**KUMARAGURUCOLLEGE OF TECHNOLOGY**

**(An Autonomous Institution Affiliated to Anna University, Chennai)**

**COIMBATORE – 641049**

# REGULATIONS 2015

# CURRICULUM AND SYLLABUS

# F:\KCT LOGO (4).jpg

**3rd to 8th Semesters**

**BE MECHATRONICS ENGINEERING**

**DEPARTMENT OF MECHATRONICS ENGINEERING**

**KUMARAGURU COLLEGE OF TECHNOLOGY**

**(Autonomous Institution Affiliated to Anna University, Chennai)**

**COIMBATORE – 641049**

**B.E. MECHATRONICS ENGINEERING**

**VISION**

To achieve academic and industrial excellence in industrial automation research and innovative product development driven by mechatronics systems.

**MISSION**

“The Department is committed to impart the right blend of knowledge and apply the knowledge in real life situations with constant engagement in research to cater the local and global needs.

**PROGRAM EDUCATIONAL OBJECTIVES (PEO):**

* Develop innovative and sustainable products with multidisciplinary Engineering expertise.
* Solve complex engineering problems by applying mechanical, electrical and .computer knowledge and engage in life long learning in their profession
* Work or pursue higher education in multicultural, multilingual and multinational environment with competent oral and written communication.
* Lead and contribute in a team entrusted with professional, social and ethical responsibilities.

**(A)PROGRAM OUTCOMES (PO):**

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**(B) PROGRAM SPECIFIC OUTCOMES (PSOs)**

1. Design and develop Mechatronics systems to solve the complex engineering problem by integrating electronics, mechanical and control systems.
2. Apply the engineering knowledge to conduct investigations of complex engineering problem related to instrumentation, control, automation, robotics and provide solutions.

KUMARAGURU COLLEGE OF TECHNOLOGY, COIMBATORE 641 049

**(An Autonomous Institution to Anna University, Chennai)**

# Regulations - 2015

**B.E. MECHATRONICS ENGINEERING**

**CURRICULUM AND SYLLABI**

**SEMESTER – III**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MAT305 | Transform methods and Partial Differential Equations | BS | 4 | 3 | 2 | 0 | 4 |  |
| U15MC*T*301 | Mechanics of solids for Mechatronics | ES | 4 | 3 | 1 | 0 | 4 |  |
| U15MC*T*302 | Mechanics of Fluids for Mechatronics | ES | 4 | 3 | 1 | 0 | 4 |  |
| U15MC*T*303 | Sensors and Instrumentation | PC | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*T*304 | Electrical Machines and Drives | PC | 3 | 3 | 0 | 0 | 3 |  |
| U15GS*T*001 | Environmental Science and Engineering | MC | 3 | 3 | 0 | 0 | 3 |  |
| **PRACTICAL** | | | | | | | |  |
| U15MC*P*301 | Fluid Mechanics and Machinery Laboratory | ES | 3 | 0 | 0 | 3 | 1 |  |
| U15MC*P*302 | Sensors and Instrumentation Laboratory | PC | 3 | 0 | 0 | 3 | 1 |  |
| U15GH*P*301 | Family Values | HS | 1 | 1 | 0 | 0 | 1 |  |
|  | TOTAL |  | 28 |  |  |  | 24 |  |

**Total periods – 28 Total credits – 24**

**SEMESTER – IV**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MA*T*401 | Numerical Methods | BS | 4 | 3 | 2 | 0 | 4 |  |
| U15MC*T*401 | Manufacturing Technology | PC | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*T*402 | Industrial Electronics | PC | 3 | 3 | 0 | 0 | 3 |  |
| U15 MC*T*403 | Kinematics of Machinery | PC | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*T*404 | Digital Electronics and Microprocessor | PC | 3 | 3 | 0 | 0 | 3 |  |
| U15GS*T*008 | Foundation skills in Integrated Product Development | EEC | 3 | 3 | 0 | 0 | 3 |  |
| **PRACTICAL** | | | | | | | |  |
| U15MC*P*401 | Electrical Drive System Laboratory | PC | 3 | 0 | 0 | 3 | 1 |  |
| U15MC*P*402 | Manufacturing Technology Laboratory | PC | 3 | 0 | 0 | 3 | 1 |  |
| U15EN*P*401 | Communication Skill Laboratory | MC | 3 | 0 | 0 | 3 | 1 |  |
| U15GHP401 | Professional Values | HS | 1 | 1 | 0 | 0 | 1 |  |
|  | TOTAL |  | 29 |  |  |  | 23 |  |

**Total periods – 29 Total credits - 23**

**SEMESTER – V**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MC*T*501 | Signals and Systems | PC | 4 | 3 | 1 | 0 | 4 |  |
| U15MC*T*502 | Control Engineering | PC | 4 | 2 | 2 | 0 | 3 |  |
| U15MC*T*503 | Dynamics of Machinery | PC | 4 | 2 | 2 | 0 | 3 |  |
| U15MC*T*504 | Mechatronics for Machining | PC | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*T*505 | Industrial Automation I | PC | 3 | 3 | 0 | 0 | 3 |  |
| OE1\* | Open Elective–I | OE | 3 | 3 | 0 | 0 | 3 |  |
| **PRACTICAL** | | | | | | | |  |
| U15MC*P*501 | Industrial Automation I Laboratory | PC | 3 | 0 | 0 | 3 | 1 |  |
| U15MC*P*502 | Machine Dynamics Laboratory | PC | 3 | 0 | 0 | 3 | 1 |  |
| U15GHP501 | Social Values | HS | 1 | 1 | 0 | 1 | 1 |  |
|  | TOTAL |  | 30 |  |  |  | 22 |  |

**Total periods – 30 Total credits - 22**

**SEMESTER–VI**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MC*T*601 | Microcontroller and Embedded Systems | PC | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*T*602 | Design of Machine Elements | PC | 4 | 2 | 2 | 0 | 3 |  |
| U15MC*T*603 | Thermodynamics and Heat Transfer | ES | 4 | 2 | 2 | 0 | 3 |  |
| E1 \* | Elective – I | PE | 3 | 2 | 0 | 1 | 3 |  |
| E2\*\* | Elective–II | PE | 3 | 3 | 0 | 0 | 3 |  |
| OE2\*\* | Open Elective–II | OE | 3 | 3 | 0 | 0 | 3 |  |
| **PRACTICAL** | | | | | | | |  |
| U15MC*P*601 | CAD/CAM Laboratory | PC | 3 | 0 | 0 | 3 | 1 |  |
| U15MC*P*602 | Embedded system laboratory | PC | 3 | 0 | 0 | 3 | 1 |  |
| U15GH*P*601 | National Values | HS | 1 | 1 | 0 | 1 | 1 |  |
|  | TOTAL |  | 27 |  |  |  | 21 |  |

**Total periods – 27 Total credits – 21**

**SEMESTER–VII**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MC*T*701 | Robotics Engineering | PC | 3 | 3 | 0 | 0 | 3 |  |
| U15MCT702 | Industrial Automation II | PC | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*T*703 | Automotive Electronics | PC | 3 | 3 | 0 | 0 | 3 |  |
| E3\*\*\* | Elective–III | PE | 3 | 3 | 0 | 0 | 3 |  |
| E4\*\*\*\* | Elective–IV | PE | 3 | 3 | 0 | 0 | 3 |  |
| OE3\*\*\* | Open Elective–III | OE | 3 | 3 | 0 | 0 | 3 |  |
| **PRACTICAL** | | | | | | | |  |
| U15MCP701 | Project Work Phase I | EEC | 4 | 0 | 0 | 4 | 2 |  |
| U15MC*P*702 | Robotics Laboratory | PC | 3 | 0 | 0 | 3 | 1 |  |
| U15MC*P*703 | Industrial Automation II Laboratory | PC | 3 | 0 | 0 | 3 | 1 |  |
| U15GHP601 | Global Values | HS | 1 | 1 | 0 | 1 | 1 |  |
|  | TOTAL |  | 29 |  |  |  | 23 |  |

**Total periods – 29 Total credits – 23**

**SEMESTER–VIII**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| E5\*\*\*\*\* | Elective–V | PE | 3 | 3 | 0 | 0 | 3 |  |
| E6\*\*\*\*\*\* | Elective–VI | PE | 3 | 3 | 0 | 0 | 3 |  |
| **PRACTICAL** | | | | | | | |  |
| U15MCP801 | Project Work Phase II | EEC | 24 | 0 | 0 | 24 | 12 |  |
|  | TOTAL |  | 30 |  |  |  | 18 |  |

**Total periods – 30 Total credits - 18**

**Total Credits (3rd to 8th Semesters) = 131**

**Overall Total Credits (1st to 8th Semesters) = 182**

**\*OPEN ELECTIVE**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MC*OE*01 | Robotics for Engineers | OE | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*OE*02 | Biomimetics and bioinspired design | OE | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*OE*03 | Textile Mechatronics | OE | 3 | 3 | 0 | 0 | 3 |  |

**ELECTIVE I**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MCE101 | Soft Computing | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15MCE102 | Functional programming | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15MCE103 | Introduction to Android Programming | PE | 3 | 3 | 0 | 0 | 3 |  |

**ELECTIVE II**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MCE201 | Machine Vision System | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*E*202 | Medical Mechatronics | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*E*203 | Digital Signal Processing | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*E*204 | Micro Electro Mechanical Systems | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*E205* | Mobile Robotics | PE | 3 | 3 | 0 | 0 | 3 |  |

**ELECTIVE III**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MC*E*301 | Finite Element Analysis | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15MC*E*302 | Design of Material Handling System | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15MCE303 | Computer Integrated Manufacturing | PE | 3 | 3 | 0 | 0 | 3 |  |

**ELECTIVE IV**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MCE401 | Modeling and Simulation | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15MAT701 | Probability and Applied Statistics | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15GST004 | Operations Research | PE | 3 | 3 | 0 | 0 | 3 |  |

**ELECTIVE V**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MCE501 | Engineering Economics and Project Management | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15GS*T*002 | Total quality Management | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15GST003 | Principles of Management | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15GST007 | Professional Ethics | PE | 3 | 3 | 0 | 0 | 3 |  |

**ELECTIVE VI**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| **THEORY** | | | | | | | |  |
| U15MC*E*601 | Renewable Energy Sources | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15MCE602 | Composite Materials and Sustainable Development | PE | 3 | 3 | 0 | 0 | 3 |  |
| U15MCE603 | Engineering Metrology | PE | 3 | 3 | 0 | 0 | 3 |  |

**ONE CREDIT COURSES**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Code No.** | **Course Title** | **Category** | **Contact Hours** | **L** | **T** | **P** | **C** | **Pre- requisites** |
| U15MCINX | Certification Program | EEC | 2 | 2 | 0 | 0 | 1 |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **U15MA*T*305** | | | **TRANSFORM METHODS AND PARTIAL DIFFERENTIAL EQUATIONS** | | | | | | | | | | | **L** | **T** | | | | **P** | | **C** |
| **3** | **2** | | | | **0** | | **4** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Determine the Fourier series and half range sine and cosine Series of a function. | | | | | | | | | | | | | | | | | | | | | |
| 1. Find the Fourier transform, sine and cosine transform of certain functions and use Parseval’s identity to evaluate integrals. | | | | | | | | | | | | | | | | | | | | | |
| 1. Formulate partial differential equations and solve certain types of partial differential equations. | | | | | | | | | | | | | | | | | | | | | |
| 1. Estimate the displacement for transverse vibrations of a stretched string and get solution for problems on Transmission line equations using Fourier series. | | | | | | | | | | | | | | | | | | | | | |
| 1. Apply Laplace transform methods to solve the diffusion equation. | | | | | | | | | | | | | | | | | | | | | |
| 1. Make use of Fourier transform methods to solve diffusion equation and Laplace equation. | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| |  |  | | --- | --- | |  | 1. U15MAT101 Engineering Mathematics -I | |  | 1. U15MAT201 Engineering Mathematics – II | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | PO6 | | PO7 | PO8 | PO9 | PO10 | PO11 | | | PO12 | | PSO1 | | PSO2 | |
| CO1 | S |  | |  |  |  |  | |  |  |  |  |  | | |  | |  | |  | |
| CO2 | S |  | |  |  |  |  | |  |  |  |  |  | | |  | |  | |  | |
| CO3 | S |  | |  |  |  |  | |  |  |  |  |  | | |  | |  | |  | |
| CO4 | S |  | |  |  |  |  | |  |  |  |  |  | | |  | |  | |  | |
| CO5 | S |  | |  |  |  |  | |  |  |  |  |  | | |  | |  | |  | |
| CO6 | S |  | |  |  |  |  | |  |  |  |  |  | | |  | |  | |  | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | | Course end survey | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **FOURIER SERIES** | | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval’s identity – Harmonic Analysis. | | | | | | | | | | | | | | | | | | | | | |
| **FOURIER TRANSFORM** | | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Infinite Fourier transform pair – Infinite Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval’s identity | | | | | | | | | | | | | | | | | | | | | |
| **PARTIAL DIFFERENTIAL EQUATIONS** | | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange’s linear equation – Linear Homogeneous partial differential equations of second and higher order with constant coefficients. | | | | | | | | | | | | | | | | | | | | | |
| **SOLUTION OF WAVE EQUATIONS** | | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Fourier series method: Solution of transverse vibrations of a stretched string - Problems on Transmission line equations. | | | | | | | | | | | | | | | | | | | | | |
| **SOLUTION OF HEAT EQUATIONS** | | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Laplace Transform Method: Solution of diffusion equation. Fourier Transform Method: Solution of diffusion equation and Laplace equation. | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Theory: 45 Hrs Tutorial: 15 Hrs Total Hours: 60** | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | |
| 1. Sankara Rao K., “Introduction to partial differential equations”, Prentice Hall of India, New Delhi, 2006. | | | | | | | | | | | | | | | | | | | | | |
| 1. Veerarajan T., “Engineering Mathematics”, Third Edition, Tata McGraw Hill, New Delhi, 2007. | | | | | | | | | | | | | | | | | | | | | |
| 1. Grewal B S., “Higher Engineering Mathematics”, 42nd Edition, Khanna Publishers, Delhi, 2012. | | | | | | | | | | | | | | | | | | | | | |
| 1. Ian Sneddon , “Elements of partial differential equations”, McGraw – Hill New Delhi, 2003. | | | | | | | | | | | | | | | | | | | | | |
| 1. Howard B.Wilson and Louis H. Turcotte, “Advanced Mathematics and Mechanics Applications Using MATLAB”, McGraw Hill, 1998. | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **U15MC*T*301** | | | **MECHANICS OF SOLIDS FOR MECHATRONICS** | | | | | | | | | | **L** | | | **T** | | | **P** | **C** | |
| **3** | | | **1** | | | **0** | **4** | |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Recognize the elastic response of the materials and types of failures | | | | | | | | | | | | | | | | | | | | | |
| 1. Calculate the stresses and deflection in simple bars, compound bars and bi-axial load system | | | | | | | | | | | | | | | | | | | | | |
| 1. Find the strain energy store in the member for different loadings | | | | | | | | | | | | | | | | | | | | | |
| 1. Locate maximum values of shear force and bending moments in a given beam | | | | | | | | | | | | | | | | | | | | | |
| 1. Calculate the stresses induced in various types of beams | | | | | | | | | | | | | | | | | | | | | |
| 1. Estimate the slope and deflection of beams for various loading conditions | | | | | | | | | | | | | | | | | | | | | |
| 1. Find the crippling load for a column with different end conditions | | | | | | | | | | | | | | | | | | | | | |
| 1. Determine the power transmitting, torque carrying capacities of the circular shafts | | | | | | | | | | | | | | | | | | | | | |
| 1. Calculate the required thickness of the pressure vessel for a given internal pressure | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| |  |  | | --- | --- | |  | 1. U15MET201 Engineering Mechanics 2. U15MAT101 Engineering Mathematics -I 3. U15MAT201 Engineering Mathematics - II | | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | PO6 | | PO7 | PO8 | PO9 | PO10 | | PO  11 | PO12 | | | PSO 1 | | | PSO2 |
| CO1 | M |  | | M |  |  |  | |  |  |  |  | |  |  | | |  | | |  |
| CO2 | M |  | | M |  |  |  | |  |  |  |  | |  |  | | | S | | | M |
| CO3 | M |  | | M |  |  |  | |  |  |  |  | |  |  | | | S | | |  |
| CO4 | M |  | | M |  |  |  | |  |  |  |  | |  |  | | | S | | | M |
| CO5 | M |  | | M |  |  |  | |  |  |  |  | |  |  | | | S | | | W |
| CO6 | M |  | | M |  |  |  | |  |  |  |  | |  |  | | | S | | | W |
| CO7 | M | M | | M |  |  |  | |  |  |  |  | |  |  | | | S | | |  |
| CO8 | M |  | | M |  |  |  | |  |  |  |  | |  |  | | | S | | | M |
| CO9 | M |  | | M |  |  |  | |  |  |  |  | |  |  | | | S | | |  |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **ELASTIC RESPONSE OF MATERIALS** | | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Introduction to elastic response – stresses (tensile, compressive, shear & bending) & strength – strain and deformation, stress-strain curve for steel - Stresses and deformation of simple and compound bars under axial loads - Elastic constants and their relations - Introduction to types of failures- strength and stiffness based design-Thermal stresses and creep. **Tutorials**: Measurement of tensile strength and modulus of elasticity. | | | | | | | | | | | | | | | | | | | | | |
| **BI-AXIAL STRESSES AND STRAIN ENERGY** | | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Principal stresses – Introduction, significance, calculation of principal stresses - Mohr’s circle to find principal stresses - Strain energy in gradually applied loads, suddenly applied loads and Impact loads Elements of fracture mechanics. | | | | | | | | | | | | | | | | | | | | | |
| **STRESSES IN BEAMS** | | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Types of beams: supports and loads – Cantilever, Simply supported and Overhanging beams -  Shear force and bending moment diagrams.  Stresses in beams – theory of simple bending and its applicability for actual conditions effect of shape of beams on stress induced - Bending stress and flexural strength.  **Tutorials:** Measurement of flexural strength - Shear stresses in beams. | | | | | | | | | | | | | | | | | | | | | |
| **DEFLECTION OF BEAMS** | | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Elastic curve– Evaluation of beam deflection and slope: Double integration method & Macaulay’s method  Columns: End conditions, equivalent length – Euler’s equation and its limitations – slenderness ratio – Rankine’s formula for columns | | | | | | | | | | | | | | | | | | | | | |
| **TORSION OF CIRCULAR SECTIONS AND DESIGN OF PRESSURE VESSELS** | | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Analysis of torsion of circular bars – shear stress distribution – twist and torsional stiffness – Bars of solid and hollow circular sections - Thin cylinders and shells – Hoop stress and longitudinal stresses. | | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Tutorial: 15 Hrs Total Hours: 60** | | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | |
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| 1. Ferdinand Beer and Russell Johnston Jr., “Mechanics of materials”, 3rd edition, Tata McGraw Hill 2007. | | | | | | | | | | | | | | | | | | | | | |
| 1. Nash W A, “Strength of materials”, 4th edition, Tata McGraw Hill, 2011. | | | | | | | | | | | | | | | | | | | | | |
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| **U15MCT302** | | | **MECHANICS OF FLUID FOR MECHATRONICS** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** | |
| **3** | | **1** | | **0** | | **4** | |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the properties of fluids and its importance in selection of fluid for suitable application. | | | | | | | | | | | | | | | | | | | | | |
| 1. Apply the concept of fluid statics to determine the pressure and forces on plane and curved surfaces. | | | | | | | | | | | | | | | | | | | | | |
| 1. Differentiate the types of flow with its characteristics and also calculate the flow rate by applying concept of fluid kinematics and dynamics. | | | | | | | | | | | | | | | | | | | | | |
| 1. Identify the major and minor losses involved in the fluid flow through pipes. | | | | | | | | | | | | | | | | | | | | | |
| 1. Generate set of dimensionless parameters in fluid flow problems and also perform dimensional analysis on them. | | | | | | | | | | | | | | | | | | | | | |
| 1. Define and classify the different types of hydraulic machines and select them based on performance for real time applications. | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | | PSO 1 | | PSO2 | |
| CO1 | S |  | |  |  |  | |  |  |  |  |  |  | |  | | | |  | | M | |
| CO2 | S | M | |  |  |  | |  |  |  |  |  |  | |  | | | |  | | M | |
| CO3 | S |  | |  |  |  | |  |  |  |  |  |  | |  | | | |  | | M | |
| CO4 | S |  | |  |  |  | |  |  |  |  |  |  | |  | | | |  | | M | |
| CO5 | S | M | |  |  |  | |  |  |  |  |  |  | |  | | | |  | | M | |
| CO6 | S |  | |  |  |  | |  |  |  |  |  |  | |  | | | |  | | M | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | | |
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| **FLUID PROPERTIES AND FLUID STATICS** | | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Fluid - definition, distinction between solid and fluid - Units and dimensions – Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapor pressure, capillary and surface tension.  Fluid statics: Pascal law - Hydrostatic law - Pressure measurements using Manometers and pressure gauges - Forces on immersed plane and curved surfaces – Buoyancy – Meta-centre - Stability of floating and submerged bodies. | | | | | | | | | | | | | | | | | | | | | |
| **FLIUD KINEMATICS AND FLUID DYNAMICS** | | | | | | | | | | | | | | | | | **15 Hours** | | | | |
| Fluid Kinematics – Lagrangian and Eulerian descriptions - Flow visualization - Lines of flow - Types of flow - Flow characteristics – concept of control volume - velocity field and acceleration -continuity equation – energy equation – momentum equation – Impact of jets - Equation of streamline - stream function - velocity potential function - circulation – flow net.  Fluid dynamics - equations of motion - Euler's equation along streamline - Bernoulli’s equation – Applications - Venturi meter, Orifice meter, Pitot tube. | | | | | | | | | | | | | | | | | | | | | |
| **FLUID FLOW AND DIMENSIONAL ANALYSIS** | | | | | | | | | | | | | | | | | **15 Hours** | | | | |
| Laminar flow between parallel plates - Laminar flow through circular tubes (Hagen Poiseuille equation) - Hydraulic and energy gradient - Darcy Weisbach equation - Pipe roughness - Friction factor - Moody's diagram minor losses - Flow through pipes in series and in parallel.  Dimension and units - Buckingham π theorem - Discussions on dimensionless parameters – applications - Laws of models and similitude. | | | | | | | | | | | | | | | | | | | | | |
| **HYDRAULIC TURBINES** | | | | | | | | | | | | | | | | | **11 Hours** | | | | |
| Fluid machines: definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagram's - head and specific work - components of energy transfer - degree of reaction.  Hydro turbines: definition and classifications - Pelton turbine - Francis turbine – propeller turbine - Kaplan turbine - working principles - velocity triangles - work done – specific speed - efficiencies -performance curve for turbines. | | | | | | | | | | | | | | | | | | | | | |
| **HYDRAULIC PUMPS** | | | | | | | | | | | | | | | | | **10 Hours** | | | | |
| Pumps: definition and classifications - Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principles, indicator diagram, and work saved by air vessels and performance curves - Cavitations in pumps. | | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Tutorial: 15 Hrs Total Hours: 60** | | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES::** | | | | | | | | | | | | | | | | | | | | | |
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| 1. Ramamirtham S., “Fluid Mechanics and Hydraulics and Fluid Machines”, Dhanpat Rai and Sons, Delhi, 2006. | | | | | | | | | | | | | | | | | | | | | |

