html

**Online Resources:**

1 https://www.edx.org/course/medical-genomics-101-davidsonx-medgen101x
2 https://www.edx.org/course/cyber-physical-systems-uc-berkeleyx-eecs149-1x

| **Assessment Methods & Levels (based on Bloom’s Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom’s Level** | **Assessment Component** | **Marks** |
| C411.1 | Remember | Test | **5** |
| C411.2 | Understand | Online Quiz | **5** |
| C411.3 | Analyse | Presentation-Case study | **5** |
| C411.4 | Apply | Group Assignment | **5** |

**Summative assessment based on Continuous and End Semester Examination**

| **Bloom’s Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
|---|---|---|---|---|
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 45 | 20 | 15 | 20 |
| Understand | 30 | 20 | 20 | 20 |
| Apply | 25 | 25 | 35 | 35 |
| Analyse | 0 | 35 | 20 | 25 |
| Evaluate | 0 | 0 | 10 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT412/ 16MT412/ 17MT412** **MOBILE ROBOTICS** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Knowledge of Python

**Course Objectives:**

1. To familiarize the students with mobile robots.
2. To understand the basic methods for achieving mobility and autonomy.
3. To provide a practical understanding of robotic navigation and locomotion

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C412.1 | Select various sensors used for perception, localization and mapping | [R] |
| C412.2 | Formulate control algorithms involved in mobile robots | [U] |
| C412.3 | Analyse kinematic modeling in mobile robots | [A] |
| C412.4 | Create various algorithms in path planning and navigation | [AP] |

**Course Contents:**

Introduction - Locomotion, Classification- Key issues in locomotion. Mobile Robot Kinematics - Kinematic model- Forward Kinematic model, Representing position, Wheel kinematic constraints. Motion control - Control theory - Control design basics, Cruise-Controllers, Performance Objectives. Simple robot – State space model, Linearization, LTI system, stability. PID control, basic control algorithms

Perception - Sensors for mobile robots – Classification, performance, uncertainty in sensors, wheel sensor, heading sensor, accelerometers, inertial measurement, motion sensor, range sensors. Vision sensor- Basics of computer vision, image processing techniques, feature extraction – image, range data location recognition.

Localization - Major challenges, localization based navigation. Belief representation, map representation, probabilistic Map. Examples of localization systems. Autonomous map building Planning and Reaction- Path Planning – graph search, D* algorithm, Potential field. Obstacle avoidance – bug algorithm, histogram, curvature velocity techniques. Navigation architecture, Case study- Mobile robot in military application.

**Total Hours: 45**

**Text Books:**


1 Roland Siegwart, IllahR.Nourbakhsh, “Introduction to Autonomous Mobile Robots”, 2nd Edition, 2011
2 Choset. et al, “Principles of Robot Motion: Theory, Algorithm & Implementations”, MIT Press, 2011


**Reference Books:**


1 Thrun, Burgard, Fox, “Probabilistic Robotics”, MIT Press, 2013
2 Siciliano, Khatib, Eds., “Handbook of Robotics”, Springer, 2011

**Web References:**

1 http://nptel.ac.in/courses/112108093/module1/lecture.pdf
2 http://nptel.ac.in/courses/112101099/
3 http://www.cas.kth.se/cosy-lite/presentations/robot-intro.pdf

**Online Resources:**

1 https://www.open2study.com/courses/mobile-robotics
2 http://www.skyfilabs.com/online-courses/mobile-robotics?v1

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C412.1 | Remember | Simulation Exercise | **5** |
| C412.2 | Understand | Quiz | **5** |
| C412.3 | Analyse | Presentation on advanced robots | **5** |
| C412.4 | Apply | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 15 | 15 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 40 | 40 | 40 |
| Analyse | 0 | 30 | 15 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

| | | |
|---|---|---|
| **15MT413/ 16MT413/ 17MT413** | **INTEGRATED ELECTRONIC CIRCUIT** | **3/0/0/3** |

**Nature of Course :** C (Theory Concept)

**Pre requisites :** 15UE305- Fundamentals of Electrical circuits andElectron Devices

**Course Objectives:**

1. To provide insight on basic feedback amplifier.
2. To understand Power amplifier and signal generation circuits.
3. To develop knowledge of Tuned amplifier.
4. To enable the students to be aware of the application areas of operational amplifiers