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| **U15MCT303** | | | **SENSORS AND INSTRUMENTATION** | | | | | | | | | | | **L** | | **T** | | | **P** | | **C** |
| **3** | | **0** | | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Classify the transducers and instruments based on their working principles, characteristics and order of the system. | | | | | | | | | | | | | | | | | | | | | |
| 1. Use statistical methods to compute the errors in the measurements and calculate the response of zero, 1st and second order measurement systems. | | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the working principle and characteristics of non electrical transducers Such as displacement, velocity, temperature, pressure, humidity, force and light. | | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the working principle, characteristics of non electrical transducers such as force (resistive, fiber optic and piezo), vacuum, airflow and light. | | | | | | | | | | | | | | | | | | | | | |
| 1. Explain and differentiate various acoustic parameters and systems with their measurement transducer. | | | | | | | | | | | | | | | | | | | | | |
| 1. Discuss about the construction, working principles and characteristics of bio medical sensors. | | | | | | | | | | | | | | | | | | | | | |
| 1. Choose appropriate transducer and a signal conditioning circuit for a given mechatronics application. | | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the principles of various elements used in signal conditioning, conversion, acquisition and transmission. Also able to design simple circuits related signal conditioning and conversion. | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT201 Electronic Devices and Circuits | | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | PSO 1 | | PSO2 | |
| CO1 |  |  | |  |  | S | |  |  |  |  |  |  | |  | | |  | | S | |
| CO2 |  | S | |  | S |  | |  |  |  |  |  |  | |  | | |  | | M | |
| CO3 |  | M | | S |  |  | |  |  |  |  |  |  | |  | | |  | | S | |
| CO4 |  | M | | S |  |  | |  |  |  |  |  |  | |  | | |  | | S | |
| CO5 |  | M | | S |  |  | |  |  |  |  |  |  | |  | | |  | | S | |
| CO6 |  | M | | S |  |  | |  |  |  |  |  |  | |  | | |  | | S | |
| CO7 |  |  | | S |  | S | |  |  |  |  |  |  | |  | | |  | | S | |
| CO8 |  |  | | S |  |  | |  |  |  |  |  |  | |  | | |  | | S | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | | |
| **MEASUREMENT SYSTEMS** | | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Generalized Measurement System – Performance Characteristics: Static and Dynamic Characteristics – Errors in Measurements – statistical Analysis of errors - Calibration and Standards – Generalized Performance of Zero Order, First Order and Second Order Systems – Classifications of Transducers. | | | | | | | | | | | | | | | | | | | | | |
| **MEASUREMENT OF NON ELECTRICAL PARAMETERS-1** | | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Linear and angular displacemen**t: Resistive, capacitive, inductive types and Optics (encoders), proximity sensors  **Velocity measurement:** tachometers, tachogenerators and resolvers  **Temperature measurement:** Contact type: Bimetallic, RTD, Thermocouple and Thermistor **Non- Contact type:** Radiation Pyrometer – Optical Pyrometer  **Humidity:** Capacitive and resistive and hot and wet bulbs.  **Other sensors:** Fire, smoke and metal detectors. | | | | | | | | | | | | | | | | | | | | | |
| **MEASUREMENT OF NON ELECTRICAL PARAMETERS-2** | | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Force measurement:** Resistive type strain gauges: Bridge configurations, Temperature compensation, Load cells, Fiber optic strain gauge- Semiconductor strain gauges- Piezo electric transducers.  **Vacuum Measurement**: McLeod Gauge, Thermal Conductivity Gauge – Ionization Gauge.  **Airflow:** Anemometers  **Light:** UV, IR, Light emitter and detector  **Introduction to Acoustics and acoustic sensors:** Ultrasonic sensor- Types and working of Microphones and Hydrophones – Sound level meters- Nuclear radiation sensors. | | | | | | | | | | | | | | | | | | | | | |
| **MEASUREMENT OF BIO SIGNALS** | | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Basic transducer principles Types – source of bioelectric potentials - electrode – electrolyte interface, electrode potential, resting and action potential – electrodes for their measurement, ECG, EEG, EMG. | | | | | | | | | | | | | | | | | | | | | |
| **SIGNAL CONDITIONING AND DATA ACQUISITION** | | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Amplification, Filtering – Level conversion – Linearization - Buffering – Sample and Hold circuit – Quantization – Multiplexer / Demultiplexer – Analog to Digital converter – Digital to Analog converter- I/P and P/I converter - Instrumentation Amplifier-V/F and F/V converter- Data Acquisition -Data Logging – Data conversion – Introduction to Digital Transmission system. | | | | | | | | | | | | | | | | | | | | | |
| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | |
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| **U15MC*T* 304** | | | **ELECTRICAL MACHINES AND DRIVES** | | | | | | | | | | **L** | | | **T** | | **P** | | **C** |
| **3** | | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Define the basic theorems in Magnetic circuits. | | | | | | | | | | | | | | | | | | | | |
| 1. Construct, state the principle of operation and performance of DC motors. | | | | | | | | | | | | | | | | | | | | |
| 1. Construct, state the principle of operation and performance of Induction machines. 2. Summarize the speed control methods of electrical machines | | | | | | | | | | | | | | | | | | | | |
| 1. Construct, state the principle of operation and performance of special machines | | | | | | | | | | | | | | | | | | | | |
| 1. Construct, state the principle of operation and performance of permanent magnet machines | | | | | | | | | | | | | | | | | | | | |
| 1. Construct, state the principle of operation and performance of linear electrical machines. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| U15MCT201 Electronic Devices and Circuits | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | PSO 1 | | PSO2 | |
| CO1 | S |  |  |  |  | |  |  |  |  |  |  | |  | | |  | |  | |
| CO2 | M |  |  |  |  | |  |  |  |  |  |  | |  | | | M | |  | |
| CO3 | M |  |  |  |  | |  |  |  |  |  |  | |  | | | M | |  | |
| CO4 | M |  |  |  |  | |  |  |  |  |  |  | |  | | | M | |  | |
| CO5 | M |  |  |  |  | |  |  |  |  |  |  | |  | | | M | |  | |
| CO6 | M |  | M |  |  | |  |  |  |  |  |  | |  | | | M | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | Course end survey | | | | | | | | | | | | | | |
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| **BASIC OF ELECTRICAL MACHINES** | | | | | | | | | | | | | | | **9 Hours** | | | | | |
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| **Fundamental Equation** – First Maxwell Equation (Ampere’s Law) - Second Maxwell-Equation (Faraday’s Law)  **Lorentz Force Law -**  Lorentz Force - Magnetic Force - Force caused by variation of magnetic energy  **Power Calculation** - Average value, Rms value, efficiency  **Methods of connection (three-phase systems**) - Symmetrical components (+ve, -ve, Zero sequence)  **Rotating field theory** – Introduction | | | | | | | | | | | | | | | | | | | | |
| **DC AND AC MACHINES** | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| **DC Motor – Shunt and Series -** Construction – working – Armature Reactions.  **3Phase Induction Motor-** Construction – working – RMF - Slip- cogging – crawling. | | | | | | | | | | | | | | | | | | | | |
| **ELECTRICAL DRIVES** | | | | | | | | | | | | | | | **12 Hours** | | | | | |
| Types of electrical drives - Factors influencing the choice of electrical drives  **Speed control** - DC series and Shunt motors - Armature and Field control, controlled rectifiers - Speed control of three phase induction motor - Voltage control, Voltage/frequency control, slip power recovery scheme. | | | | | | | | | | | | | | | | | | | | |
| **SPECIAL MACHINES** | | | | | | | | | | | | | | | **6 Hours** | | | | | |
| **Stepper Motor** - Construction – working – Torque  **Switched Reluctance Motor (SRM)** - Construction – working – Torque – Characteristics | | | | | | | | | | | | | | | | | | | | |
| **PERMANENT MAGNET MACHINES** | | | | | | | | | | | | | | | **6 Hours** | | | | | |
| **Permanent Magnet DC (PMDC) Motor** - Construction – working – Torque  **Brushless Permanent Magnet DC (BLDC) Motors** - Construction – working – Electronic commutation – Types of BLDC | | | | | | | | | | | | | | | | | | | | |
| **LINEAR ELECTRICAL MACHINES** | | | | | | | | | | | | | | | **6 Hours** | | | | | |
| **Linear Induction Motor (LIM)** - Construction – Trust Equation of LIM – Eq. CKT of LIM – Characteristics of LIM – Control of LIM | | | | | | | | | | | | | | | | | | | | |
| **CASE STUDY:** Section of suitable application of each and every motor considering the selection process. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **U15GST001** | | | **ENVIRONMENTAL SCIENCE AND ENGINEERING** | | | | | | | | | | | | **L** | | **T** | **P** | | **C** |
| **3** | | **0** | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze the impact of engineering solutions in a global and societal context. | | | | | | | | | | | | | | | | | | | | |
| 1. Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems | | | | | | | | | | | | | | | | | | | | |
| 1. Highlight the importance of ecosystem and biodiversity. | | | | | | | | | | | | | | | | | | | | |
| 1. Ability to consider issues of environment and sustainable development in his personal and professional undertakings | | | | | | | | | | | | | | | | | | | | |
| 1. Paraphrase the importance of conservation of resources. 2. Play an important role in transferring a healthy environment for future generations. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | PSO 1 | | | PSO2 | |
| CO1 |  | M | |  |  |  | |  | S |  | M |  |  |  | |  | | |  | |
| CO2 |  |  | |  |  |  | | M |  |  |  | M |  |  | |  | | |  | |
| CO3 |  |  | |  |  |  | |  | M |  |  |  |  |  | |  | | |  | |
| CO4 |  |  | |  |  |  | | M | S |  |  |  |  |  | |  | | |  | |
| CO5 |  |  | |  |  |  | |  | S |  |  |  |  |  | |  | | |  | |
| CO6 |  |  | | W |  |  | |  | S |  |  |  |  | M | |  | | |  | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Assignment  Internal test  Group Presentation  End semester Examination | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES** | | | | | | | | | | | | | | | | | **14 Hours** | | | |
| Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people  Water resources: Use and overutilization of surface and ground water, conflicts over water, dams-benefits and problems – Water conservation, rain water harvesting, watershed management  Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies  Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Case studies  Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies  Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Wasteland reclamation - Role of an individual in conservation of natural resources. | | | | | | | | | | | | | | | | | | | | |
| **ECOSYSTEMS AND BIODIVERSITY** | | | | | | | | | | | | | | | | | **9 Hours** | | | |
| **ECOSYSTEM** :Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)  **BIODIVERSITY** :Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. | | | | | | | | | | | | | | | | | | | | |
| **ENVIRONMENTAL POLLUTION** | | | | | | | | | | | | | | | | | **10 Hours** | | | |
| Definition – Causes, effects and control measures of: (a) Air pollution - Organic and inorganic pollution - cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies - Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – waste minimization - Disaster management: floods, earthquake, cyclone and landslides. | | | | | | | | | | | | | | | | | | | | |
| **SOCIAL ISSUES AND THE ENVIRONMENT** | | | | | | | | | | | | | | | | | **7 Hours** | | | |
| From Unsustainable to Sustainable development – Urban problems related to energy –Resettlement and rehabilitation of people; its problems and concerns, case studies –Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion– Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Human Rights. | | | | | | | | | | | | | | | | | | | | |
| **HUMAN POPULATION AND THE ENVIRONMENT** | | | | | | | | | | | | | | | | | **5 Hours** | | | |
| Population growth and explosion – Welfare Programme - Environment and human health –  Communicable disease – Role of Information Technology in Environment and human health –  Case studies. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| **U15MC*P*301** | | | **FLUID MECHANICS AND MACHINERY LABORATORY** | | | | | | | | | | | **L** | | **T** | | **P** | **C** |
| **0** | | **0** | | **3** | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | |
| 1. Determine the viscosity of fluids and its importance in selection of fluids | | | | | | | | | | | | | | | | | | | |
| 1. Identify the different pressure measurements and able to determine the pressure in a fluid at rest and in motion. | | | | | | | | | | | | | | | | | | | |
| 1. Determine the flow rate and Co-efficient of discharge for given Orificemeter and Venturimeter. | | | | | | | | | | | | | | | | | | | |
| 1. Calculate the friction factor of pipes made up of various materials. | | | | | | | | | | | | | | | | | | | |
| 1. Compare the performance characteristics of various hydraulic turbines. | | | | | | | | | | | | | | | | | | | |
| 1. Test the performance of various positive and non-positive displacement pumps. | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 |
| CO1 | S | M | |  |  |  | |  |  |  | S |  |  | |  | |  | | M |
| CO2 | S | M | |  |  |  | |  |  |  | S |  |  | |  | |  | | M |
| CO3 | S | M | |  |  |  | |  |  |  | S |  |  | |  | |  | | M |
| CO4 | S | M | |  |  |  | |  |  |  | S |  |  | |  | |  | | M |
| CO5 | S | M | |  |  |  | |  |  |  | S |  |  | |  | |  | | M |
| CO6 | S | M | |  |  |  | |  |  |  | S |  |  | |  | |  | | M |
|  | | | | | | | | | |  | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | |
| Lab Exercises  Model Practical Examination  End Semester Practical Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | |
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| **LIST OF EXPERIMENTS** | | | | | | | | | | | | | | | | | | | |
| 1. Measurement of viscosity of a given liquid. | | | | | | | | | | | | | | | | | | | |
| 1. Measurement of Atmospheric, Absolute and Gauge Pressures. | | | | | | | | | | | | | | | | | | | |
| 1. Pressure Measurements using U-tube differential manometers, Bellows Pressure gauge, Bourdon tube Pressure gauge and Diaphragm Pressure gauge. | | | | | | | | | | | | | | | | | | | |
| 1. Determination of the Coefficient of discharge of given    1. Orificemeter,    2. Venturimeter | | | | | | | | | | | | | | | | | | | |
| 1. Flow rate measurement through Orifice by    1. Constant Head Method    2. Variable Head Method | | | | | | | | | | | | | | | | | | | |
| 1. Calculation of the rate of flow using Roto meter. | | | | | | | | | | | | | | | | | | | |
| 1. Determination of friction factor of given set of pipes. | | | | | | | | | | | | | | | | | | | |
| 1. Conducting experiments and drawing the characteristic curves of centrifugal pump / submersible pump | | | | | | | | | | | | | | | | | | | |
| 1. Conducting experiments and drawing the characteristic curves of reciprocating Pump. | | | | | | | | | | | | | | | | | | | |
| 1. Conducting experiments and drawing the characteristic curves of Gear pump. | | | | | | | | | | | | | | | | | | | |
| 1. Conducting experiments and drawing the characteristic curves of Pelton wheel. | | | | | | | | | | | | | | | | | | | |
| 1. Conducting experiments and drawing the characteristics curves of Francis turbine. | | | | | | | | | | | | | | | | | | | |
| 1. Conducting experiments and drawing the characteristic curves of Kaplan turbine. | | | | | | | | | | | | | | | | | | | |
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| **Total Hours: 45** | | | | | | | | | | | | | | | | | | | |

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| **U15MCP302** | | | **SENSORS AND INSTRUMENTATION LABORATORY** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **0** | | **0** | | **3** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Generate appropriate design procedure, suitable for signal conversion to interface with computer. | | | | | | | | | | | | | | | | | | | | |
| 1. Design appropriate circuits by using conventional formulas used in signal conditioning and conversion. | | | | | | | | | | | | | | | | | | | | |
| 1. Implement their design in bread board and test it. | | | | | | | | | | | | | | | | | | | | |
| 1. Generate appropriate design procedure to obtain a required measurement data for temperature, force, humidity, displacement and sound. | | | | | | | | | | | | | | | | | | | | |
| 1. Log the data in computer using LABVIEW/ MATLAB/SCILAB. | | | | | | | | | | | | | | | | | | | | |
| 1. Present data in a clear and meaningful manner. | | | | | | | | | | | | | | | | | | | | |
| 1. Use transducers to create simple Mechatronics applications using data logging software. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| U15MCT301 Sensors and Instrumentation | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | P10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 |  |  | | S |  | S | |  |  |  |  |  |  | |  | |  | | S | |
| CO2 |  |  | | S |  |  | |  |  |  |  |  |  | |  | |  | | S | |
| CO3 |  |  | | S |  |  | |  |  |  |  |  |  | |  | |  | | S | |
| CO4 |  |  | | S | S |  | |  |  |  |  |  |  | |  | |  | | S | |
| CO5 |  |  | | S |  | S | |  |  |  |  |  |  | |  | |  | | S | |
| CO6 |  |  | |  |  |  | |  |  |  |  | S |  | |  | |  | |  | |
| CO7 |  |  | | S |  | S | |  |  |  |  |  |  | |  | | S | | S | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Lab Exercises  Model Practical Examination  End Semester Practical Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **LIST OF EXPERIMENTS** | | | | | | | | | | | | | | | | | | | | |
| 1. Design and testing of Digital Comparator | | | | | | | | | | | | | | | | | | | | |
| 1. Design and testing of Voltage to frequency converter and frequency to voltage converter. | | | | | | | | | | | | | | | | | | | | |
| 1. Design and testing of sample and hold circuit. | | | | | | | | | | | | | | | | | | | | |
| 1. Design and testing of Flash type Analog to Digital Converters. | | | | | | | | | | | | | | | | | | | | |
| 1. Design and testing of instrumentation amplifier using OP-AMP. | | | | | | | | | | | | | | | | | | | | |
| 1. Displacement measurement using potentiometer and LVDT and plotting the characteristic curves. | | | | | | | | | | | | | | | | | | | | |
| 1. Study of Characteristics and calibration of strain gauge and Load Cell   a. Measurement of strain using resistive type strain gauges with temperature compensation and various bridge configurations. | | | | | | | | | | | | | | | | | | | | |
| 1. Temperature measurement using Thermocouple, Thermistor and RTD and comparing the characteristics. | | | | | | | | | | | | | | | | | | | | |
| 1. Comparison of capacitive and resistive type transducer for humidity measurement with their characteristics. | | | | | | | | | | | | | | | | | | | | |
| 1. Measurement of sound using microphones and sound level meter. | | | | | | | | | | | | | | | | | | | | |
| **ADDITIONAL EXPERIMENTS** | | | | | | | | | | | | | | | | | | | | |
| 1. Conversation of time domain audio signal into frequency domain signal (FFT). | | | | | | | | | | | | | | | | | | | | |
| 1. Measurements of 3 phase power and power factor. | | | | | | | | | | | | | | | | | | | | |
| **NOTE:** Experiments 6- 9 should be logged in computer by using data acquisition system and LABVIEW/MATLAB/SCILAB. | | | | | | | | | | | | | | | | | | | | |
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| **Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |

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| **U15GHP301** | | | | **FAMILY VALUES**  **(Common to all branches of Engineering and Technology)** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **1** | | **0** | | **0** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Acquire knowledge on the Clarity, courage, confidence, commitment, compassion this required for a good professional. | | | | | | | | | | | | | | | | | | | | | |
| 1. Understand the concept of Karma Yoga and lead his/her life accordingly. | | | | | | | | | | | | | | | | | | | | | |
| 1. Understand the importance of ethics in ones profession and practice it 2. Apply leadership theories and use them in his/her profession appropriately 3. Learn how to be an empowered professional and how to empower colleagues | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | P10 | PO11 | PO12 | | | | PSO 1 | | PSO2 | |
| CO1 |  |  |  | |  |  | | M |  | M | S | W |  | M | | | |  | |  | |
| CO2 |  |  |  | |  |  | | S | M |  | W |  |  | S | | | |  | |  | |
| CO3 |  |  |  | |  |  | | W |  |  |  |  |  | M | | | |  | |  | |
| CO4 |  |  |  | |  |  | | M |  |  | M |  |  | S | | | |  | |  | |
| CO5 |  |  |  | |  |  | | M |  |  |  |  |  | M | | | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Continuous Assessment | | | | | | | Course end survey | | | | | | | | | | | | | | |
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| Introduction to Family Life – An Overall Perspective | | | | | | | | | | | | | | | | **1 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Personal & Spiritual development through good Family life | | | | | | | | | | | | | | | | **1 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Importance of Relationships & Blessings | | | | | | | | | | | | | | | | **3 Hours** | | | | | |
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| Food as Medicine – Quantum Healing | | | | | | | | | | | | | | | | **3 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Greatness of womanhood | | | | | | | | | | | | | | | | **2 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Simplified Physical Exercises (Kundalini Exercises) | | | | | | | | | | | | | | | | **5 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Total Hours: 15** | | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | |
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**SEMESTER IV**

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| **U15MA*T*401** | | | **NUMERICAL METHODS** | | | | | | | | | | | **L** | | | **T** | | **P** | **C** |
| **3** | | | **2** | | **0** | **4** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Solve a set of algebraic equations representing steady state models formed in engineering problems | | | | | | | | | | | | | | | | | | | | |
| 1. Fit smooth curves for the discrete data connected to each other or to use interpolation methods over these data tables | | | | | | | | | | | | | | | | | | | | |
| 1. Find the trend information from discrete data set through numerical differentiation. | | | | | | | | | | | | | | | | | | | | |
| 1. Estimate integrals from discrete data through numerical methods. | | | | | | | | | | | | | | | | | | | | |
| 1. Predict the system dynamic behaviour through solution of ODEs modeling the system | | | | | | | | | | | | | | | | | | | | |
| 1. Solve PDE models representing spatial and temporal variations in physical systems through numerical methods. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | PSO 1 | | PSO2 |
| CO1 | S | S | |  |  |  | |  |  |  | M | M |  | |  | | |  | |  |
| CO2 | S | S | |  |  |  | |  |  |  | M | M |  | |  | | |  | |  |
| CO3 | S | S | |  |  |  | |  |  |  | M | M |  | |  | | |  | |  |
| CO4 | S | S | |  |  |  | |  |  |  | M | M |  | |  | | |  | |  |
| CO5 | S | S | |  |  |  | |  |  |  | M | M |  | |  | | |  | |  |
| CO6 | S | S | |  |  |  | |  |  |  | M | M |  | |  | | |  | |  |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS** | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Solution of nonlinear equations: False position method, Fixed point iteration method, Newton Raphson method for a single equation and a set of non- linear equations - Solution of linear system of equations: Gaussian elimination method, Gauss Jordan method and Gauss Seidel method - Matrix Inversion by Gauss Jordan method - Eigen values of a matrix by Power method. | | | | | | | | | | | | | | | | | | | | |
| **CURVE FITTING AND INTERPOLATION** | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Curve fitting: Method of least squares – Interpolation: Newton’s forward and backward difference formulae – Divided differences – Newton’s divided difference formula - Lagrange’s interpolation – Inverse interpolation. | | | | | | | | | | | | | | | | | | | | |
| **NUMERICAL DIFFERENTIATION AND INTEGRATION** | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Numerical differentiation by using Newton’s forward, backward and divided differences – Numerical integration by Trapezoidal and Simpson’s 1/3 and 3/8 rules– Truncation error – Evaluation of double integrals. | | | | | | | | | | | | | | | | | | | | |
| **NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS** | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Single step methods: Taylor’s series method, Euler and Improved Euler methods, Fourth order Runge – Kutta method – Multistep method: Milne’s predictor - corrector method. | | | | | | | | | | | | | | | | | | | | |
| **NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS** | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Finite difference techniques for the solution of two dimensional Laplace’s and Poisson’s equations on rectangular domain– Solution of one dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes –Solution of one dimensional wave equation by explicit scheme. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Tutorial: 15 Hrs Total Hours: 60** | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| **U15MC*T* 401** | | | **MANUFACTURING TECHNOLOGY** | | | | | | | | | | | **L** | | **T** | | | **P** | | **C** |
| **3** | | **0** | | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Define and distinguish various manufacturing processes | | | | | | | | | | | | | | | | | | | | | |
| 1. Select and justify appropriate casting methods | | | | | | | | | | | | | | | | | | | | | |
| 1. Anticipate general casting defects and explain their remedies | | | | | | | | | | | | | | | | | | | | | |
| 1. Summarize various bulk deformation processes and the explain the working machineries | | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the working principles of machines and various machining processes. 2. Choose a suitable metal joining process for a given application. | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO  1 | PO  2 | | PO3 | PO4 | PO  5 | PO  6 | PO  7 | PO8 | PO  9 | | PO  10 | PO11 | | PO12 | | PSO 1 | | | PSO2 | |
| CO1 | M |  | |  |  |  |  |  |  |  | |  |  | |  | | W | | | M | |
| CO2 | M |  | |  |  |  |  |  |  |  | |  |  | |  | | W | | | M | |
| CO3 | M |  | |  |  |  |  |  |  |  | |  |  | |  | | W | | | M | |
| CO4 | M |  | |  |  |  |  |  |  |  | |  |  | |  | | W | | | M | |
| CO5 | M |  | |  |  |  |  |  |  |  | |  |  | |  | | W | | | M | |
| CO6 | M |  | |  |  |  |  |  |  |  | |  |  | |  | | W | | | M | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | | | | | **Indirect** | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | | | | | Course end survey | | | | | | | | | | |
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| **FOUNDRY TECHNOLOGY** | | | | | | | | | | | | | | | | | | **9 Hours** | | | |
| Pattern and Core making – Moulding sand – Melting furnaces: Cupola and Induction furnaces – Special casting processes – Shell, Investment, Die casting – Defects in casting. | | | | | | | | | | | | | | | | | | | | | |
| **FORMING PROCESSES** | | | | | | | | | | | | | | | | | | **9 Hours** | | | |
| Hot and Cold Working Rolling - Introduction – Rolling Mills – Rolling Operations – Forging - Introduction – Related Forging Operations – Drop forging- Extrusion and Drawing - Extrusion Practice – Hot, Cold, Impact and Hydrostatic extrusion. Drawing Process – Defects and Residual Stresses – Drawing Equipment. Sheet metal operations – Blanking, Punching and Piercing. (Treatment is to be given only on operations) | | | | | | | | | | | | | | | | | | | | | |
| **CONVENTIONAL MACHINING PROCESS** | | | | | | | | | | | | | | | | | | **9 Hours** | | | |
| Lathes and Lathe Operations, Drilling and Drilling Machines, Reaming and Reamers, Tapping and Taps – Tool nomenclature, cutting speed, feed, machining Time calculations. (No Treatment on mechanisms). | | | | | | | | | | | | | | | | | | | | | |
| **SPECIALIZED MACHINING AND SUPER FINISHING PROCESS** | | | | | | | | | | | | | | | | | | **9 Hours** | | | |
| Milling Machines and Operations, Planning and Shaping, Broaching, Gear Hobbing and Shaping. Grinding Process – Abrasives – Finishing Operations – Lapping, Honing Burnishing. (No Treatment on mechanisms). | | | | | | | | | | | | | | | | | | | | | |
| **PRINCIPLES & APPLICATIONS OF JOINING PROCESSES** | | | | | | | | | | | | | | | | | | **9Hours** | | | |
| Gas welding, Basic Arc Welding Processes, Thermit Welding, Electron – Beam Welding, Laser – Beam Welding. Solid State Welding: Cold Welding, Ultrasonic Welding, Friction Welding, Resistance Welding and Explosive Welding. Principles and applications of Brazing and Soldering. | | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES::** | | | | | | | | | | | | | | | | | | | | | |
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| 1. Sharma P C., “A Textbook of Production Technology”, S. Chand and Co., Ltd., 2009. | | | | | | | | | | | | | | | | | | | | | |

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| **U15MCT402** | | | | **INDUSTRIAL ELECTRONICS** | | | | | | | | | | **L** | | | **T** | | **P** | **C** |
| **3** | | | **0** | | **0** | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Relate the basic semiconductor physics to the properties of real power semiconductor devices and differentiate from low power devices. | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the concepts of operation of AC-DC converters in steady state of both continuous and discontinuous modes. | | | | | | | | | | | | | | | | | | | | |
| 1. Identify the operating the single phase and three phase inverter circuits | | | | | | | | | | | | | | | | | | | | |
| 1. Design a pure sine wave inverter output. | | | | | | | | | | | | | | | | | | | | |
| 1. identify DC equipment with changing DC voltage | | | | | | | | | | | | | | | | | | | | |
| 1. Classify and design choppers for simple electrical application | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| U15MCT201 Electronic Devices and Circuits | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | | PO4 | PO5 | PO6 | | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | PSO1 | | PSO2 |
| CO1 | S |  |  | |  |  |  | |  |  |  |  |  | |  | | | S | |  |
| CO2 | S |  |  | |  |  |  | |  |  |  |  |  | |  | | | M | |  |
| CO3 | S | S |  | |  |  |  | |  |  |  |  |  | |  | | | M | |  |
| CO4 | S |  | S | |  |  |  | |  |  |  |  |  | |  | | | S | |  |
| CO5 | S | M |  | |  |  |  | |  |  |  |  |  | |  | | | S | |  |
| CO6 | S |  |  | |  |  |  | |  |  |  |  |  | |  | | | M | |  |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | | **Indirect** | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | | Course end survey | | | | | | | | | | | | |
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| **POWER SEMICONDUCTOR DEVICES** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Diodes** – Volt-Ampere Characteristics – Switching Characteristics  **Thyristors** – Volt-Ampere Characteristics – Switching Characteristics  **Triacs** – Volt-Ampere Characteristics – Switching Characteristics  **Power BJT** – Volt-Ampere Characteristics – Switching Characteristics  **Power MOSFET** – Volt-Ampere Characteristics – Switching Characteristics  **Power IGBT** – Volt-Ampere Characteristics – Switching Characteristics | | | | | | | | | | | | | | | | | | | | |
| **PHASE CONTROLLED CONVERTERS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Diode Rectifiers** – Single phase Bridge – R, RL – Effects of Source Inductance – Distortion factor – displacement power factor  **Thyristor Converter –** Single phase bridge – RL – Discontinues conduction  **Thyristor Converter** – Three phase Bridge – Discontinuous converter.. | | | | | | | | | | | | | | | | | | | | |
| **INVERTERS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Single-phase inverter** – Half-bridge – center tapped inverter – Full or H- bridge inverter – Phase shit voltage control  **Three-phase Inverter** – Square-wave or six-step operation – Input ripple | | | | | | | | | | | | | | | | | | | | |
| **PURE WAVE INVERTER** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Multi stepped inverter** – 12 step inverter – 18 Step inverter.  **PWM Inverter** – PWM Principles – SPWM – Selected harmonic inverter | | | | | | | | | | | | | | | | | | | | |
| **DC- DC CONVERTER** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **DC Chopper -**  Step Down Converter – Step Up Converter  **Buck Boost Converter – I**ntroduction **-** Fly Back converter  **Bidirectional Converter**  **Switching** **and Voltage/Current Regulation** - Voltage Control mode – Current control mode. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES::** | | | | | | | | | | | | | | | | | | | | |
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| 1. Joseph Vithayathil, “Power Electronics – Principle and Applications”, Tata McGraw-Hill Inc, New Delhi, 2010. | | | | | | | | | | | | | | | | | | | | |
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| 1. Bimbhra P S, “Power Electronics” Tata McGraw Hill, 2012 | | | | | | | | | | | | | | | | | | | | |

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| **U15MCT403** | | | **KINEMATICS OF MACHINES** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Select mechanisms to achieve desired motion transformation | | | | | | | | | | | | | | | | | | | | |
| 1. Calculate the position, velocity, acceleration of multi-bar mechanisms by graphical methods | | | | | | | | | | | | | | | | | | | | |
| 1. Construct a cam profile for a given application. | | | | | | | | | | | | | | | | | | | | |
| 1. Calculate the primary dimensions of a gear. | | | | | | | | | | | | | | | | | | | | |
| 1. Choose appropriate gear train for a given application. | | | | | | | | | | | | | | | | | | | | |
| 1. Solve problems on power transmission and power loss due to friction in various machine elements. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| |  |  | | --- | --- | | U15MET101 | Engineering Graphics | | U15MET201 | Engineering Mechanics | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | | PSO 1 | | PSO2 | |
| CO1 | M |  |  |  |  | |  |  |  |  |  |  |  | | | | S | |  | |
| CO2 | M |  |  |  |  | |  |  |  |  |  |  |  | | | |  | |  | |
| CO3 | M |  | M |  |  | |  |  |  |  |  |  |  | | | | M | |  | |
| CO4 | M |  | W |  |  | |  |  |  |  |  |  |  | | | | M | |  | |
| CO5 | M |  | W |  |  | |  |  |  |  |  |  |  | | | | M | |  | |
| CO6 | M |  | M |  |  | |  |  |  |  |  |  |  | | | | M | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | Course end survey | | | | | | | | | | | | | | |
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| **BASICS OF MECHANISMS** | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Terminology and Definitions - Degree of Freedom Mobility - Kutzbach criterion - Grashoff‟s law-Kinematic Inversions of 4-bar chain and slider crank chains – Mechanical Advantage - Transmission angle - Description of common Mechanisms - Single, double and offset slider mechanisms - Quick return mechanisms – Ratchets and escapements – Indexing Mechanisms - Rocking Mechanisms. | | | | | | | | | | | | | | | | | | | | |
| **KINEMATICS** | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Displacement, velocity and acceleration analysis in simple mechanisms - Construction of velocity and acceleration polygons using graphical mehod - Velocity analysis: Instantaneous centre method- Acceleration analysis: Klein‟s construction - Coriolis Acceleration | | | | | | | | | | | | | | | | | | | | |
| **KINEMATICS OF CAM** | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Classifications - Displacement diagrams – Modified uniform velocity, Parabolic, Simple harmonic and Cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion  – Circular arc and tangent cams - Standard cam motion – Significance of Pressure angle and undercutting. | | | | | | | | | | | | | | | | | | | | |
| **GEAR AND GEAR TRAINS** | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Introduction - Spur gear Terminology and definitions-Fundamental Law of toothed gearing and involute gearing - Inter changeable gears - gear tooth action - Terminology - Interference and undercutting - Non standard gear teeth- Helical, Bevel, Worm, Rack and Pinion gears (Basics only) - Gear trains - Parallel axis gear trains -Epicyclic gear trains – Differentials. | | | | | | | | | | | | | | | | | | | | |
| **FRICTION** | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Introduction- Friction drives - Friction in screw threads – Friction clutches: cone and plate clutches - Belt and rope drives, Friction aspects in Brakes. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| 1. Sadhu Singh, “Theory of Machines”, Pearson Education, 2nd Edition, 2008. | | | | | | | | | | | | | | | | | | | | |
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| **U15MCT404** | | | **DIGITAL ELECTRONICS AND MICROPROCESSOR** | | | | | | | | | | **L** | **T** | | **P** | **C** |
| **3** | **0** | | **0** | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | |
| 1. Use number systems, Boolean algebra and explain various digital logic families. | | | | | | | | | | | | | | | | | |
| 1. Apply basic logic gates to form simple circuits and can simplify logic circuits using K- Map technique. | | | | | | | | | | | | | | | | | |
| 1. Design combinational logic circuits using logic Gates and explain simple memory systems. | | | | | | | | | | | | | | | | | |
| 1. Design flip flops and realize one flip flop using the other. | | | | | | | | | | | | | | | | | |
| 1. Design counters and construct their timing diagrams. | | | | | | | | | | | | | | | | | |
| 1. Explain the architecture of 8085 microprocessor and their peripheral ICs (8255, 8279 and 8251 A). | | | | | | | | | | | | | | | | | |
| 1. Write assembly language program for 8085 for the given application. | | | | | | | | | | | | | | | | | |
| 1. Explain the memory Mapping and I/O devices. | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | |
| U15MCT201 Electronics Devices And Circuits | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | PSO 1 | PSO2 |
| CO1 | M |  | |  |  |  | |  |  |  |  |  |  |  | | W |  |
| CO2 | S | W | |  |  |  | |  |  |  |  |  |  |  | | M |  |
| CO3 | M | S | | M |  |  | |  |  |  |  |  |  |  | | S | M |
| CO4 | M | S | | M |  |  | |  |  |  |  |  |  |  | | M | W |
| CO5 | M | S | | M |  |  | |  |  |  |  |  |  |  | | S | M |
| CO6 | M |  | |  |  |  | |  |  |  |  |  |  |  | | M |  |
| CO7 | M | M | |  |  |  | |  |  |  |  |  |  |  | | S | M |
| CO8 | M | M | | M |  |  | |  |  |  |  |  |  |  | | M |  |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | |
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| **NUMBER SYSTEMS, DIGITAL LOGIC FAMILIES AND BOOLEAN LOGIC** | | | | | | | | | | | | | | | **9 Hours** | | |
| Introduction to Number systems: Binary, Octal, Hexadecimal, BCD, Gray code, Excess 3 code - Binary arithmetic: 1’s complements, 2’s complements, and Code conversions -Digital Logic Families: TTL, CMOS, NMOS, ECL- Performance comparison of various logic families- Boolean algebra: Basic Postulates and theorems, Switching functions, Canonical forms, Logic gates- Simplification using K-maps and Implementation using logic gates. | | | | | | | | | | | | | | | | | |
| **COMBINATIONAL CIRCUITS** | | | | | | | | | | | | | | | **9 Hours** | | |
| Problem formulation and design of combinational circuits: adder, subtractor, Serial adder and Subtractor - Parallel adder and Subtractor- Carry look ahead adder- BCD adder, Magnitude Comparator , parity checker Encoder , decoder, Multiplexer/ Demultiplexer , code converters, Function realization using gates and multiplexers. Implementation of Combinational circuits using Multiplexers and Demultiplexers- Memory: PROMs and PLAs. | | | | | | | | | | | | | | | | | |
| **SEQUENTIAL CIRCUITS** | | | | | | | | | | | | | | | **9 Hours** | | |
| General model of sequential circuits: Latch, Flip Flops, Level triggering, Edge triggering, Master slave configuration- Realization of one flip flop using other flip flop- Registers-Counters: Binary counters, Modulo–n counter, Decade, BCD counters, Ring counter and Johnson counter with their  timing diagram. | | | | | | | | | | | | | | | | | |
| **MICROPROCESSOR 8085** | | | | | | | | | | | | | | | **9 Hours** | | |
| Organization of 8085: Architecture, Internal Register Organization and Pin Configuration – Instruction Set of 8085 – addressing modes - instruction and machine cycles with states and timing diagram - 8085 assembly language programming. | | | | | | | | | | | | | | | | | |
| **MEMORY AND I/O INTERFACING** | | | | | | | | | | | | | | | **9 Hours** | | |
| Address space partitioning – address map – Address decoding – Designing decoder circuit for the given address map -I/O Interfacing- Data transfer schemes – programmed synchronous and asynchronous – Interrupt driven Transfer - Peripheral ICs\*: 8255, 8279 and 8251 A. | | | | | | | | | | | | | | | | | |
| \* Emphasis to be given on architecture with simple applications. | | | | | | | | | | | | | | | | | |
| **Total Hours: 45** | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | |
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| 1. Salivahanan S. and Arivazhagan S., “Digital Circuits and Design”, 4th edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012. | | | | | | | | | | | | | | | | | |
| 1. Ramesh Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, 6th edition, Penram International (India), 2013. | | | | | | | | | | | | | | | | | |
| 1. Aditya P Mathur, “Introduction to Microprocessor”, 3rd edition, Tata McGraw Hill, New Delhi, 2003. | | | | | | | | | | | | | | | | | |