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C413.1 | Demonstrate operation of Integrated circuits and Feedback amplifiers | [R] |
| C413.2 | Explain the working of Oscillators and Signal generator | [U] |
| C413.3 | Interpret the working of Tuned amplifiers used in Electronic Circuit design. | [AP] |
| C413.4 | Analyse linear and non-linear applications of operational amplifiers. | [AN] |

**Course Contents:**

Integrated Circuits: Fabrication and Characteristics; Transistor at Low Frequencies; Feedback amplifiers; Stability and Oscillators; Power amplifiers: class A, B, AB, C, D, E stages, output stages, short circuit protection; Signal generation: sinusoidal oscillators- RC, LC, and crystal oscillators, multi-vibrators.

Tuned Amplifiers: Single tuned amplifier, Overview of Double tuned amplifier and stagger tuned amplifier. Operational Amplifiers :Basic information about IC741 op-amps, Applications- Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier.

Integrator, Differentiator, Comparators, Schmitt trigger, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.
Case study- µA741-operational amplifier

**Total Hours: 45**

**Text Books:**


1. Jacob Millman, Chritos C Halkias, SatyabrataJit, “Electronic Devices and Circuits”, 4th edition (SIE), McGraw Hill Education India Private Ltd., 2015.
2. D.RoyChoudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2011.


**Reference Books:**


1. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 9th Edition, Pearson Education / PHI, 2014.
2. Floyd, “Electronic Devices”, 9th Edition, Pearson Education, 2011

**Web References:**

1 www.allaboutcircuits.com
2 www.circuitstoday.com

**Online Resources:**

1 http://www.electronics-tutorials.ws

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C413.1 | Remember | Quiz | **5** |
| C413.2 | Understand | Test | **5** |
| C413.3 | Apply | Group Assignment | **5** |
| C413.4 | Analyse | Class Presentation | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 40 | 20 | 20 | 20 |
| Understand | 60 | 60 | 40 | 40 |
| Apply | - | 20 | 20 | 20 |
| Analyse | - | - | 20 | 20 |
| Evaluate | - | - | - | - |
| Create | - | - | - | - |

**15MT414/ 16MT414/ 17MT414** **PRINCIPLES OF AI AND EXPERT SYSTEMS** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To study the idea of intelligent agents and search methods.
2. To study the reasoning and decision making in uncertain world.
3. To study the concepts of expert systems and machine learning

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C414.1 | Identify problems that are amenable to solution by AI methods. | [R] |
| C414.2 | Formalise a given problem in the language/framework of different methods. | [U] |
| C414.3 | Identify appropriate AI methods to solve a given problem. | [A] |
| C414.4 | Implement Basic AI algorithms. | [AP] |

**Course Contents:**

Introduction to AI: Intelligent agents – Problem solving- Solving problems by searching, Informed search methods- Knowledge and reasoning- logical reasoning system- First order logic.

Planning- Practical planning, planning and acting, conditional planning- Uncertainty- Making simple and complex decisions- Learning from observations, Learning in neural and belief network, Reinforcement learning, Knowledge in learning- Communicate agent.

Practical natural language processing- Perception. Expert systems - Architecture of an expert system–Knowledge Acquisition in expert systems – Expert system shells- Expert system tools. Machine learning, Adaptive learning
Case Study-Robotic process automation combines artificial intelligence.

**Total Hours: 45**

**Text Books:**


1 Stuart Russel and Peter Norvig, “Artificial Intelligence A Modern Approach”, Second Edition, Pearson Education, 2014.
2 Timothy Jordanides& Bruce Torby, “Expert System and Robotics”, Springer Publishing Company,2012.