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| **U15GS*T*008** | | | **FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT** | | | | | | | | | | | **L** | | | **T** | | | **P** | | **C** |
| **3** | | | **0** | | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze various factors affecting the product development decision and their importance on new product development | | | | | | | | | | | | | | | | | | | | | | |
| 1. Comparison of various products and services, types and methods of product development, its planning and management. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze and apply the requirement based on critical parameters and develop system models. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Apply and analyze the conceptualization, design prototyping, testing certification and documentation processes related to product development. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Apply and analyze concepts of product maintenance and strategies for obsolescence management, replacement and disposal. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Demonstrate understanding of product development in academic and real life situations, breakeven and tradeoff analysis in product development, IPR and security aspects related to product development. | | | | | | | | | | | | | | | | | | | | | | |
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| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | | PSO 1 | | PSO2 | |
| **CO1** | M | S | |  | S |  | | S |  | W | W | M | W | | S | | | |  | |  | |
| **CO2** | M |  | | S |  |  | | W |  |  | M | M | W | |  | | | |  | |  | |
| **CO3** |  | M | | S | W | M | |  |  |  |  |  |  | |  | | | |  | |  | |
| **CO4** |  |  | | S |  |  | |  |  |  | M | S |  | |  | | | |  | |  | |
| **CO5** |  |  | | M | S |  | |  |  | M |  |  |  | |  | | | |  | |  | |
| **CO6** |  |  | |  |  |  | |  | M |  |  |  |  | | M | | | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | | |
| Assignment  Internal test  Group Presentation  End semester Examination | | | | | | | Course end survey | | | | | | | | | | | | | | | |
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| **FUNDAMENTALS OF PRODUCT DEVELOPMENT** | | | | | | | | | | | | | | | | | | **10 Hours** | | | | |
| **Global Trends Analysis and Product decision**: Types of various trends affecting product decision - Social Trends (Demographic, Behavioral, Psychographic), Technical Trends (Technology, Applications, Tools, Methods), Economical Trends (Market, Economy, GDP, Income Levels, Spending Pattern, target cost, TCO), Environmental Trends (Environmental Regulations and Compliance), Political/Policy Trends (Regulations, Political Scenario, IP Trends and Company Policies); PESTLE Analysis  **Introduction to Product Development Methodologies and Management**: Overview of Products and Services (Consumer product, Industrial product, Specialty products etc); Types of Product Development (NPD/ Re-Engineering (Enhancements, Cost Improvements)/ Reverse Engineering/ Design Porting & Homologation); Overview of Product Development methodologies (Over the Wall/ Waterfall/ V-Model/ Stage-Gate Process/ Spiral/Systems Engineering/ Agile); Product Life Cycle (S- Curve, Reverse Bathtub Curve); Product Development Planning and Management (Budgeting, Risk, Resources and Design Collaboration, Scheduling, Change Management, Product Cost Management). | | | | | | | | | | | | | | | | | | | | | | |
| **REQUIREMENTS AND SYSTEM DESIGN** | | | | | | | | | | | | | | | | | | **8 Hours** | | | | |
| **Requirement Engineering:** Types of Requirements (Functional, Performance, Physical, Regulatory, Economical, Behavioral, Technical, Stakeholder, Environmental, Industry specific, Internal-Company Specific); Requirement Engineering (Gathering (VOC), Analysis (QFD), Design Specification); Traceability Matrix and Analysis; Requirement Management .  **System Design & Modeling:** Introduction to System Modeling; System Optimization; System Specification; Sub-System Design; Interface Design. | | | | | | | | | | | | | | | | | | | | | | |
| **DESIGN AND TESTING** | | | | | | | | | | | | | | | | **13 Hours** | | | | | | |
| **Conceptualization:** Industrial Design and User Interface Design; Introduction to Concept generation Techniques; Concept Screening & Evaluation - Concept Design, S/W Architecture, Hardware Schematics and simulation.  **Detailed Design**: Component Design and Verification; High Level Design/Low Level Design of S/W Programs, S/W Testing; Hardware Schematic, Component design, Layout and Hardware Testing.  **Prototyping:** Types of Prototypes (Mockups, Engineering Assessment Prototype, Alpha, Beta, Gama); Introduction to Rapid Prototyping and Rapid Manufacturing.  **System Integration, Testing, Certification and Documentation**: Manufacturing/Purchase and Assembly of Systems; Integration of Mechanical, Embedded and S/W systems; Introduction to Product verification processes and stages – Industry specific (DFMEA, FEA, CFD); Introduction to Product validation processes and stages - Industry specific (Sub-system Testing/ Integration Testing/ Functional Testing/ Performance Testing / Compliance Testing); Product Testing standards and Certification – Industry specific; Product Documentation (Compliance Documentation, Catalogue, Brochures, user manual, maintenance Manual, Spares Parts List, Warranty, Disposal Guide, IETMS, Web Tools). | | | | | | | | | | | | | | | | | | | | | | |
| **SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT** | | | | | | | | | | | | | | | | | | **6 Hours** | | | | |
| **Sustenance:** Maintenance and Repair; Enhancements.  **Product EoL:** Obsolescence Management; Configuration Management; EoL Disposal. | | | | | | | | | | | | | | | | | | | | | | |
| **BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY** | | | | | | | | | | | | | | | | | | **8 Hours** | | | | |
| **The Industry:** Engineering Services Industry – Overview; Product development in Industry versus Academia.  **The IPD Essentials:** Introduction to vertical specific product development processes; Product development Trade-offs; Intellectual Property Rights and Confidentiality; Security and Configuration management. | | | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES::** | | | | | | | | | | | | | | | | | | | | | | |
| 1. “Foundation Skills in Integrated Product Development (FSIPD)”, 1st Edition, Published by NASSCOM, 2013. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Ulrich Karl T. and Eppinger Steven D, “Product Design and Development”, 5th edition, McGraw-Hill, 2012. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Kevin N Otto, “Product design – Techniques in Reverse Engineering and New Product Development”, PEARSON, New Delhi, 2011. | | | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*P*401** | | | **ELECTRICAL DRIVE SYSTEM LABORATORY** | | | | | | | | | | | **L** | | **T** | | **P** | **C** | |
| **0** | | **0** | | **3** | **1** | |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Test and assess the performances of the DC motors and AC motor for varying load. | | | | | | | | | | | | | | | | | | | | |
| 1. Control the speed of AC and DC motor. | | | | | | | | | | | | | | | | | | | | |
| 1. Test the working of semiconductor devices | | | | | | | | | | | | | | | | | | | | |
| 1. Convert DC supply to required AC frequency | | | | | | | | | | | | | | | | | | | | |
| 1. convert fixed or constant dc supply to variable dc supply | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze and present the findings of experimental observations in both written and oral format. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT402 - Industrial Electronics | | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT304 - Electrical Machines and Drives | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO  11 | | PO  12 | | PSO 1 | | | PSO2 |
| CO1 | M | M | |  |  |  | |  |  |  |  |  |  | |  | | M | | |  |
| CO2 | M |  | | M |  |  | |  |  |  |  |  |  | |  | | M | | |  |
| CO3 | M | M | | M |  |  | |  |  |  |  |  |  | |  | | M | | |  |
| CO4 | M |  | | M |  |  | |  |  |  |  |  |  | |  | | M | | |  |
| CO5 | M |  | | M |  |  | |  |  |  |  |  |  | |  | | M | | |  |
| CO6 |  | S | |  |  |  | |  |  |  |  | S |  | |  | |  | | |  |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Lab Exercises  Model Practical Examination  End Semester Practical Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **LIST OF EXPERIMENTS** | | | | | | | | | | | | | | | | | | | | |
| **Electrical Machines** | | | | | | | | | | | | | | | | | | | | |
| 1. Load test on DC Shunt motor | | | | | | | | | | | | | | | | | | | | |
| 1. Load test on DC series motors | | | | | | | | | | | | | | | | | | | | |
| 1. Speed control of DC shunt motor (Armature and Field Control) | | | | | | | | | | | | | | | | | | | | |
| 1. Load Test on Three Phase Squirrel Cage Induction motor | | | | | | | | | | | | | | | | | | | | |
| 1. Speed control of three phase slip ring induction motor | | | | | | | | | | | | | | | | | | | | |
| 1. Speed control of DC shunt motor using controlled rectifiers | | | | | | | | | | | | | | | | | | | | |
| 1. Speed control of BLDC motor | | | | | | | | | | | | | | | | | | | | |
| 1. Speed control of Stepper motor. | | | | | | | | | | | | | | | | | | | | |
| 1. Voltage / Frequency control of three phase induction motor using inverter. | | | | | | | | | | | | | | | | | | | | |
| **Power Electronics** | | | | | | | | | | | | | | | | | | | | |
| 1. Study of SCR, MOSFET & IGBT characteristics. | | | | | | | | | | | | | | | | | | | | |
| 1. UJT, R and RC firing circuits for SCR. | | | | | | | | | | | | | | | | | | | | |
| 1. IGBT based PWM inverter (single phase). | | | | | | | | | | | | | | | | | | | | |
| 1. SCR / TRIAC phase control circuits. | | | | | | | | | | | | | | | | | | | | |
| 1. Study of half controlled & fully controller converters. | | | | | | | | | | | | | | | | | | | | |
| 1. Speed control of DC shunt motor using three phase fully controlled converter. | | | | | | | | | | | | | | | | | | | | |
| 1. IGBT Chopper. | | | | | | | | | | | | | | | | | | | | |
| |  | | --- | | **Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*P*402** | | | **MANUFACTURING TECHNOLOGY LABORATORY** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **0** | | **0** | | **3** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Perform various operations in lathe. 2. Inspect the manufactured components using suitable measurement techniques | | | | | | | | | | | | | | | | | | | | |
| 1. Read and interpret the shop floor drawings. | | | | | | | | | | | | | | | | | | | | |
| 1. Perform various milling operation for a given drawing. 2. Demonstrate various grinding operations. 3. Perform machining operation in shaping and slotting machine. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT401 Manufacturing Technology | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 | W |  | |  |  |  | |  |  |  |  | M |  | |  | |  | | W | |
| CO2 | M |  | |  |  |  | |  |  |  |  | M |  | |  | |  | | W | |
| CO3 | W |  | |  |  |  | |  |  |  |  | M |  | |  | |  | | W | |
| CO4 | W |  | |  |  |  | |  |  |  |  | M |  | |  | |  | | W | |
| C05 | W |  | |  |  |  | |  |  |  |  | M |  | |  | |  | | W | |
| C06 | W |  | |  |  |  | |  |  |  |  | M |  | |  | |  | | W | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Lab Exercises  Model Practical Examination  End Semester Practical Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **LIST OF EXPERIMENTS** | | | | | | | | | | | | | | | | | | | | |
| 1. Experiment on mechanical measurement (linear and angular measurement). | | | | | | | | | | | | | | | | | | | | |
| 1. Turning : Step, taper | | | | | | | | | | | | | | | | | | | | |
| 1. Thread cutting 2. Knurling | | | | | | | | | | | | | | | | | | | | |
| 1. Tapping | | | | | | | | | | | | | | | | | | | | |
| 1. Boring 2. Surface Milling 3. Gear Cutting | | | | | | | | | | | | | | | | | | | | |
| 1. Grinding (surface, cylindrical and center less) | | | | | | | | | | | | | | | | | | | | |
| 1. Cutting key way (shaping and slotting machine) 2. Dove Tail Cutting | | | | | | | | | | | | | | | | | | | | |
| **Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |

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| **U15GHP401** | | | | **PROFESSIONAL VALUES**  **(Common to all branches of Engineering and Technology)** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **1** | | **0** | | **0** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Acquire knowledge on the Clarity, courage, confidence, commitment, compassion this required for a good professional. | | | | | | | | | | | | | | | | | | | | | |
| 1. Understand the concept of Karma Yoga and lead his/her life accordingly. | | | | | | | | | | | | | | | | | | | | | |
| 1. Understand the importance of ethics in ones profession and practice it 2. Apply leadership theories and use them in his/her profession appropriately 3. Learn how to be an empowered professional and how to empower colleagues | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | P10 | PO11 | PO12 | | | | PSO 1 | | PSO2 | |
| CO1 |  | M | W | |  |  | | W | M | M | M |  |  | M | | | |  | |  | |
| CO2 |  | W |  | |  |  | | M | S | M | M |  |  | S | | | |  | |  | |
| CO3 |  |  |  | |  | M | |  | S | S | W | W |  | M | | | |  | |  | |
| CO4 |  | W |  | |  |  | | M | M | M | S | W |  | M | | | |  | |  | |
| CO5 |  | W |  | |  |  | | M | M | W | M |  |  | M | | | |  | |  | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| 1.Individual Assignment  2.Group Assignment  3.Presentation  4.Surprise Test  5.Practical Assessment  6.End Semester Assessment | | | | | | | Course end survey | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Introduction to Professional Values | | | | | | | | | | | | | | | | **1 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Concept of Integral Karma Yoga | | | | | | | | | | | | | | | | **3 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Professional Ethics | | | | | | | | | | | | | | | | **3 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Eastern and Western Leadership Theories | | | | | | | | | | | | | | | | **2 Hours** | | | | | |
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| Empowerment of a Professional | | | | | | | | | | | | | | | | **4 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Advanced Contemplative Practices with Demonstrations | | | | | | | | | | | | | | | | **2 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Total Hours: 15** | | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES::** | | | | | | | | | | | | | | | | | | | | | |
| 1. Vethathiri’s Maharishi’s, “Yoga for Modern Age”, The World Community Service Centre, Vedhathiri Publications, 2009. 2. Swami Vivekananda, “The Man Making Message” The Ramakrishna Tapovanam, Published 1972. 3. Vethathiri’s Maharishi’s, “Manavalakalai part 1,2&3” 11th edition, The World Community Service Centre, Vethathiri Publications,2005. 4. Brian L Weiss, “Only Love is Real”by Grand Central Publishing, Published 1997. | | | | | | | | | | | | | | | | | | | | | |

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| **U15ENP401** | **COMMUNICATION SKILL LABORATORY** | **L** | **T** | | **P** | **C** |
| **0** | **0** | | **3** | **1** |
| **(Common to all branches of Engineering and Technology)** | | | | | | |
| **Course Outcomes** | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | |
| 1. Imparting the role of communicative ability as one of the soft skills needed for placement | | | | | | |
| 1. Developing communicative ability and soft skills needed for placement | | | | | | |
| 1. Making students Industry-Ready through inculcating team-playing capacity | | | | | | |
| **Pre-requisite** | | | | | | |
| 1. U15ENT101 / Functional English I  2. U15ENT201 / Functional English II   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | COs | Programme Outcomes(POs) | | | | | | | | | | | | | | | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO 1 | PSO2 | | CO1 |  |  |  |  |  |  |  |  |  | S |  |  |  |  | | CO2 |  |  |  |  |  |  |  |  |  | S |  |  |  |  | | CO3 |  |  |  |  |  |  |  |  |  | S |  |  |  |  |  |  |  | | --- | --- | | **Course Assessment methods:** | | | **Direct** | **Indirect** | | Lab Exercises  Model Practical Examination  End Semester Practical Examination  Assignment | Course end survey | | | | | | | |
|  | | | | | | |
| **GRAMMAR IN COMMUNICATION** | | | | **9 Hours** | | |
| Grammar and Usage – Building Blocks, Homonyms, Subject and Verb Agreement, Error Correction - Grammar Application, Framing Questions – Question words, Verbal Questions, Tags, Giving Replies –Types of Sentences, Listening Comprehension –Listening and Ear training. | | | | | | |
| **ASSERTIVE COMMUNICATION** | | | | **9 Hours** | | |
| Listening Comprehension in Cross–Cultural Ambience, Telephonic Conversations/Etiquette, Role Play Activities, Dramatizing Situations- Extempore – Idioms and Phrases. | | | | | | |
| **CORPORATE COMMUNICATION** | | | | **9 Hours** | | |
|  | | | | | | |
| Video Sensitizing, Communicative Courtesy – Interactions – Situational Conversations, Time Management, Stress Management Techniques, Verbal Reasoning, Current Affairs – E Mail Communication / Etiquette. | | | | | | |
| **PUBLIC SPEAKING** | | | | **9 Hours** | | |
| Giving Seminars and Presentations, Nuances of Addressing a Gathering - one to one/ one to a few/ one to many, Communication Process, Visual Aids & their Preparation, Accent Neutralization, Analyzing the Audience, Nonverbal Communication. | | | | | | |
| **INTERVIEW & GD TECHNIQUES** | | | | **9 Hours** | | |
| Importance of Body Language –Gestures & Postures and Proxemics, Extempore, Facing the Interview Panel, Interview FAQs, Psychometric Tests and Stress Interviews, Introduction to GD, Mock GD Practices. | | | | | | |
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| **Total Hours: 45** | | | | | | |
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| **REFERENCES:** | | | | | | |
| 1. Bhatnagar R P. and Rahul Bhargava, “English for Competitive Examinations”, Macmillian Publishers, India, 1989. | | | | | | |
| 1. Devadoss K. and Malathy P., “Career Skills for Engineers”, National Book Publishers, Chennai, 2013. | | | | | | |
| 1. Aggarwal R S., “A Modern Approach to Verbal & Non–Verbal Reasoning”, S.Chand Publishers, India, 2012. | | | | | | |

**SEMESTER V**

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| **U15MCT501** | | | **SIGNALS AND SYSTEMS** | | | | | | | | | | | | **L** | | **T** | **P** | | **C** |
| **3** | | **1** | **0** | | **4** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Understand the basics of signals and systems and classify them based on their properties | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze continuous time signals and systems by applying Fourier Series and Fourier Transform | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze discrete time signals and systems by applying Fourier Series and Fourier Transform | | | | | | | | | | | | | | | | | | | | |
| 1. Apply sampling theorem to convert continuous time signal into discrete time | | | | | | | | | | | | | | | | | | | | |
| 1. Anticipate the problems related to sampling and their effect on signal reconstruction | | | | | | | | | | | | | | | | | | | | |
| 1. Compute the impulse response of CT and DT LTI systems by applying convolution | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| 1. U15MAT101 Engineering Mathematics – I 2. U15MAT201 Engineering Mathematics – II | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | PSO 1 | | | PSO2 | |
| CO1 | M |  | |  |  |  | |  |  |  |  |  |  |  | | W | | |  | |
| CO2 | M |  | |  |  |  | |  |  |  |  |  |  |  | | W | | |  | |
| CO3 | M |  | |  |  |  | |  |  |  |  |  |  |  | | W | | |  | |
| CO4 | M |  | | W |  | M | |  |  |  |  |  |  |  | | W | | |  | |
| CO5 | M |  | | W |  |  | |  |  |  |  |  |  |  | | W | | |  | |
| CO6 | M | M | | M |  |  | |  |  |  |  |  |  |  | | M | | | M | |
| CO7 | M | M | | M |  |  | |  |  |  |  |  |  |  | | M | | |  | |
| CO8 | M | M | | M |  |  | |  |  |  |  |  |  |  | | M | | | M | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **REPRESENTATION OF SIGNALS AND SYSTEMS** | | | | | | | | | | | | | | | | | **12Hours** | | | |
| Continuous and discrete time signals - unit impulse, unit step, unit ramp, unit pulse signals - Complex exponential and sinusoidal signals, Transformation of independent variable: time shifting, time scaling and folding - Properties of signals – periodicity, energy, power, deterministic, random, odd, even - Continuous Time and Discrete Time systems – Properties – linearity, time invariance, causality, stability. | | | | | | | | | | | | | | | | | | | | |
| **FOURIER ANALYSIS OF CONTINUOUS TIME SIGNALS** | | | | | | | | | | | | | | | | | **12Hours** | | | |
| Fourier series – Trigonometric and Exponential Fourier Series - Properties, Spectrum – Fourier Transform – Properties, Spectrum - Analysis of signals using Continuous Time Fourier Transform. | | | | | | | | | | | | | | | | | | | | |
| **SAMPLING** | | | | | | | | | | | | | | | | | **12Hours** | | | |
| Representation of continuous time signals by its samples - Sampling theorem – Reconstruction of a signal from its samples, aliasing – discrete time processing of continuous time signals, sampling of band pass signals. | | | | | | | | | | | | | | | | | | | | |
| **FOURIER ANALYSIS OF DISCRETE TIME SIGNALS** | | | | | | | | | | | | | | | | | **12Hours** | | | |
| Discrete Time Fourier Series (DTFS) - Properties, Spectrum - Discrete Time Fourier Transform (DTFT) – Properties, Spectrum - Analysis of signals using Discrete Time Fourier Transform. | | | | | | | | | | | | | | | | | | | | |
| **ANALYSIS OF SYSTEMS** | | | | | | | | | | | | | | | | | **12Hours** | | | |
| Impulse response of CT and DT systems, Convolution integral – Convolution sum - Properties of convolution – Transfer function - Analysis of CT and DT systems using Fourier transform. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Tutorial: 15 Hrs Total Hours: 60** | | | | | | | | | | | | | | | | | | | | |
| **\*Tutorials may be conducted using MATLAB** | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES::** | | | | | | | | | | | | | | | | | | | | |
| 1. Alan V.Oppenheim, Alan S. Willsky with S. Hamid Nawab, “Signals and Systems”, PHI Learning Private Limited, 2nd Edition, 2015. 2. Michael J Roberts, Govind Sharma, “Fundamentals of Signals and Systems”, Tata McGraw-Hill, 2nd Edition, 2012. 3. Simon Haykin and Barry Van Veen,”Signals and Systems”, 2nd edition, Wiley India. | | | | | | | | | | | | | | | | | | | | |
| 1. B.P. Lathi, “Linear Systems and Signals”, 2nd Edition, Oxford University Press, 2004. | | | | | | | | | | | | | | | | | | | | |
| 1. Mrinal Mandal and Amrit Asif, “Continuous and Discrete Time Signals and Systems”, Cambridge University Press, 2007. 2. Duane Hanselman, Brue Littlefield, “Mastering MATLAB 7”, Pearson Education, 2005. | | | | | | | | | | | | | | | | | | | | |
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| **U15MC*T*502** | | | **CONTROL ENGINEERING** | | | | | | | | | | | | **L** | **T** | | **P** | | **C** |
| **2** | **2** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Know the significance to control engineering and the basic construction of control systems | | | | | | | | | | | | | | | | | | | | |
| 1. Write mathematical equations for model mechanical, electrical systems and can able to compute transfer function using block diagram and signal flow graph methods | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze the 1st and 2nd order systems in time domain for various test signals | | | | | | | | | | | | | | | | | | | | |
| 1. Calculate steady state errors and derive generalized error series in the time domain analysis | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze the 1st and 2nd order systems in frequency domain using Bode and Polar plots | | | | | | | | | | | | | | | | | | | | |
| 1. Calculate the stability of the system using Routh Hurwitz, Nyquist and Root Locus techniques | | | | | | | | | | | | | | | | | | | | |
| 1. Define process and write process equations for a given problem | | | | | | | | | | | | | | | | | | | | |
| 1. Explain and draw the response curves of continuous and discontinuous controllers and develop circuits using pneumatic and electronic systems | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the importance of controller tuning with the help of Z-N method and also explain various special controllers. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| 1. U15MAT101 Engineering Mathematics – I 2. U15MAT201 Engineering Mathematics – II 3. U15MCT501 Signals And Systems | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | PSO 1 | | PSO2 | |
| CO1 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | |  | |
| CO2 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | |  | |
| CO3 | S |  | | M |  |  | |  |  |  |  |  |  |  | | |  | |  | |
| CO4 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | |  | |
| CO5 |  | M | | M |  |  | |  |  |  |  |  |  |  | | | M | |  | |
| CO6 | S |  | |  |  |  | |  |  |  |  |  |  |  | | | M | |  | |
| CO7 | M |  | |  |  |  | |  |  |  |  |  |  |  | | |  | |  | |
| CO8 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | |  | |
| CO9 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **INTRODUCTION** | | | | | | | | | | | | | | | | **12Hours** | | | | |
| Open loop and closed loop systems - Examples - Elements of closed loop systems - Transfer function of elements - Modeling of physical systems - Mechanical systems - Translational and Rotational systems - Electrical networks - Block diagram – Signal flow graph - Mason's gain formula. Transfer function - Transfer function of DC servomotor, AC servomotor. | | | | | | | | | | | | | | | | | | | | |
| **TIME DOMAIN ANALYSIS** | | | | | | | | | | | | | | | | **12Hours** | | | | |
| Standard Test signals – Time response of second order system - Time domain response Performance criteria - Types of systems - Steady state error constants - Generalized error series. | | | | | | | | | | | | | | | | | | | | |
| **FREQUENCY RESPONSE OF SYSTEMS** | | | | | | | | | | | | | | | | **12Hours** | | | | |
| Frequency domain specifications - correlation between time and frequency response for second order systems-Bode plots- Assessment of stability - Gain Margin and phase Margin Assessment – Lead, lag and Lead lag compensation using Bode Plot - Polar plots. **Tutorials**: Bode plot and polar plot using MATLAB. | | | | | | | | | | | | | | | | | | | | |
| **STABILITY OF CONTROL SYSTEMS** | | | | | | | | | | | | | | | | **12Hours** | | | | |
| Characteristic equation - Routh Hurwitz criterion of stability - Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin. Root Locus concept - Root Locus procedure - Root Locus construction - Root contours-  **Tutorials**: Stability analysis of higher order systems using MATLAB | | | | | | | | | | | | | | | | | | | | |
| **PROCESS CONTROL** | | | | | | | | | | | | | | | | **12Hours** | | | | |
| Process definition, equation and dynamics - Discontinuous and continuous controllers- Realization of both the controllers using Electronics and pneumatics- Tuning of controller: Ziegler-Nicholas PID controller tuning- **Special controllers**: feed forward, ratio, cascade control and adaptive control. | | | | | | | | | | | | | | | | | | | | |
| **SELF STUDY**: Transfer function of Synchro and stepper motor | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Theory: 45 Hrs Tutorial: 15 Hrs Total Hours: 60** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
| 1. Nagrath I J. and Gopal M., “Control Systems Engineering", 5th edition, Prentice Hall of India, New Delhi, 2009. | | | | | | | | | | | | | | | | | | | | |
| 1. Katsuhiko Ogata, “Modern Control Engineering”, 5th edition, Prentice Hall India, 2010. | | | | | | | | | | | | | | | | | | | | |
| 1. R.C Dorf and R.H. Bishop, “Modern Control systems”, 12th edition, Pearson India, 2014. | | | | | | | | | | | | | | | | | | | | |
| 1. Curtis D Johnson, “Process control Instrumentation technology”, Prentice Hall India, 2006. | | | | | | | | | | | | | | | | | | | | |
| 1. Singh S K., “Computer aided process control”, Prentice Hall India, 2004. | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*T*503** | | | **DYNAMICS OF MACHINERY** | | | | | | | | | | | **L** | | **T** | | | **P** | | **C** |
| **2** | | **2** | | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Differentiate and calculate various forces acting on rigid bodies under dynamic conditions 2. Calculate the energy requirements in flywheel. | | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the significance of balancing and solve balancing problems related to rotating and reciprocating masses | | | | | | | | | | | | | | | | | | | | | |
| 1. Differentiate free and forced vibration and their importance in design | | | | | | | | | | | | | | | | | | | | | |
| 1. Calculate the response for free and forced vibration of systems having single degree of freedom | | | | | | | | | | | | | | | | | | | | | |
| 1. Summarize and determine various parameters involved in controlling mechanisms such as governors and gyroscopes | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| |  |  | | --- | --- | | U15MET202 | Engineering Mechanics | | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | PSO 1 | | PSO2 | |
| CO1 | S |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  | |
| CO2 | S |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  | |
| CO3 | S | S | | S |  |  | |  |  |  |  |  |  | |  | | | M | |  | |
| CO4 | S | S | | S |  |  | |  |  |  |  |  |  | |  | | | M | |  | |
| CO5 | S | M | | M |  |  | |  |  |  |  |  |  | |  | | | M | |  | |
| CO6 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | | |
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| **FORCE ANALYSIS** | | | | | | | | | | | | | | | | | **13 Hours** | | | | |
| Rigid Body dynamics in general plane motion – Equations of motion.-Dynamic force analysis – Inertia force and Inertia torque –D’Alemberts principle –The principle of superposition – Dynamic Analysis in Reciprocating Engines – Gas Forces- Equivalent masses-Bearing loads - Crank shaft Torque- Turning moment diagrams–Flywheels– Engine shaking Forces – Cam dynamics-Unbalance, Spring Surge and Windup. | | | | | | | | | | | | | | | | | | | | | |
| **BALANCING** | | | | | | | | | | | | | | | | | **12 Hours** | | | | |
| Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing of Multi cylinder Engines: Inline and V-Engines - Balancing of linkages - Introduction to balancing machines. | | | | | | | | | | | | | | | | | | | | | |
| **FREE VIBRATION** | | | | | | | | | | | | | | | | | **13 Hours** | | | | |
| Basic features of vibratory systems - idealized models, Basic elements and lumping of parameters- Degrees of freedom – Single degree of freedom – Free vibration- Equations of motion-natural frequency-Types of Damping- Damped vibration-critical speeds of simple shaft-Torsional systems: Natural frequency of two and three rotor systems. | | | | | | | | | | | | | | | | | | | | | |
| **FORCED VIBRATION** | | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Response to periodic forcing - Harmonic Forcing - Forcing caused by unbalance-Support motion - Force transmissibility and amplitude transmissibility - Vibration isolation. Significance of vibration exposure and control. | | | | | | | | | | | | | | | | | | | | | |
| **MECHANISM FOR CONTROL** | | | | | | | | | | | | | | | | | **13 Hours** | | | | |
| Governors: Types - Centrifugal governors: Gravity and spring controlled – Inertia governors - Controlling Force – Gyroscopes: Gyroscopic forces and Torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes. | | | | | | | | | | | | | | | | | | | | | |
| **CASE STUDY:**  Isolation of vibrations in Automobiles - Engine - Suspensions. | | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Tutorial: 15 Hrs Total Hours: 60** | | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | |
| 1. Rattan S S., “Theory of Machines”, 2nd edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007. 2. Khurmi R S.and Gupta J K. “Theory of machines”, S. Chand and Company Ltd, New Delhi, 2003. | | | | | | | | | | | | | | | | | | | | | |
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| 1. Rao J S and Dukkipati R V., “Mechanism and Machine Theory”, Wiley-Eastern Limited, New Delhi, 2006. | | | | | | | | | | | | | | | | | | | | | |
| 1. John Hannah and Stephens R C., “Mechanics of Machines”, Viva low-Priced Student Edition, 1999. | | | | | | | | | | | | | | | | | | | | | |
| 1. Sadhu Singh, “Theory of Machines”, 2nd edition, Pearson Education, 2008. | | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*T*504** | | | **MECHATRONICS FOR MACHINING** | | | | | | | | | | | **L** | | **T** | | **P** | **C** |
| **3** | | **0** | | **0** | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | |
| 1. Define the fundamentals of CNC and DNC Machines 2. Describe the constructional features of CNC machines | | | | | | | | | | | | | | | | | | | |
| 1. Develop a CNC Part programming for the basic milling operations | | | | | | | | | | | | | | | | | | | |
| 1. Develop a CNC Part programming for the basic turning operations | | | | | | | | | | | | | | | | | | | |
| 1. Explain the working principle of mechanical and electrical energy based unconventional machining processes. 2. Explain the working principle of chemical and thermal energy based unconventional machining processes. | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | |
| 1. U15MC*T*401 Manufacturing Technology | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | PSO 1 | PSO2 |
| CO1 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | | W |  |
| CO2 | M |  | | W |  |  | |  |  |  |  |  |  | |  | | | M | W |
| CO3 | M | M | | M |  | M | |  |  |  |  |  |  | |  | | | M | M |
| CO4 | M | M | | M |  | M | |  |  |  |  |  |  | |  | | | M | M |
| CO5 | M |  | | W |  |  | |  |  |  |  |  |  | |  | | |  | M |
| CO6 | M |  | | W |  |  | |  |  |  |  |  |  | |  | | |  | M |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | |
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| **INTRODUCTION** | | | | | | | | | | | | | | | | | **6 Hours** | | |
| History - Classification, Comparison between conventional and non-conventional machining process - Introduction to Computer Numerical Control, Features of CNC Machines - Different types of CNC machines – Advantages and disadvantages of CNC machines DNC and Adaptive control - Maintenance features of CNC Machines. | | | | | | | | | | | | | | | | | | | |
| **COMPONENTS OF CNC MACHINES AND TOOLING** | | | | | | | | | | | | | | | | | **10 Hours** | | |
| Description of CNC components: Structure, Drive Mechanism, gearbox, Main drive, feed drive, Spindle Motors, Axes motors - Spindle bearing - Slide ways – Re circulating ball screws – Backlash measurement and compensation, linear motion guide ways - Tool magazines, ATC, APC, Chip conveyors - Types of measuring systems in CNC machines –Magnetic Sensors for Spindle Orientation. Qualified and pre-set tooling – Principles of location – Principles of clamping – Work holding devices. Retrofitting of Conventional Machine Tools. | | | | | | | | | | | | | | | | | | | |
| **CNC PART PROGRAMMING AND MAINTENANCE** | | | | | | | | | | | | | | | | | **11 Hours** | | |
| Part Program Terminology- G and M Codes – Types of interpolation Methods of CNC part programming – Manual part programming: Fixed cycle, canned cycle – Computer Assisted part programming – APT language – CNC part programming using CAD/CAM-Introduction to Computer Automated Part Programming.  Factors influencing selection of CNC Machines - Practical aspects of introducing CNC machines in industries. | | | | | | | | | | | | | | | | | | | |
| **UNCONVENTIONAL MACHINING PROCESSES I** | | | | | | | | | | | | | | | | | **9 Hours** | | |
| Abrasive Jet Machining – Water Jet Machining – Ultrasonic Machining - Working Principles – Equipment – Process parameters – MRR-Variation in techniques used – Applications.  Electric Discharge Machining (EDM) - Working Principles-Equipments-Process Parameters-MRR- Electrode / Tool – Power Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications. | | | | | | | | | | | | | | | | | | | |
| **UNCONVENTIONAL MACHINING PROCESSES II** | | | | | | | | | | | | | | | | | **9 Hours** | | |
| Chemical Machining and Electro-Chemical Machining - Etchants – Maskant-Techniques of applying maskants-Process Parameters -Principles of Electro Chemical Machining- Applications - Laser Beam machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM) ,Principles-Equipment-Types-Beam control techniques – Applications. | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | |
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| 1. Vijay K Jain “Advanced Machining Processes”, first edition, Allied Publishers Pvt. Ltd., New Delhi, 2007. | | | | | | | | | | | | | | | | | | | |
| 1. Benedict G F. “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 1987 | | | | | | | | | | | | | | | | | | | |
| 1. Pandey P C and Shan H S. “Modern Machining Processes”, Tata McGraw-Hill, New Delhi, 1980. | | | | | | | | | | | | | | | | | | | |

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| **U15MC*T*505** | | | **INDUSTRIAL AUTOMATION I** | | | | | | | | | | | **L** | | **T** | **P** | | **C** | |
| **3** | | **0** | **0** | | **3** | |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the concept of fluid power and use symbols of various components used in fluid power | | | | | | | | | | | | | | | | | | | | | |
| 1. Outline the importance of PLC, DCS, SCADA in industrial automation | | | | | | | | | | | | | | | | | | | | | |
| 1. Design fluid power circuits by selecting appropriate control valves and actuators | | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the hardware and architecture of PLCs and also identify the analogy of relay logic components | | | | | | | | | | | | | | | | | | | | | |
| 1. Write PLC program using ladder diagram for simple applications | | | | | | | | | | | | | | | | | | | | | |
| 1. Summarize the common faults and troubleshooting methods for fluid power circuits | | | | | | | | | | | | | | | | | | | | | |
| 1. Summarize various maintenance procedures practiced in industry for PLC based control systems | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT302 Mechanics of Fluid for Mechatronics 2. U15MCT404 Digital Electronics and Microprocessor | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | PSO 1 | | PSO2 | |
| CO1 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  | |
| CO2 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  | |
| CO3 | S |  | |  |  | M | |  |  |  |  |  |  | |  | | | S | | M | |
| CO4 | S |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | | M | |
| CO5 | S |  | |  |  | M | |  |  |  |  |  |  | |  | | | S | | M | |
| CO6 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  | |
| CO7 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | | |
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| **INTRODUCTION** | | | | | | | | | | | | | | | **5 Hours** | | | | | | |
| Role of automation in industries, Benefits of automation –Introduction to fluid power, Advantages of fluid power, Application of fluid power system - Types of fluid power systems - Introduction to automation tools: Low cost automation, PLC, DCS, SCADA - Automation strategy evolution. | | | | | | | | | | | | | | | | | | | | | |
| **COMPONENTS OF FLUID POWER SYSTEMS** | | | | | | | | | | | | | | | **12 Hours** | | | | | | |
| Classifications and working principles of Pumps – compressors – linear actuators – rotary actuators – directional control valves – pressure control valves – Proportional valves – Servo valves – flow control valves – accumulators - intensifiers | | | | | | | | | | | | | | | | | | | | | |
| **DESIGN OF FLUID POWER CIRCUITS** | | | | | | | | | | | | | | | **10 Hours** | | | | | | |
| Speed control circuits, synchronizing circuit and industrial application circuits – copying circuit and press circuit - accumulator circuits –Pneumohydraulic circuit - Electro Hydraulic circuits – Electro Pneumatic circuits - Sequential circuit design for simple applications using cascade method , step counter method and Karnaugh-Veitch mapping method | | | | | | | | | | | | | | | | | | | | | |
| **PLC HARDWARE MODULES AND PROGRAMMING** | | | | | | | | | | | | | | | **11 Hours** | | | | | | |
| CPU – processor’s function – PLC system memory and application memory – input modules – output modules – module selection  Introduction to IEC 61131 - System functions – sequence control – ladder logic – programming sequences – limitation of ladder programming – logic instruction sets – standard PLC functions – special function relays – data handling instructions – arithmetic instructions – data manipulation – program subroutines – programming examples. | | | | | | | | | | | | | | | | | | | | | |
| **APPLICATION AND MAINTENANCE** | | | | | | | | | | | | | | | **7 Hours** | | | | | | |
| PLC applications in fluid power control- PLC as robot controller and FMS – PLC to factory automation – PLC in process control  Failure and trouble shooting in fluid power systems- PLC maintenance – internal PLC faults – faults external to PLC – programmed error – watch dogs – safety – hardware safety circuits – troubleshooting. | | | | | | | | | | | | | | | | | | | | | |
| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | |
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| 1. [Frank D Petruzella](http://productsearch.barnesandnoble.com/search/results.aspx?store=book&ATH=Frank+D.+Petruzella), “Programmable Logic Controllers”, 3rd edition, McGraw-Hill Companies, 2013. | | | | | | | | | | | | | | | | | | | | | |
| 1. Lukcas M P., “Distributed Control Systems”, Van Nostrand Reinhold Co., New York, 1986. | | | | | | | | | | | | | | | | | | | | | |
| 1. John W Webb and Ronald A Reis, “Programmable Logic Controllers – Principles and Applications”, 5th Edition, Prentice Hall Inc., New Jersey, 2003. | | | | | | | | | | | | | | | | | | | | | |
| 1. Krishnakant, “Computer Based Industrial Control”, 2nd edition, Prentice Hall of India, 2014. | | | | | | | | | | | | | | | | | | | | | |