**Reference Books:**


1 George F.Luger, “Artificial Intelligence – Structures and Strategies for Complex Problem Solving”, Fourth Edition, Pearson Education, 2011.
2 N.P.Padhy, “Artificial Intelligence and intelligent system”, Oxford Universal Press, 2010.
3 Matt Ginsberg, “Essentials of Artificial Intelligence”, Morgan Kaufmann Publishers, 2012.
4 Michel Gondran, “AI and Expert Systems”, Prentice-Hall of India Pvt.ltd, 2012.

**Web References:**

1 http://www.nptel.ac.in/courses/106106126/
2 http://nptel.ac.in/courses/106105077//

**Online Resources:**

1 https://www.edx.org/course/artificial-intelligence-ai-columbiax-csmm-101x
2 https://www.coursera.org/learn/machine-learning

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C414.1 | Remember | Test (Definition) | **5** |
| C414.2 | Understand | Online Quiz | **5** |
| C414.3 | Analyse | Problem Solving | **5** |
| C414.4 | Apply | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 25 | 15 | 25 | 20 |
| Understand | 35 | 25 | 25 | 25 |
| Apply | 40 | 30 | 25 | 30 |
| Analyse | 0 | 30 | 25 | 25 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT415/ 16MT415/ 17MT415** **EMBEDDED SYSTEM IN AUTOMATION** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** 15MT316-Embedded System

**Course Objectives:**

1. To familiarize embedded C and assembly programming.
2. To learn software modeling fundamentals
3. To know about typical engineering issues of embedded software development

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C415.1 | Design of Embedded system | [R] |
| C415.2 | Program Embedded Systems | [U] |
| C415.3 | Develop, test & analyse new micro architecture for Embedded Processors | [A] |
| C415.4 | Design systems for Real-Time Processing. | [AP] |

**Course Contents:**

Introduction to embedded system- Embedded system Design and Development Process - Programming concepts and embedded programming in C- Programming in Assembly Language(ALP) and in High Level Language 'C ' ,'C' Program Element ,Use of Loops, Function calls, Multiple Function Calls in Cyclic Order, Queuing of Function on Interrupts and Interrupt Service Routine Queues.

Programming modelling concepts- Embedded software development process and tools-Hardware testing, simulation and debugging techniques and tools-Integration and Testing, Testing Methods, Debugging Techniques.

Design examples and case studies of program-modelling and programming with RTOS: Digital camera, application to communication- Network router for IP Packets, Embedded system in robotics, Orchestra playing robots, mobile phone software for key inputs, RTOS for control systems

**Total Hours: 45**

**Text Books:**


1 Raj Kamal, "Embedded systems- Architecture, Programming and design, Tata McGraw-Hill,2016
2 James K Peckol, "Embedded systems- A Contemporary design tool", Wiley, 2013.


**Reference Books:**


1 Hermann Kopetz, "Real-Time Syatems- Design Principles for distributed Embedded Applications", Second Edition, Springer 2011.
2 Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready- To-Use Modules in C", The Publisher, Paul Temme, 2011.

**Web References:**

1 http://www.nptel.ac.in/courses/108102045/1
2 http://nptel.ac.in/courses/Webcourse-contents/IITKharagpur/Embedded systems/New_inex1.html

**Online Resources:**

1 https://www.embedded.com
2 https://www.ecpe.nu.ac.th/ponpisut/22323006-Embeddded-c-Tutorial

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C415.1 | Remember | Test (Definition) | **5** |
| C415.2 | Understand | Online Quiz | **5** |
| C415.3 | Analyse | Problem Solving (Programming) | **5** |
| C415.4 | Apply | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 30 | 15 | 10 | 15 |
| Understand | 35 | 25 | 25 | 30 |
| Apply | 35 | 35 | 40 | 40 |
| Analyse | 0 | 25 | 25 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT416/ 16MT416/ 17MT416** **INTERNET OF THINGS FOR MECHATRONICS** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** Nil

**Course Objectives:**

1. To understand the basics of Internet of Things
2. To understand different applications of Internet of Things
3. To understand the fundamental aspects of IoT.