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| **U13MC*P* 501** | | | **INDUSTRIAL AUTOMATION I LABORATORY** | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **0** | | **0** | | **3** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | |
| 1. Select the actuators and valves for the design of fluid power circuits | | | | | | | | | | | | | | | | | | |
| 1. Design and simulate the fluid power circuits using software tool | | | | | | | | | | | | | | | | | | |
| 1. Test the simulated output by constructing the fluid power circuits using suitable actuators and valves | | | | | | | | | | | | | | | | | | |
| 1. Write a program to control various actuators using PLCs | | | | | | | | | | | | | | | | | | |
| 1. Develop a simple process logic using relay module | | | | | | | | | | | | | | | | | | |
| 1. Analyze and present the findings of experimental observations in both written and oral format | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | |
| 1. U15MCT505 Industrial Automation I | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | | PO11 | | PO12 | PSO 1 | PSO2 | |
| CO1 | S | M |  |  |  | |  |  |  | S |  | |  | |  | S | M | |
| CO2 | S | M |  |  | S | |  |  |  | S |  | |  | |  | S | M | |
| CO3 | S | M |  |  | S | |  |  |  | S |  | |  | |  | S | M | |
| CO4 | S | M |  |  | S | |  |  |  | S |  | |  | |  | S | M | |
| CO5 | S | M |  |  | S | |  |  |  | S |  | |  | |  | S | M | |
| CO6 | S |  |  |  |  | |  |  |  |  | S | |  | |  |  |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | **Indirect** | | | | | | | | | | | | |
| Lab Exercises  Model Practical Examination  End Semester Practical Examination  Assignment | | | | | | Course end survey | | | | | | | | | | | | |
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| **LIST OF EXPERIMENTS** | | | | | | | | | | | | | | | | | | |
| 1. Design and testing of the following hydraulic circuits:    1. Pressure control    2. Flow control | | | | | | | | | | | | | | | | | | |
| 1. Design and testing of sequential circuit using an Electro hydraulic Trainer kit. | | | | | | | | | | | | | | | | | | |
| 1. Design and testing of hydraulic circuits using PLC | | | | | | | | | | | | | | | | | | |
| 1. Design and testing of the following pneumatic circuits:    1. Pressure control    2. Flow control | | | | | | | | | | | | | | | | | | |
| 1. Design and testing of Sequential circuit using an Electro pneumatic Trainer kit. | | | | | | | | | | | | | | | | | | |
| 1. Design and testing of pneumatic circuits using PLC | | | | | | | | | | | | | | | | | | |
| 1. Simulation of basic hydraulic, pneumatic and electrical circuits using Automation Studio software. | | | | | | | | | | | | | | | | | | |
| 1. PLC programming for industrial process system. | | | | | | | | | | | | | | | | | | |
| 1. Process logic development using Relay Logic module. | | | | | | | | | | | | | | | | | | |
| 1. PLC digital, analog signal interface with field devices. | | | | | | | | | | | | | | | | | | |
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| **Total Hours: 45** | | | | | | | | | | | | | | | | | | |

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| **U15MC*P*502** | | | **MACHINE DYNAMICS LABORATORY** | | | | | | | | | | | | **L** | **T** | **P** | | **C** |
| **0** | **0** | **3** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | |
| 1. Relate the different characteristics of governors and verify gyroscopic relation. | | | | | | | | | | | | | | | | | | | |
| 1. Draw the cam profile with different followers and Study of jump phenomenon. | | | | | | | | | | | | | | | | | | | |
| 1. Identify the system response, natural frequency and resonance for free, forced and torsional vibrations. 2. Identify the system response, natural frequency and resonance for whirling of shaft. | | | | | | | | | | | | | | | | | | | |
| 1. Experimental verification of dynamic balancing of rotating and reciprocating masses. | | | | | | | | | | | | | | | | | | | |
| 1. Analyze and present the findings of experimental observations in both written and oral format. | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | |
| 1. U15MC*T5*03 *–* Dynamics of Machinery | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | |
| **Cos** | Programme Outcomes(Pos) | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | PSO 1 | | PSO2 | |
| CO1 | S |  | |  |  |  | |  |  |  |  |  |  |  | |  | |  | |
| CO2 | S |  | |  | W |  | |  |  |  |  |  |  |  | |  | |  | |
| CO3 | S |  | |  | W |  | |  |  |  |  |  |  |  | | W | |  | |
| CO4 | S |  | |  | W |  | |  |  |  |  |  |  |  | | W | |  | |
| CO5 | S |  | |  | M |  | |  |  |  |  |  |  |  | |  | | M | |
| CO6 |  |  | |  |  |  | |  |  |  |  | S |  |  | |  | |  | |
|  | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | |
| 1. Lab Exercises 2. Model Practical Examination 3. End Semester Practical Examination 4. Assignment | | | | | | | Course end survey | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | |
| **LIST OF EXPERIMENTS** | | | | | | | | | | | | | | | | | | | |
| 1. Governors – Determination of sensitivity, effort, etc. for watt, porter, proell, Hartnell governors | | | | | | | | | | | | | | | | | | | |
| 1. Cam – Study of jump phenomenon and drawing profile of the cam. | | | | | | | | | | | | | | | | | | | |
| 1. Motorized Gyroscope-Determination of Gyroscopic couple Verification of Laws. | | | | | | | | | | | | | | | | | | | |
| 1. Bifilar Suspension and Compound Pendulum – Determination of Moment of Inertia of Rod. | | | | | | | | | | | | | | | | | | | |
| 1. Turn Table – Determination of Moment of Inertia of Disc and Ring. | | | | | | | | | | | | | | | | | | | |
| 1. Epicyclic Gear Train Apparatus – Gear Ratio and Torques. | | | | | | | | | | | | | | | | | | | |
| 1. Balancing of rotating masses (Static and Dynamic Balancing) | | | | | | | | | | | | | | | | | | | |
| 1. Balancing of reciprocating masses. | | | | | | | | | | | | | | | | | | | |
| 1. A) Helical Spring – Natural Frequency of Longitudinal Vibrations   B) Transverse Vibrations Verification of Dunkerley’s Rule. | | | | | | | | | | | | | | | | | | | |
| 1. Rotor Systems – Natural Frequency of Torsional Vibrations. | | | | | | | | | | | | | | | | | | | |
| 1. A) Whirling of Shaft – Determination of Critical Speed   B) Vibrating Table – Determination of Transmissibility Ratio. | | | | | | | | | | | | | | | | | | | |
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| **Total Hours: 45** | | | | | | | | | | | | | | | | | | | |

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| **U15GHP501** | | | | **SOCIAL VALUES**  **(Common to all branches of Engineering and Technology)** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **1** | | **0** | | **0** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Acquire knowledge about how societies are formed and social values are created. | | | | | | | | | | | | | | | | | | | | | |
| 1. Understand and empathize various social issues and contribute towards finding a solution | | | | | | | | | | | | | | | | | | | | | |
| 1. Understand the causes of disparity among human beings 2. Know about social welfare organizations and to use social media effectively 3. Understand various social parameters that influences individual and society at large | | | | | | | | | | | | | | | | | | | | | |
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| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **Cos** | Programme Outcomes(Pos) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | P10 | PO11 | PO12 | | | | PSO 1 | | PSO2 | |
| CO1 |  | W |  | |  |  | | M | W | M | W |  |  | M | | | |  | |  | |
| CO2 |  | W | W | |  |  | | W | M | M |  | W |  | M | | | |  | |  | |
| CO3 |  | W |  | |  |  | | M | W | S |  |  |  | M | | | |  | |  | |
| CO4 |  | W |  | |  |  | | S |  | M | W | M |  | S | | | |  | |  | |
| CO5 |  |  | W | |  | W | | M | W |  |  | W |  | M | | | |  | |  | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| 1.Individual Assignment  2.Group Assignment  3.Presentation  4.Surprise Test  5.Practical Assessment  6.End Semester Assessment | | | | | | | Course end survey | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Introduction to Social Values – Society | | | | | | | | | | | | | | | | **1 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Development of Science, Education, Politics & Economics | | | | | | | | | | | | | | | | **3 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Disparity among human beings | | | | | | | | | | | | | | | | **3 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Social Issues & Welfare | | | | | | | | | | | | | | | | **3 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Social Welfare Organizations | | | | | | | | | | | | | | | | **2 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Yogasanas & Meditation | | | | | | | | | | | | | | | | **2 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Total Hours: 15** | | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES::** | | | | | | | | | | | | | | | | | | | | | |
| 1. Swami Vivekananda, “Prosperous India” 1stedition, The Ramakirshna Mission Institute of Culture, 1937. 2. Fritz Schumacher, “Small is Beautiful”, The Blond & Briggs, Published 1973. 3. Vethathiri Maharishi, “Logical Solutions for the Problems of Humanity”, The World Community Service Centre, Vethathiri Publications, 1999. 4. Sarvepalli Radhakrishnan, “The Source Book on Indian Philosophy”, Princeton, N.J. : Princeton University Press, 1957. 5. Sarvepalli Radhakrishnan, “Religion, Science and Culture”, The Orient Paperbacks, India, Published 1994. 6. Vethathiri’s Maharishi’s, “Vethathirian Principles of Life” The World Community Service Centre, Vethathiri Publications, 2003. | | | | | | | | | | | | | | | | | | | | | |

**SEMESTER VI**

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| **U15MCT601** | | | **MICROCONTROLLER AND EMBEDDED SYSTEMS** | | | | | | | | | | | | **L** | | **T** | **P** | | **C** |
| **3** | | **0** | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Differentiate microcontroller from microprocessor and explain the general architecture of microcontrollers | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the applications of micro controllers and differentiate few microcontroller cores based on their construction and applications | | | | | | | | | | | | | | | | | | | | |
| 1. Summarize the memory organization and internal communication of 8051 and PIC micro controller. | | | | | | | | | | | | | | | | | | | | |
| 1. Program, 8051 using different addressing modes and effectively use the timers, counters and interrupts for a given application | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the architecture of real time operating systems with inter task communication | | | | | | | | | | | | | | | | | | | | |
| 1. Design embedded system scheme for few real time domestic, auto and space applications | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT 405 Digital Electronics And Microprocessor | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **Cos** | Programme Outcomes(Pos) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | PSO 1 | | PSO2 | |
| CO1 | W |  | |  |  |  | |  |  |  |  |  |  |  | | | W | | W | |
| CO2 | M |  | |  |  |  | |  |  |  |  |  |  |  | | | W | | W | |
| CO3 |  | M | | W |  |  | |  |  |  |  |  |  |  | | | W | | W | |
| CO4 | M | M | | M |  |  | |  |  |  |  |  |  |  | | | M | | M | |
| CO5 | W | M | | M |  |  | |  |  |  |  |  |  |  | | | W | | W | |
| CO6 | M | M | | M |  |  | |  |  |  |  |  |  |  | | | S | | M | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **INTRODUCTION TO EMBEDDED SYSTEMS** | | | | | | | | | | | | | | | | **6 Hours** | | | | |
| Overview of Embedded Systems: Architecture, Application areas-Categories of embedded systems-specialties of embedded systems- Recent trends in embedded systems- Brief introduction to embedded microcontroller cores: CISC, RISC, ARM and DSP. | | | | | | | | | | | | | | | | | | | | |
| **THE MICROCONTROLLER ARCHITECTURE** | | | | | | | | | | | | | | | | **8 Hours** | | | | |
| Introduction to 8051 Microcontroller: Architecture, Pin configuration, Memory organization, Input /Output Ports, Counter and Timers, Serial communication and Interrupts. | | | | | | | | | | | | | | | | | | | | |
| **ASSEMBLY LANGUAGE PROGRAMMING OF 8051** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Instruction set, Addressing modes, Development tools, Assembler Directives, Programming based on Arithmetic & Logical operations, I/O parallel and serial ports, Timers & Counters, and ISR | | | | | | | | | | | | | | | | | | | | |
| **PIC MICROCONTROLLER** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Introduction – CPU architecture – Instruction set – Addressing modes – Loop timing – Timers – Interrupt logic – I/O expansion – IIC bus operation– A/D converter. | | | | | | | | | | | | | | | | | | | | |
| **EMBEDDED / REAL TIME OPERATING SYSTEM** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Architecture of kernel, Task and Task scheduler, Semaphores and shared data, Priority inversion problem, Mailboxes, Message queues, Event registers, Pipes, Timers, Memory management, Interrupt service routines. Off-the-Shelf Operating Systems- Embedded Operating Systems, Real Time Operating System (RTOS) and Handheld Operating Systems. | | | | | | | | | | | | | | | | | | | | |
| **EMBEDDED SYSTEM – DESIGN CASE STUDIES** | | | | | | | | | | | | | | | | **4 Hours** | | | | |
| Washing machines – Cruise control – antilock braking systems – satellite launch control. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
| 1. Mazidi M A, Mazidi J G. and McKinlay R D., “The 8051 Microcontroller & Embedded systems”, 2nd Edition, Pearson, 2008. | | | | | | | | | | | | | | | | | | | | |
| 1. Kenneth J Ayala and Dhananjay V Gadre, “The 8051 Microcontroller & Embedded Systems using Assembly and C” Cengage Learning (India edition), 2010 | | | | | | | | | | | | | | | | | | | | |
| 1. Shibu K V., “Introduction to Embedded Systems” McGraw Hill, 2009. | | | | | | | | | | | | | | | | | | | | |
| 1. Andrew N Sloss, Dominic Symes and Chris Wright, “ARM system developer’s guide”, Elsevier, 2010. | | | | | | | | | | | | | | | | | | | | |

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| **U15MCT602** | | | **DESIGN OF MACHINE ELEMENTS** | | | | | | | | | | **L** | | | | **T** | | **P** | | **C** |
| **2** | | | | **2** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Recognize the design process and the factors influencing it and design the simple components for static loading | | | | | | | | | | | | | | | | | | | | | |
| 1. Estimate the life of the components subjected to varying loads | | | | | | | | | | | | | | | | | | | | | |
| 1. Design the circular shafts based on strength and rigidity, keys and couplings for power transmission | | | | | | | | | | | | | | | | | | | | | |
| 1. Design the welded joints and threaded joints subjected to static loads 2. Design the springs subjected to static and dynamic loads | | | | | | | | | | | | | | | | | | | | | |
| 1. Select the rolling contact bearings for static and cyclic loads 2. Select the lubricants and bearing dimensions for hydrodynamic bearings | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| 1. U15MET201 Engineering Mechanics | | | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT403 Mechanics of Solids for Mechatronics 2. U15MCT 304 Mechanics of Fluid for Mechatronics | | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **Cos** | Programme Outcomes(Pos) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | | PSO 1 | | PSO2 | |
| CO1 | S | M | W |  |  | |  |  |  |  |  |  | |  | | | | W | |  | |
| CO2 | S | M |  |  |  | |  |  |  |  |  |  | |  | | | | W | | W | |
| CO3 | S | M |  |  |  | |  |  |  |  |  |  | |  | | | | M | | W | |
| CO4 | S | M |  |  |  | |  |  |  |  |  |  | |  | | | | M | |  | |
| CO5 | S | M |  |  |  | |  |  |  |  |  |  | |  | | | | M | |  | |
| CO6 | S |  |  |  |  | |  |  |  |  |  |  | |  | | | | M | |  | |
| CO7 | S |  |  |  |  | |  |  |  |  |  |  | |  | | | | W | |  | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | **Indirect** | | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | Course end survey | | | | | | | | | | | | | | | |
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| **DESIGN PROCESS AND DESIGN FOR STATIC LOAD** | | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Machine Design – Design Process – Factors influencing design – Calculation of stresses for various load combinations - theories of failure – Factor of safety – Design of curved beams – Crane hook and ‘C’ frame – Design of levers | | | | | | | | | | | | | | | | | | | | | |
| **DESIGN OF FLUCTUATING LOAD** | | | | | | | | | | | | | | | | | **8 Hours** | | | | |
| Stress concentration – causes & remedies – fluctuating stresses – fatigue failures – S-N curve – endurance limit – notch sensitivity – endurance strength modifying factors – design for finite and infinite life – cumulative damage in fatigue failure – Soderberg, Gerber, Goodman, Modified Goodman diagrams – Fatigue design of components under combined stresses | | | | | | | | | | | | | | | | | | | | | |
| **DESIGN OF SHAFTS, KEYS AND COUPLINGS** | | | | | | | | | | | | | | | | | **7 Hours** | | | | |
| Shaft design on the basis of strength, torsional rigidity and lateral rigidity and A.S.M.E. code – Design of keys and splines – Design of flange coupling and flexible bushed pin coupling | | | | | | | | | | | | | | | | | | | | | |
| **DESIGN OF JOINTS AND SPRINGS** | | | | | | | | | | | | | | | **10 Hours** | | | | | | |
| Threaded fasteners – Bolts of uniform strength – Bolts under tension – Eccentrically loaded bolted joints Welded joints – Welding symbols – Stresses in butt and fillet welds, Design of Welded Joints for static loads – Axially loaded unsymmetrical welded joints, Eccentric load in the plane of welds – theory of bonded joints  **Design of springs**  Types – applications and materials for springs – Stress and deflection equations for helical compression springs – Style of ends – Design of helical compression and tension springs – Springs in series and parallel – Introduction to Concentric helical springs, Helical torsion Spring, Multi-leaf springs – Surge in springs | | | | | | | | | | | | | | | | | | | | | |
| **ROLLING CONTACT AND SLIDING CONTACT BEARINGS** | | | | | | | | | | | | | | | | **11 Hours** | | | | | |
| Types of rolling contact Bearings – Static and dynamic load carrying capacities, Stribeck’s Equation, Equivalent bearing load – Load-life relationship – Selection of rolling contact bearings – Design for cyclic loads and speed – mounting of bearings – Types of failure in rolling contact bearings – causes and remedies.  Sliding contact Bearings Lubricating oils: Properties, additives, selection of lubricating oils, Properties & selection of bearing materials – Theory of Hydrodynamic Lubrication, Pressure Development in oil film, Parameters of bearing design, Length to Diameter ratio, Unit bearing Pressure, Radial Clearance, minimum oil film thickness | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Theory: 45 Hrs Practical: 15 Hrs Total Hours: 60** | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES::** | | | | | | | | | | | | | | | | | | | | | |
| 1. Bhandari V B., “Design of Machine Elements”, 2nd edition, Tata McGraw Hill Publication Co. Ltd., 2007. | | | | | | | | | | | | | | | | | | | | | |
| 1. Shigley J E. and Mischke C R., “Mechanical Engineering Design”, 8th edition, McGraw Hill International, 2008. | | | | | | | | | | | | | | | | | | | | | |
| 1. Prabhu T J, “Fundamentals of Machine Design”, Bharat Institute of Science and Technology, 1999. | | | | | | | | | | | | | | | | | | | | | |
| 1. Alfred Hall, Alfred Holowenko, Herman Laughlin and Somani S, “Machine design”, Tata McGraw Hill, 2007. | | | | | | | | | | | | | | | | | | | | | |

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| **U15MCT603** | | | **THERMODYNAMICS AND HEAT TRANSFER** | | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Define the laws of thermodynamics and calculate the properties of the system | | | | | | | | | | | | | | | | | | | | | |
| 1. Estimate the various air standard cycle efficiency and describe the working of I.C engines | | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the various modes of heat transfer for different applications. 2. Describe the boundary layer concepts and different modes of convection 3. Explain the different laws in radiation heat transfer concepts. | | | | | | | | | | | | | | | | | | | | | |
| 1. Discuss the concepts of mass transfer and derive their correlations. | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **Cos** | Programme Outcomes(Pos) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | | PSO 1 | | PSO2 | |
| CO1 | M |  | |  |  |  | |  |  |  | W | W |  |  | | | |  | |  | |
| CO2 | M | W | |  |  |  | |  |  |  | W | W |  |  | | | |  | |  | |
| CO3 | M |  | |  |  |  | |  |  |  | W | W |  |  | | | | W | |  | |
| CO4 | M |  | |  |  |  | |  |  |  | W | W |  |  | | | |  | |  | |
| CO5 | M |  | |  |  |  | |  |  |  | W | W |  |  | | | |  | |  | |
| CO6 | M |  | |  |  |  | |  |  |  | W | W |  |  | | | |  | |  | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | | |
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| **LAWS OF THERMODYNAMICS** | | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Systems-closed and open systems – properties, processes and cycles - equilibrium - work and heat transfers-first law for a closed system and flow processes - enthalpy - second law – entropy - entropy change - reversibility. | | | | | | | | | | | | | | | | | | | | | |
| **AIR-STANDARD CYCLES** | | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Air standard cycles: Carnot cycle - Otto cycle - Diesel cycle(descriptive only) - Brayton cycle (descriptive only) - two stroke and four stroke engines - SI, and CI engines. | | | | | | | | | | | | | | | | | | | | | |
| **HEAT TRANSFER : CONDUCTION** | | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Basic Concepts - Mechanism of Heat Transfer - Conduction, Convection and Radiation - Fourier Law of Conduction - General Differential equation of Heat Conduction - Cartesian and Cylindrical Coordinates - One Dimensional Steady State Heat Conduction - Conduction through Plane Wall, Cylinders and Spherical systems. | | | | | | | | | | | | | | | | | | | | | |
| **CONVECTION AND RADIATION** | | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Convection: Basic Concepts – Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – External Flow and Internal Flow.  Radiation: Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoffs Law – Black Body and Grey body radiation. | | | | | | | | | | | | | | | | | | | | | |
| **MASS TRANSFER** | | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Basic Concepts – Diffusion Mass Transfer – Fick’s Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations. | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | |
| 1. Yunus A. Cengel and Michael A Boles, “Thermodynamics – An Engineering Approach, in SI Units”, Tata McGraw Hill, 7th edition New Delhi, 2011. 2. CP.Kothandaraman, S.Subramanya, “ Fundamentals of Heat and Mass Transfer” New Age International Publishers, New Delhi, 4rd edition, 2012. 3. Nag P. K, “Engineering Thermodynamics” Tata McGraw-Hill, 5th edition 2013. 4. EastopT.D. andMcConkey, “Applied Thermodynamics for Engineering Technologists”, Pearson, New Delhi, 5th Edition, 2004. 5. C. P. Kothandaraman, S. Domkundwar and A.V.Domkundwar, “A course in Thermal Engineering” Dhanpatrai & Co, 5th edition, 2000. 6. Frank P. Incropera and David P. DeWitt, “Fundamentals of Heat and Mass Transfer” John Wiley, Singapore, 5th edition, 2006. | | | | | | | | | | | | | | | | | | | | | |

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| **U15MCP601** | | | **CAD/CAM LABORATORY** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **0** | | **0** | | **3** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Draft different two dimensional views for the given components. 2. Model and assemble a given three dimensional engineering components | | | | | | | | | | | | | | | | | | | | |
| 1. Perform structural analysis on simple structures. 2. Perform thermal analysis on simple structures. | | | | | | | | | | | | | | | | | | | | |
| 1. Generate CNC programs for a given components to work with CNC machines. | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze and present the findings of experimental observations in both written and oral format. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT504 Mechatronics for Machining | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | PO6 | | PO7 | PO8 | PO9 | PO  10 | PO  11 | | PO  12 | | PSO 1 | | PSO2 | |
| CO1 | S |  | |  |  | S |  | |  |  |  |  |  | |  | | M | |  | |
| CO2 | M |  | |  |  | S |  | |  |  |  |  |  | |  | | M | |  | |
| CO3 | M |  | | M |  | S |  | |  |  |  |  |  | |  | | M | |  | |
| CO4 | M |  | | M |  | S |  | |  |  |  |  |  | |  | | M | |  | |
| CO5 | M |  | |  |  | S |  | |  |  |  |  |  | |  | |  | |  | |
| CO6 | M |  | |  |  |  |  | |  |  |  | S |  | |  | |  | |  | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | | **Indirect** | | | | | | | | | | | | |
| Lab Exercises  Model Practical Examination  End Semester Practical Examination  Assignment | | | | | | | | Course end survey | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **LIST OF EXPERIMENTS** | | | | | | | | | | | | | | | | | | | | |
| **COMPUTER AIDED DESIGN AND ANALYSIS LAB** | | | | | | | | | | | | | | | | | | | | |
| 1. 3D Modeling using appropriate software of given components / product assemblies (at least 2 components/product assemblies) | | | | | | | | | | | | | | | | | | | | |
| 1. Analysis of engineering problems using FEA package (any 2 components) | | | | | | | | | | | | | | | | | | | | |
| **COMPUTER AIDED MANUFACTURING LAB** | | | | | | | | | | | | | | | | | | | | |
| 1. Given a component drawing to write the manual part programming and execute on CNC Milling Machine | | | | | | | | | | | | | | | | | | | | |
| 1. Generation of NC codes and simulation of tool path using Master CAM software. | | | | | | | | | | | | | | | | | | | | |
| 1. Post processing of NC code file for various controllers. | | | | | | | | | | | | | | | | | | | | |
| **Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*P*602** | | | **EMBEDDED SYSTEM DESIGN LABORATORY** | | | | | | | | | | | **L** | **T** | | **P** | | **C** |
| **0** | **0** | | **3** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | |
| 1. Perform arithmetic operations in 8051architecture | | | | | | | | | | | | | | | | | | | |
| 1. Perform signal conversion using 8051architecture | | | | | | | | | | | | | | | | | | | |
| 1. Generate and execute program to control the speed of DC and stepper motor using 8051 architecture. | | | | | | | | | | | | | | | | | | | |
| 1. Write programs and interface sensors to measure temperature and load with microchip controller and PSOC Controllers 2. Communicate with the Personal computer using UART protocol 3. Analyze and present the findings of experimental observations in both written and oral format. | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | |
| * 1. U15MCT404 Digital Electronics And Microprocessor | | | | | | | | | | | | | | | | | | | |
| * 1. U15MCT601 Microcontrollers And Embedded Systems | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | |
| **Cos** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO  10 | PO11 | PO12 | | | PSO 1 | | PSO2 | |
| CO1 | M |  | |  |  |  |  |  |  |  |  |  |  | | |  | |  | |
| CO2 | M |  | |  |  |  |  |  |  |  |  |  |  | | |  | |  | |
| CO3 | M |  | |  |  |  |  |  |  |  |  |  |  | | |  | |  | |
| CO4 | M |  | |  |  |  |  |  |  |  |  |  |  | | | M | |  | |
| CO5 | M |  | |  |  |  |  |  |  |  |  |  |  | | |  | |  | |
| CO6 |  |  | |  |  |  |  |  |  |  | S |  |  | | |  | |  | |
|  | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | | **Indirect** | | | | | | | | | | | |
| Lab Exercises  Model Practical Examination  End Semester Practical Examination  Assignment | | | | | | | | Course end survey | | | | | | | | | | | |
| **LIST OF EXPERIMENTS** | | | | | | | | | | | | | | | | | | | |
| 1. Arithmetic operations (addition, subtraction, multiplication, ascending, descending) using 8051 architecture. | | | | | | | | | | | | | | | | | | | |
| 1. Analog to digital conversion in 8051 architecture. | | | | | | | | | | | | | | | | | | | |
| 1. Stepper motor controller in 8051 architecture. | | | | | | | | | | | | | | | | | | | |
| 1. DC motor controller interface using 8051 architecture. | | | | | | | | | | | | | | | | | | | |
| 1. Interface an ADC and a temperature sensor to measure temperature using 8051 architecture. | | | | | | | | | | | | | | | | | | | |
| 1. Interface LCD with Microchip Controller. | | | | | | | | | | | | | | | | | | | |
| 1. Development of hypothetical Switch Protocol using GPIO and timer using ARM7and PSoC3 | | | | | | | | | | | | | | | | | | | |
| 1. Utilization of capacitive sensing (CapSense) module of PSoC3 board for simple applications. | | | | | | | | | | | | | | | | | | | |
| 1. Implementation of combination Lock with CapSense Swipe. | | | | | | | | | | | | | | | | | | | |
| 1. Pulse Width Measurement. | | | | | | | | | | | | | | | | | | | |
| 1. Development of simple hand shaking protocol using UART | | | | | | | | | | | | | | | | | | | |
| 1. Measurement of Strain using strain gauge. | | | | | | | | | | | | | | | | | | | |
| 1. Wireless LED display control system similar to traffic light. | | | | | | | | | | | | | | | | | | | |
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| **Total Hours: 45** | | | | | | | | | | | | | | | | | | | |

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| **U15GHP601** | | | | **NATIONAL VALUES**  **(Common to all branches of Engineering and Technology)** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **1** | | **0** | | **0** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Acquire knowledge on the Enlightened Citizenship | | | | | | | | | | | | | | | | | | | | | |
| 1. Understand and know the greatness of India and Indian Culture. | | | | | | | | | | | | | | | | | | | | | |
| 1. Aware of the messages of India to the world 2. Aware of the uniqueness of India beings 3. Know about social welfare organizations and to use social media effectively 4. know about the inspiring Indian personalities and emulate them | | | | | | | | | | | | | | | | | | | | | |
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| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | P10 | PO11 | PO12 | | | | PSO 1 | | PSO2 | |
| CO1 |  | W |  | |  |  | | M |  | M |  |  |  | M | | | |  | |  | |
| CO2 |  | W |  | |  |  | | S | W | S | M | M |  | M | | | |  | |  | |
| CO3 |  | W | W | |  | W | | M | W | M | M | M |  | M | | | |  | |  | |
| CO4 |  | W |  | |  |  | | M | W | M | W | W |  | M | | | |  | |  | |
| CO5 |  |  |  | |  |  | | W | M | W | W | W |  | S | | | |  | |  | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| 1.Individual Assignment  2.Group Assignment  3.Presentation  4.Surprise Test  5.Practical Assessment  6.End Semester Assessment | | | | | | | Course end survey | | | | | | | | | | | | | | |
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| Enlightened Citizenship | | | | | | | | | | | | | | | | **2 Hours** | | | | | |
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| Greatness of India & Indian Culture | | | | | | | | | | | | | | | | **2 Hours** | | | | | |
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| Uniqueness of India | | | | | | | | | | | | | | | | **2 Hours** | | | | | |
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| Famous Indian Personalities | | | | | | | | | | | | | | | | **2 Hours** | | | | | |
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| India’s messages to the world | | | | | | | | | | | | | | | | **3Hours** | | | | | |
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| Meditation & Yogasanas | | | | | | | | | | | | | | | | **4 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Total Hours: 15** | | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | |
| 1. Gurcharan Das, “India Grows at Night”, Penguin Books India, Published September 2012. 2. Swami Vivekananda, “Prosperous India” 1stedition, The Ramakirshna Mission Institute of Culture, 1937. 3. Sarvepalli Radhakrishnan, “The Source Book on Indian Philosophy”, Princeton, N.J. : Princeton University Press, 1957. 4. Amartya Sen, “The Argumentative Indian”, Allen Lane, Published 2005. | | | | | | | | | | | | | | | | | | | | | |

**SEMESTER VII**

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| **U15MCT701** | | | **ROBOTICS ENGINEERING** | | | | | | | | | | | | | **L** | | **T** | **P** | | **C** |
| **3** | | **0** | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Define robotic terminologies and apply the concept of degrees of freedom for a particular robotic configuration. | | | | | | | | | | | | | | | | | | | | | |
| 1. Select an appropriate gripper for a given application and also estimate the force components acting on a gripper. | | | | | | | | | | | | | | | | | | | | | |
| 1. Develop homogeneous transformation matrices to solve kinematic problems. | | | | | | | | | | | | | | | | | | | | | |
| 1. Effectively apply DH notations for direct kinematic problems. | | | | | | | | | | | | | | | | | | | | | |
| 1. Explain various motion planning algorithms. | | | | | | | | | | | | | | | | | | | | | |
| 1. Apply Lagrangian and Newton-Euler methods to analyze dynamic characteristics of a robot | | | | | | | | | | | | | | | | | | | | | |
| 1. Describe various control strategies used in robot control. | | | | | | | | | | | | | | | | | | | | | |
| 1. Explain various programming techniques used in industrial robots. | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT303 Kinematics of Machinery | | | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT301 Sensors and Instrumentation | | | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT505 Industrial Automation | | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | | PSO 1 | | PSO2 | |
| CO1 | S |  | |  |  |  | |  |  |  |  |  |  |  | | | | M | | M | |
| CO2 | S | M | |  |  |  | |  |  |  |  |  |  |  | | | | S | | M | |
| CO3 | S |  | | W |  |  | |  |  |  |  |  |  |  | | | | M | | M | |
| CO4 | S |  | | W |  | M | |  |  |  |  |  |  |  | | | | M | | M | |
| CO5 | S |  | |  |  |  | |  |  |  |  |  |  |  | | | | M | | M | |
| CO6 | S | M | |  |  |  | |  |  |  |  |  |  |  | | | | M | | M | |
| CO7 | S |  | |  |  |  | |  |  |  |  |  |  |  | | | | M | | M | |
| CO8 | S |  | |  |  | S | |  |  |  |  |  |  |  | | | | M | | M | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **INTRODUCTION** | | | | | | | | | | | | | | | | | **6 Hours** | | | | |
| Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Mechanisms and transmission - Applications. | | | | | | | | | | | | | | | | | | | | | |
| **KINEMATICS OF ROBOTS** | | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Introduction - Matrix Representation - Homogeneous transformation matrices – Forward and Inverse kinematics Equations: Position and Orientation -Denavit- Hartenberg Representation of forward kinematics equations of robots- Degeneracy and Dexterity. | | | | | | | | | | | | | | | | | | | | | |
| **DYNAMICS OF ROBOTS** | | | | | | | | | | | | | | | | **11 Hours** | | | | | |
| Introduction- Differential motions of a frame – Jacobian – Singularities – Lagrangian and Newton-Euler formulations – Basics of Trajectory Planning. | | | | | | | | | | | | | | | | | | | | | |
| **MOTION CONTROL AND SOFTWARE INTERFACES** | | | | | | | | | | | | | | | **11 Hours** | | | | | | |
| Introduction to Laplace transform and transfer functions - Independent joint control, PD and PID controllers- Software interfaces: Low level interfaces, IO digital signals, Fieldbuses – Data protocols and connections | | | | | | | | | | | | | | | | | | | | | |
| **END EFFECTORS** | | | | | | | | | | | | | | | | **4 Hours** | | | | | |
| End effectors and Different types of grippers, vacuum and other methods of gripping - Grippers force analysis-Gripper design-Simple problems | | | | | | | | | | | | | | | | | | | | | |
| **ROBOT PROGRAMMING** | | | | | | | | | | | | | | | | **4 Hours** | | | | | |
| Robot programming: Introduction; On-line programming: Manual input, lead through programming, teach pendant programming; Off-line programming languages, Simulation. | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES::** | | | | | | | | | | | | | | | | | | | | | |
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| **U15MCT702** | | | **INDUSTRIAL AUTOMATION II** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Classify the different types of communication protocols | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the importance of SCADA systems | | | | | | | | | | | | | | | | | | | | |
| 1. Summarize the fundamentals of Distributed control systems | | | | | | | | | | | | | | | | | | | | |
| 1. Design power supply, panel disk control for automation. | | | | | | | | | | | | | | | | | | | | |
| 1. Describe various safety related parameters in designing automated system | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 | M |  | | W |  |  | |  |  |  |  |  |  | |  | | M | | M | |
| CO2 | M |  | | M |  | M | |  |  |  |  |  |  | |  | | M | | M | |
| CO3 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | M | | M | |
| CO4 | M | M | | W |  |  | |  |  |  |  |  |  | |  | | M | | M | |
| CO5 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | M | | M | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **INDUSTRIAL COMMUNICATION PROTOCOLS** | | | | | | | | | | | | | | | | **11Hours** | | | | |
| Definition of protocol, Introduction to Open System Interconnection (OSI) model, Communication standard (RS232, RS485), Modbus (ASCII/RTU), Introduction to third party interface, concept of OPC (Object linking and embedding for Process Control), HART Protocol: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation.  Foundation Fieldbus H1: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation. Comparison of HART, Foundation Fieldbus, Devicenet, Profibus, Controlnet, Industrial Ethernet. | | | | | | | | | | | | | | | | | | | | |
| **SCADA SYSTEMS** | | | | | | | | | | | | | | | | **11Hours** | | | | |
| Concept of SCADA systems, Programming techniques for : Creation of pages, Sequencing of pages, Creating graphics & animation, Dynamos programming with variables, Trending, Historical data storage & Reporting, Alarm management, reporting of events and parameters, Comparison of different SCADA packages, Interfacing PLC and SCADA using communication links, Development stages involved for PLC based automation systems, Application Development using SCADA system. | | | | | | | | | | | | | | | | | | | | |
| **DISTRIBUTED CONTROL SYSTEMS** | | | | | | | | | | | | | | | | **11Hours** | | | | |
| DCS introduction, Various function Blocks, DCS components/block diagram, DCS Architecture of different makes, comparison of these architectures with automation pyramid, DCS specification, latest trend and developments, DCS support to Enterprise Resources Planning (ERP), performance criteria for DCS and other automation tools. | | | | | | | | | | | | | | | | | | | | |
| **INDUSTRIAL WIRING CONTROL** | | | | | | | | | | | | | | | | **7 Hours** | | | | |
| Introduction – Drawings – wire types and preparation – soldering and termination - Connection and routing – Hardware – Components: active and passive – Earthing – PLC wiring | | | | | | | | | | | | | | | | | | | | |
| **PROCESS SAFETY MANAGEMENT** | | | | | | | | | | | | | | | | **5 Hours** | | | | |
| Introduction to process safety, IEE Regulations, risk, risk terminologies, consequence and risk, risk measurement, Process Hazard Analysis | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| **U15MC*T*703** | | | **AUTOMOTIVE ELECTRONICS** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the changes took place over the industrial revolution in automobile industry | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the working of various parts of automobile systems. | | | | | | | | | | | | | | | | | | | | |
| 1. State the working principle of automotive sensors. | | | | | | | | | | | | | | | | | | | | |
| 1. Select the sensor for appropriate application | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the working of Engine control systems. 2. Explain about the safety and comfort system. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| 1. U15MC*T*303 Sensors and Instrumentation | | | | | | | | | | | | | | | | | | | | |
| 1. U15MC*T*601 Microcontrollers and Embedded Systems | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | W | |  | |
| CO2 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | M | |  | |
| CO3 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | M | |  | |
| CO4 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | M | |  | |
| CO5 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | W | |  | |
| C06 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | W | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **INTRODUCTION** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Automotive Fundamentals** - automobile physical configuration - Evolution of electronics in automobiles  **Electronics Fundamentals** – Diodes - Rectifier Circuit – Transistors - Field Effect Transistors –  transistor amplifiers - operational amplifiers | | | | | | | | | | | | | | | | | | | | |
| **BASICS OF ENGINES** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Engines**  Operating principles of IC engine – major engine components – engine cylinder arrangements – the ignition systems – working of the carburetor  **Electronic Engine Control -** exhaust emissions - engine functions and control - definition of engine performance terms - electronic fuel control system - electronic ignition | | | | | | | | | | | | | | | | | | | | |
| **SENSORS AND ACTUATORS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **APPLICATIONS OF SENSORS AND ACTUATORS -** Mass air flow (MAF) rate - Exhaust gas oxygen concentration (possibly heated) - Throttle plate angular position - Crankshaft angular position/RPM - Coolant temperature - Intake air temperature - Manifold absolute pressure (MAP) - Differential exhaust gas pressure - Vehicle speed - Transmission gear selector position - Air conditioner clutch engaged - Brake on/off - Wide open throttle - Closed throttle | | | | | | | | | | | | | | | | | | | | |
| **ENGINE CONTROL SYSTEMS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **DIGITAL ENGINE CONTROL FEATURES** - Engine Crank (Start) - Engine Warm-Up - Open-Loop Control - Closed-Loop Control - Hard Acceleration - Deceleration and Idle  **IN VEHICLE NETWORKS:** CAN standard, format of CAN standard – diagnostics systems in modern automobiles | | | | | | | | | | | | | | | | | | | | |
| **CHASSIS, COMFORT AND SAFETY SYSTEMS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Traction control system – Cruise control system– electronic control of automatic transmission antilock braking system – electronic suspension system –airbag systems – centralized door locking system – Navigation systems – climate control of cars. | | | | | | | | | | | | | | | | | | | | |
| **CASE STUDY:** Design of the Passenger comfort and safety systems. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| **U14MC*P*701** | | | **PROJECT WORK PHASE I** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **0** | | **0** | | **4** | | **2** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Design, analyze, realize / simulate a physical system by using the technology they learnt during the program. | | | | | | | | | | | | | | | | | | | | |
| 1. Integrate various systems into one Mechatronics product. | | | | | | | | | | | | | | | | | | | | |
| 1. Work in a team with confined time duration. | | | | | | | | | | | | | | | | | | | | |
| 1. Disseminate his work both in oral and written format. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 | S | S | | S | S | S | |  | M | M |  |  |  | | S | | S | | S | |
| CO2 | S | S | | S | S | S | | M | M | M |  |  |  | | S | | S | | S | |
| CO3 |  |  | |  |  |  | |  |  |  | S |  |  | |  | |  | |  | |
| CO4 |  |  | |  |  |  | |  |  |  |  | S | S | |  | |  | |  | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| End Semester Viva Voice  Interdisciplinary work  Publication  Working model/ simulation result  Innovation  Report with good referencing | | | | | | | Course end survey | | | | | | | | | | | | | |
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| Students in the form of group, not exceeding 4 members in a group to carry out their main project. It should be a Mechatronics project. However, special considerations can be given for interdisciplinary measurement and computer based simulation projects. This exception should be recorded and approved by the department committee. Management related projects will not be allowed. The interdisciplinary projects will carry more weightage. It is mandatory to publish their main project in national/international level conferences to appear in the viva-voce exam. | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*P*702** | | | **ROBOTICS LABORATORY** | | | | | | | | | | | **L** | | **T** | | **P** | **C** |
| **0** | | **0** | | **3** | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | |
| 1. Control mobile robots using different sensors and actuators. 2. Model kinematics of robotics arm using mathematical software. | | | | | | | | | | | | | | | | | | | |
| 1. Manipulate an industrial robot using a machine vision system and HMIs | | | | | | | | | | | | | | | | | | | |
| 1. Handle a robot model using the robotics simulation software. 2. Apply control algorithms in a robot | | | | | | | | | | | | | | | | | | | |
| 1. Analyze and present the findings of experimental observations in both written and oral format. | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT701 – Robotics Engineering | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 |
| CO1 |  |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  |
| CO2 |  |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  |
| CO3 |  |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  |
| CO4 |  |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  |
| CO5 |  |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  |
| CO6 |  |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | |
| Lab Exercises  Model Practical Examination  End Semester Practical Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | |
| **LIST OF EXPERIMENTS** | | | | | | | | | | | | | | | | | | | |
| 1. Study of different types of robots based on configuration and application. | | | | | | | | | | | | | | | | | | | |
| 1. Study of different type of links and joints used in robots | | | | | | | | | | | | | | | | | | | |
| 1. Study of components of robots with drive system and end effectors. | | | | | | | | | | | | | | | | | | | |
| 1. Modeling Forward and inverse kinematics for robotic arm using Mathematical Software | | | | | | | | | | | | | | | | | | | |
| 1. Offline programming of an Industrial robot using Robotics simulation Software | | | | | | | | | | | | | | | | | | | |
| 1. Setup and program a station with conveyor tracking using the Robotics simulation Software 2. Vision-Based Control on an Industrial Robot | | | | | | | | | | | | | | | | | | | |
| 1. Writing and verifying a Program for point to point operations for mobile robots | | | | | | | | | | | | | | | | | | | |
| 1. Obstacle Avoidance of a mobile robot with Ultrasonic Sensor | | | | | | | | | | | | | | | | | | | |
| 1. Tilt sensing for an autonomous mobile robot using accelerometer sensor. | | | | | | | | | | | | | | | | | | | |
| 1. Line following robot 2. Speech recognition and object recognition algorithm in a robot. | | | | | | | | | | | | | | | | | | | |