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C416.1 | Explain the basic architecture and platform of IoT. | [R] |
| C416.2 | Explain the working principle of IoT | [U] |
| C416.3 | Develop, test & analyse a new IoT system. | [A] |
| C416.4 | Design systems for Real-Time Processing. | [AP] |

**Course Contents:**

Definitions and Functional Requirements –Motivation – Architecture - IoT architecture and platforms - IoT Devices vs. Computers - Trends in the Adoption of IoT - Societal Benefits of IoT – IoT Information Security - Embedded Systems. Sensing methods - Sensors types – Active, Passive sensors – Environmental sensing methods.

Sensor Fusion - Evolving Sensor Technologies - Leveraging Sensor Fusion for the IoT - IoT Sensor Manufacturers - IoT Sensor Data Platforms. Basics of Controllers - Interfacing methodologies - Controllers selection – GPIO interfaces – SPI interfaces – I2C interfaces – RTC interfaces – IDE usage – Bootloader – Memory utilization (EEPROM /Flash).

Basic programing of controllers – Controllers Expansion boards (breakouts). Hardware Platforms - Intel Galileo, Edison, Arduino, Beaglebone Black & Raspberry Pi.
Software Platforms - Intel XDK, Node-RED, VISUINO, Fritzing, 123dCircuits, Scratch.

**Total Hours: 45**

**Text Books:**


1 MaciejKranz, “Building Internet of Things”, John Wiley and Sons, 2016
2 Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015.


**Reference Books:**


1 Samuel Greengard, “The Internet of Things”, Second Edition, MIT Press, 2015.
2 Michael Miller, “The Internet of Things”, Que Publishing, 2015.


**Web References:**

1 iofthings.org/
2 https://www.theguardian.com /Technology/Internet of things

**Online Resources:**

1 https://www.coursera.org/specializations/iot
2 http://web.mit.edu/professional/digital-programs/courses/IoT/

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C416.1 | Remember | Weekly Milestones | **5** |
| C416.2 | Understand | Online Quiz | **5** |
| C416.3 | Analyse | Prototypes | **5** |
| C416.4 | Apply | Demonstration / Showcasing an Idea | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 30 | 15 | 10 | 15 |
| Understand | 35 | 25 | 25 | 30 |
| Apply | 35 | 35 | 40 | 40 |
| Analyse | 0 | 25 | 25 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT417/ 16MT417/ 17MT417** **AUTOMATIC CONTROL SYSTEM** **3/0/0/3**

**Nature of Course :** H (Theory Technology)

**Pre requisites :** 15MT311- Theory of Control Systems

**Course Objectives:**

1. To apply the knowledge of mathematics, science and engineering.
2. To analyze different controllers for various applications.
3. To design and develop real time systems

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C417.1 | Predict system behavior based mathematical model in time or frequency domain | [R] |
| C417.2 | Devise a safe and effective method of investigating a system | [A] |
| C417.3 | Design controllers using classical PID methods. | [AP] |
| C417.4 | Determine the (absolute) stability of a closed-loop control system | [A] |

**Course Contents:**

Introduction to Automatic Control - Configurations of controllers, time and frequency domain performance measures, PID control of SISO systems and TITO systems, PID controller, its variants and limitations, PI-PD control, effects of measurement noise and load disturbances, Identification of plant model, frequency domain, off-line, on-line, accuracy and sensitivity.

Time domain based and state space based identification methods, accuracy and sensitivity, model based controller design, model-free controller design, automatic and on-line tuning of controllers, real time applications of the control algorithms, Field programmable analog/digital array based design of controllers.

Introduction to Sequence Control, PLC, RLL - Sequence Control. Scan Cycle, Simple RLL Programs.

**Total Hours: 45**

**Text Books:**


1 Benjamin C.Kuo, FaridGolnaraghi, “Automatic Control Systems”, 8th Edition, John Wiley & Sons, 2013.
2 Katsuhiko Ogata, “Modern Control Engineering”, 4th Edition, Prentice Hall of India 2010.


**Reference Books:**


1. Richarc C. Drof and Robert H. Bishop, “Modern Control System”,11th Edition Person International, 2012
2. Nagrath and Gopal, “Control Systems Engineering”, New Age Publication, 2011

**Web References:**

1 http://www.nptelvideos.in/2012/11/industrial-automation-and-control.html
2 http://freevideolectures.com/Course/2345/Industrial-Automation-and-Control/11

**Online Resources:**

1 https://www.edx.org/course?search_query=automatic+control+systems
2 https://www.coursera.org/courses?languages=en&query=automatic+control+systems

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C417.1 | Remember | Test (Definition) | **5** |
| C417.2 | Understand | Online Quiz | **5** |
| C417.3 | Apply | Problem Solving | **5** |
| C417.4 | Analyse | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 20 | 10 | 15 | 15 |
| Understand | 40 | 20 | 30 | 30 |
| Apply | 40 | 40 | 40 | 40 |
| Analyse | 0 | 30 | 15 | 15 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |

**15MT418/ 16MT418/ 17MT418** **INTELLIGENT CONTROL SYSTEMS** **3/0/0/3**

**Nature of Course :** H (Theory and Technology)

**Pre requisites :** 15MT311- Theory of Control system

**Course Objectives:**

1. To introduce the ideas of artificial neural network, fuzzy sets and fuzzy logic
2. To study basics of control-theoretic foundations such as stability and robustness in the frame work of intelligent control.
3. To impart knowledge on various control techniques
4. To create awareness of the application areas of intelligent technique

**Course Outcomes:**

**Upon completion of the course, students shall have ability to**

| | | |
|---|---|---|
| C418.1 | Select the most appropriate biological intelligent system | [U] |
| C418.2 | Optimize the system using various techniques | [A] |
| C418.3 | Analyse the stability of the system | [A] |
| C418.4 | Apply intelligent techniques to overcome real world problems | [AP] |

**Course Contents:**

Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks - Fuzzy logic, knowledge representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Fuzzy and expert control (standard, Takagi - Sugeno, Parametric optimization of fuzzy logic controller using genetic algorithm - System identification using neural and fuzzy neural networks - Lyapunov stability theory.

Adaptive control using neural and fuzzy neural networks, Direct and Indirect adaptive control, and Self-tuning PID Controllers- Applications to pH reactor control, robot manipulator dynamic control, under actuated systems such as inverted pendulum and inertia wheel pendulum control

**Total Hours: 45**

**Text Books:**


1 S.N.Sivanandam, S.N. Deepa, “Principles of soft computing”, John Willey & sons, 2013
2 J.S. R. Jang, C.T. Sun, and E. Mizutani, “Neuro-Fuzzy and Soft Computing - A computational approach to learning and machine intelligence”, Prentice Hall, 2011.


**Reference Books:**


1 LaureneFauseett, “Fundamentals of Neural Networks”, Prentice Hall India, New Delhi, 2012
2 ErdalKayacan, MojtabaAhmadiehKhaneswar, “ Fuzzy neural networks for Real time control applications”, Elsevier, 2015

**Web References:**

1 http://www.softcomputing.es
2 www.soft-computing.de/def.html

**Online Resources:**

1 https://www.edx.org/course/artificial-intelligence-ai-columbiax-csmm-101x

| **Assessment Methods & Levels (based on Bloom's Taxonomy)** | | | |
|---|---|---|---|
| **Formative assessment based on Capstone Model (Max. Marks:20)** | | | |
| **Course Outcome** | **Bloom's Level** | **Assessment Component** | **Marks** |
| C418.1 | Understanding | Test (Definition) | **5** |
| C418.2 | Analyse | Online Quiz | **5** |
| C418.3 | Analyse | Case study | **5** |
| C418.4 | Apply | Group Assignment | **5** |

| **Summative assessment based on Continuous and End Semester Examination** | | | | |
|---|---|---|---|---|
| **Bloom's Level** | **Continuous Assessment** | | | **End Semester Examination [60 marks]** |
| | **CIA-I [6 marks]** | **CIA-II [6 marks]** | **Term End Examination [8 marks]** | |
| Remember | 0 | 0 | 0 | 0 |
| Understand | 40 | 30 | 40 | 40 |
| Apply | 30 | 40 | 35 | 40 |
| Analyse | 30 | 30 | 25 | 20 |
| Evaluate | 0 | 0 | 0 | 0 |
| Create | 0 | 0 | 0 | 0 |