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| **U15MC*P*703** | | | **INDUSTRIAL AUTOMATION II LABORATORY** | | | | | | | | | | | **L** | **T** | | **P** | | **C** | |
| **0** | **0** | | **3** | | **1** | |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | |
| 1. Select the suitable communication protocol for the process control applications. | | | | | | | | | | | | | | | | | | | |
| 1. Use different sensors and actuators to control various industrial parameters: temperature, pressure, level and flow. | | | | | | | | | | | | | | | | | | | |
| 1. Construct a SCADA HMI screen for the process automation. | | | | | | | | | | | | | | | | | | | |
| 1. Build a communication network between PLC, HMI and field devices. | | | | | | | | | | | | | | | | | | | |
| 1. Make use of GSM module to interface with PLC, filed devices and SCADA systems. | | | | | | | | | | | | | | | | | | | |
| 1. Inspect and control the industrial process using SCADA systems. | | | | | | | | | | | | | | | | | | | |
| 1. Analyze and present the findings of experimental observations in both written and oral format. | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT505 Industrial Automation I | | | | | | | | | | | | | | | | | | | |
| 1. U15MCT702 Industrial Automation II | | | | | | | | | | | | | | | | | | | |
| 1. U15MCP501 Industrial Automation I Laboratory | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | PSO  1 | | PSO2 | |
| CO1 |  |  | |  |  |  | |  |  |  |  |  |  |  | |  | |  | |
| CO2 |  |  | |  |  |  | |  |  |  |  |  |  |  | |  | |  | |
| CO3 |  |  | |  |  |  | |  |  |  |  |  |  |  | |  | |  | |
| CO4 |  |  | |  |  |  | |  |  |  |  |  |  |  | |  | |  | |
| CO5 |  |  | |  |  |  | |  |  |  |  |  |  |  | |  | |  | |
| CO6 |  |  | |  |  |  | |  |  |  |  |  |  |  | |  | |  | |
| CO7 |  |  | |  |  |  | |  |  |  |  |  |  |  | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | |
| Lab Exercises  Model Practical Examination  End Semester Practical Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | |
| **LIST OF EXPERIMENTS** | | | | | | | | | | | | | | | | | | | |
| 1. Study of industrial process automation and communication network architecture | | | | | | | | | | | | | | | | | | | |
| 1. Construct a communication network for process control(HMI, Filed devices) | | | | | | | | | | | | | | | | | | | |
| 1. Build a Real time data logging and data processing system | | | | | | | | | | | | | | | | | | | |
| 1. Design to control process parameters such as level, flow, temperature and pressure using closed loop control system | | | | | | | | | | | | | | | | | | | |
| 1. Development of SCADA HMI for process automation | | | | | | | | | | | | | | | | | | | |
| 1. Test the digital I/O functions using SCADA panel. | | | | | | | | | | | | | | | | | | | |
| 1. design a T-junction traffic light controller using SCADA | | | | | | | | | | | | | | | | | | | |
| 1. Development of SCADA systems for automating bottle filling systems | | | | | | | | | | | | | | | | | | | |
| 1. Development of SCADA systems for Monitoring and control of fluid power systems. | | | | | | | | | | | | | | | | | | | |
| 1. Implementation of GSM module to interface with PLC, Field devices and SCADA systems | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | |
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|  | | | | | | | | | | | | | | | | | | | |
| **Total Hours: 45** | | | | | | | | | | | | | | | | | | | |

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| **U15GHP701** | | | | **GLOBAL VALUES**  **(Common to all branches of Engineering and Technology)** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **1** | | **0** | | **0** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Understand importance of ecology and its preservations | | | | | | | | | | | | | | | | | | | | | |
| 1. Understand the various global issues and their causes and solutions. | | | | | | | | | | | | | | | | | | | | | |
| 1. Approach any problem holistically as against giving a reductionist solution 2. Learn impact of globalization on various factors such as environment, local population 3. Learn to integrate and understand how an Individual peace impacts world peace | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | P10 | PO11 | PO12 | | | | PSO 1 | | PSO2 | |
| CO1 |  | W |  | |  |  | |  | M | M | M | M |  | M | | | |  | |  | |
| CO2 |  | W |  | |  |  | | M | S | S | M | M |  | M | | | |  | |  | |
| CO3 |  | W | W | |  | W | | M | M | M | W | W |  | M | | | |  | |  | |
| CO4 |  | W |  | |  |  | | S | M | M | W | W |  | M | | | |  | |  | |
| CO5 |  |  |  | |  |  | | W | W | W |  |  |  | S | | | |  | |  | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| 1.Individual Assignment  2.Group Assignment  3.Presentation  4.Surprise Test  5.Practical Assessment  6.End Semester Assessment | | | | | | | Course end survey | | | | | | | | | | | | | | |
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| Introduction to Global Values | | | | | | | | | | | | | | | | **1 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Introduction to Systems Thinking | | | | | | | | | | | | | | | | **1 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Ecology, ecological imbalances and its solution | | | | | | | | | | | | | | | | **3 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Globalisation Vs Localisation – an economic and Spiritual Perspective | | | | | | | | | | | | | | | | **3 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Global Issues & Solutions | | | | | | | | | | | | | | | | **3Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| Advanced Contemplative Practices | | | | | | | | | | | | | | | | **4 Hours** | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **Total Hours: 15** | | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | |
| 1. Vethathiri’s Maharishi’s, “World peace” The World Community Service Centre, Vethathiri Publications, 1957. 2. Fritz Schumacher, “Small is Beautiful”, The Blond & Briggs, Published 1973. 3. Noam Chomsky, “Profit over People”, Seven Stories Press, Published 1999. 4. Vethathiri’s Maharishi’s, “Atomic Poison” The World Community Service Centre, Vethathiri Publications, 1983. | | | | | | | | | | | | | | | | | | | | | |

**SEMESTER VIII**

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| **U15MC*P*801** | | | **PROJECT WORK PHASE II** | | | | | | | | | | **L** | | **T** | | **P** | **C** |
| **0** | | **0** | | **24** | **12** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | |
| 1. Design, analyze, realize / simulate a physical system by using the technology they learnt during the program. | | | | | | | | | | | | | | | | | | |
| 1. Integrate various systems into one Mechatronics product. | | | | | | | | | | | | | | | | | | |
| 1. Work in a team with confined time duration. | | | | | | | | | | | | | | | | | | |
| 1. Disseminate his work both in oral and written format. | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | | PO11 | | PO12 | PSO 1 | PSO2 |
| CO1 | S | S | | S | S | S | |  | M | M |  |  | |  | | S | S | S |
| CO2 | S | S | | S | S | S | | M | M | M |  |  | |  | | S | S | S |
| CO3 |  |  | |  |  |  | |  |  |  | S |  | |  | |  |  |  |
| CO4 |  |  | |  |  |  | |  |  |  |  | S | | S | |  |  |  |
|  | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | |
| End Semester Viva Voice  Interdisciplinary work  Publication  Working model/ simulation result  Innovation  Report with good referencing | | | | | | | Course end survey | | | | | | | | | | | |
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| Students in the form of group, not exceeding 4 members in a group to carry out their main project. It should be a Mechatronics project. However, special considerations can be given for interdisciplinary measurement and computer based simulation projects. This exception should be recorded and approved by the department committee. Management related projects will not be allowed. The interdisciplinary projects will carry more weightage. It is mandatory to publish their main project in national/international level conferences to appear in the viva-voce exam. | | | | | | | | | | | | | | | | | | |

**OPEN ELECTIVE**

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| **U15MC*OE*01** | | | **ROBOTICS FOR ENGINEERS** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Define robotic terminologies and explain the importance of kinematics and dynamics in robotics. | | | | | | | | | | | | | | | | | | | | |
| 1. Summarize the different types of robotic control system. 2. Explain the basics of drives in robotics. 3. Illustrate different sensors used in robotics. 4. Explain the basics of machine vision and their operation. 5. Explain the application of robotics | | | | | | | | | | | | | | | | | | | | |
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| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 | S |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  | |
| CO2 | S | M | |  |  |  | |  |  |  |  |  |  | |  | |  | |  | |
| CO3 | S |  | | W |  |  | |  |  |  |  |  |  | |  | |  | |  | |
| CO4 | S |  | | W |  | M | |  |  |  |  |  |  | |  | |  | |  | |
| CO5 | S |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  | |
| CO6 | S | M | |  |  |  | |  |  |  |  |  |  | |  | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **INTRODUCTION** | | | | | | | | | | | | | | | | **10 Hours** | | | | |
| Evolution of robotics - Laws of robotics – classification - robot anatomy – specification –  Resolution, repeatability and precision movement. Introduction to robot arm kinematics and dynamics – planning of manipulator trajectories. | | | | | | | | | | | | | | | | | | | | |
| **ROBOTIC DRIVES AND CONTROL** | | | | | | | | | | | | | | | | **10 Hours** | | | | |
| Hydraulic, Electric and Pneumatic drives – linear and rotary actuators – end-effectors –classification-control of robot manipulator - variable structure control – non-linear decoupled and feedback control – effect of external disturbance – PID control scheme – resolved motion control - computed torque control, force control of robotic manipulators. Adaptive control. | | | | | | | | | | | | | | | | | | | | |
| **SENSORS** | | | | | | | | | | | | | | | | **10 Hours** | | | | |
| Need for sensing system - classification of robotic sensors - status sensors, environmental sensors, quality control sensors, safety sensors and work cell control sensors.– non optical and optical position sensors – velocity sensors – proximity sensors – contact and noncontact type – touch and slip sensors – force and torque sensors – selection of right sensors. | | | | | | | | | | | | | | | | | | | | |
| **MACHINE VISION SYSTEM** | | | | | | | | | | | | | | | | **10 Hours** | | | | |
| Image Sensing and Digitizing - Image definition, Image acquisition devices, specialized lighting techniques. Digital Images - Sampling, Quantization and Encoding. Image storage. Image Processing and Analysis Data reduction – digital conversion and windowing. Segmentation – Thresholding, Edge detection and Region growing. Binary Morphology and grey morphology operations. Feature Extraction, Object recognition, Depth measurement. | | | | | | | | | | | | | | | | | | | | |
| **APPLICATION** | | | | | | | | | | | | | | | | **5 Hours** | | | | |
| Introduction - Delivery Robots – Intelligent vehicles – Survey and inspection robots – Space Robots – Autonomous aircrafts – Underwater Inspection – Agriculture and Forestry. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
| 1. Saeed B Niku, ‘Introduction to Robotics’, 2nd edition, Prentice Hall of India, 2010. | | | | | | | | | | | | | | | | | | | | |
| 1. S. R. Deb and S. Deb, “Robotics Technology and Flexible Automation”, Tata McGraw Hill Education Pvt. Ltd, 2010. 2. Mikell P. Groover, “Industrial Robots - Technology, Programming and Applications”, McGraw Hill, New York, 2008. 3. Fu K S, Gonzalez R C, Lee C.S.G, “Robotics : Control, Sensing, Vision and Intelligence”, McGraw Hill, 1987 4. Ramesh Jam, Rangachari Kasturi, Brain G. Schunck, “Machine Vision”, Tata McGraw-Hill, 1991. 5. Yoremkoren, “Robotics for Engineers”, McGraw-Hill, USA, 1987. 6. P.A. Janaki Raman, “Robotics and Image Processing”, Tata McGraw-Hill, 1991. | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*OE*02** | | | **BIOMIMETICS AND BIO INSPIRED DESIGN** | | | | | | | | | | | | **L** | | **T** | **P** | | **C** |
| **3** | | **0** | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Appreciate the various biological systems which can be adopted for engineering design | | | | | | | | | | | | | | | | | | | | |
| 1. Discuss the functional units of muscle and muscle adaptation for novel design. | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the various sensing systems of biology and correlate it with engineering systems. | | | | | | | | | | | | | | | | | | | | |
| 1. Describe various natural mechanisms to adopt in developing robots and automation solution | | | | | | | | | | | | | | | | | | | | |
| 1. Explain various natural materials and provide alternate solutions for existing systems. | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the efficient control systems of nature and apply to solve simple problems. | | | | | | | | | | | | | | | | | | | | |
| 1. Apply concepts of biology to develop simple systems. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | PSO 1 | | PSO2 | |
| CO1 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | |  | |
| CO2 | S | M | |  |  |  | |  | S |  |  |  |  |  | | |  | |  | |
| CO3 | S |  | | S |  |  | |  | S |  |  |  |  |  | | |  | |  | |
| CO4 | S | S | |  |  |  | |  | S |  |  |  |  |  | | |  | |  | |
| CO5 | S | S | |  |  |  | |  | S |  |  |  |  |  | | |  | |  | |
| CO6 | S |  | |  |  |  | |  | S |  |  |  |  |  | | |  | |  | |
| CO7 | S |  | |  |  |  | |  | S |  |  |  |  |  | | |  | |  | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **LEARNING FROM NATURE** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Introduction - Mimicking and Inspiration of Nature - Synthetic Life - Artificial Life - Three main strands of development in Biomimetics- Three levels of learning from nature- Exceptional scientific and technological nature of Biomimetics- Artificial Intelligence - Nature as a Model for Structures and Tools - Constructing Structures from Cells - Biologically Inspired Mechanisms - Pumping Mechanisms - Controlled Adhesion - Biologically Inspired Structures - Defense and Attack Mechanisms in Biology - Materials and Processes in Biology - Spider Web : Strong Fibers- Multifunctional Materials - Bio-Sensors- Robotics Emulating Biology -Interfacing Biology and Machines- Aerodynamic and Hydrodynamic Mobility. | | | | | | | | | | | | | | | | | | | | |
| **BIOLOGICAL MECHANISMS AS MODELS FOR MIMICKING** | | | | | | | | | | | | | | | | **6 Hours** | | | | |
| Introduction- Muscle Function- The Functional Units- The Sarcomere- Muscle Design- Not all Sarcomeres Are Alike- Rearranging the Sarcomeres, Muscle Morphology- Muscle Adaptation- Biomimetics of Muscle Design. | | | | | | | | | | | | | | | | | | | | |
| **MECHANIZATION OF COGNITION** | | | | | | | | | | | | | | | | **6 Hours** | | | | |
| Mechanized Cognition: The Most Important Piece of AI- Training and Education- Language Cognition- Sound Cognition- Visual Cognition. | | | | | | | | | | | | | | | | | | | | |
| **EVOLUTIONARY ROBOTICS AND OPEN-ENDED DESIGN AUTOMATION** | | | | | | | | | | | | | | | | **6 Hours** | | | | |
| Introduction -Machine Bodies and Brains- Morphology Representations- Evolving Machines in Physical Reality- The Economy of Design Automation- Future Challenges: Principles of Design- Research Methodology | | | | | | | | | | | | | | | | | | | | |
| **ROBOTIC BIOMIMESIS OF INTELLIGENT MOBILITY, MANIPULATION, AND EXPRESSION** | | | | | | | | | | | | | | | | **6 Hours** | | | | |
| Introduction- Mobility and Motility: Flying, Walking, Crawling, Manipulation- Behavior, Expressivity- Robotic Materials, Structures, and Manufacturability | | | | | | | | | | | | | | | | | | | | |
| **MULTIFUNCTIONAL MATERIALS** | | | | | | | | | | | | | | | | **6 Hours** | | | | |
| Introduction- Multifunctional Composites - Heating Functionality- Healing Functionality- Sensing Functionality: Integrating Sensing into Composites, Sensor Communications and Power, Mechanical Integration, Data Management and Sensors for Structural Health Monitoring. | | | | | | | | | | | | | | | | | | | | |
| **BIOMIMETIC AND BIOLOGICALLY INSPIRED CONTROL** | | | | | | | | | | | | | | | | **6 Hours** | | | | |
| Review of the Development of System Control- Sensory-Motor Organization- Optimal Motion Formation- Mechanical Interaction and Environmental Adaptation | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
| 1. Yoseph Bar- Cohen, “Biomimetics: Biologically Inspired Technologies”, CRC press, 2006. | | | | | | | | | | | | | | | | | | | | |
| 1. Arnim von Gleich, Christian Pade, Ulrich Petschow and Eugen Pissarskoi, “Potentials and Trends in Biomimetics”, Springer Science & Business Media, 2010. | | | | | | | | | | | | | | | | | | | | |
| 1. Benyus, Janine M, “Biomimicry: Innovation Inspired by Nature”. New York: Harper Collins, 1997. | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*OE*03** | | | **TEXTILE MECHATRONICS** | | | | | | | | | | | **L** | | **T** | | **P** | **C** |
| **3** | | **0** | | **0** | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | |
| 1. Describe various process and machines involved in spinning | | | | | | | | | | | | | | | | | | | |
| 1. Explain various process and machines involved in weaving 2. Summarize the objectives and process variables of processing machines. | | | | | | | | | | | | | | | | | | | |
| 1. Explain various stages of automation scopes in spinning 2. Describe various stages of automation scopes in weaving | | | | | | | | | | | | | | | | | | | |
| 1. Explain the role of CAD/CAM/CIM in textile manufacturing | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 |
| CO1 | M |  | |  |  |  | |  |  |  |  |  |  | |  | |  | | M |
| CO2 | M |  | |  |  |  | |  |  |  |  |  |  | |  | |  | | M |
| CO3 | M |  | |  |  |  | |  |  |  |  |  |  | |  | |  | | M |
| CO4 | M |  | |  |  |  | |  |  |  |  |  |  | |  | |  | | M |
| CO5 | M |  | |  |  |  | |  |  |  |  |  |  | |  | |  | | M |
| CO6 | M |  | |  |  |  | |  |  |  |  |  |  | |  | |  | | M |
|  | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | |
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| **INTRODUCTION TO TEXTILE TECHNOLOGY** | | | | | | | | | | | | | | | | **4 Hours** | | | |
| History of textile technology and its advancements, introduction to textile fibers, overview of textile manufacturing, Introduction to automation in textile industries. | | | | | | | | | | | | | | | | | | | |
| **BASICS OF SPINNING** | | | | | | | | | | | | | | | | **8 Hours** | | | |
| Spinning process flow chart – Objectives and process variables of textile spinning machineries: Mixing, Blow room, Carding, Draw frame, Combing, Speed frame, Ring frame, rotor spinning. | | | | | | | | | | | | | | | | | | | |
| **BASICS OF WEAVING** | | | | | | | | | | | | | | | | **8 Hours** | | | |
| Weaving process flowchart – Objectives and process variables in weaving preparatory: Winding, Warping, Sizing and beaming. Objectives and process variables in weaving: drawing in, knotting, denting and weaving. | | | | | | | | | | | | | | | | | | | |
| **BASICS OF PROCESSING** | | | | | | | | | | | | | | | | **5 Hours** | | | |
| Objectives and process variables in processing machines: Singeing, Desizing, Scouring, Bleaching, Mercerizing, Dyeing, Printing, Finishing. | | | | | | | | | | | | | | | | | | | |
| **AUTOMATION IN SPINNING MACHINERY** | | | | | | | | | | | | | | | | **8 Hours** | | | |
| Machinery material flow and its variation controls – Feeders & Stop motions – Auto levelers – Safety switches – Production and quality monitors – Full doff and pre-set length monitors. Data acquisition system for spinning preparatory, ring spinning – rotor spinning. | | | | | | | | | | | | | | | | | | | |
| **AUTOMATION IN WEAVING MACHINERY** | | | | | | | | | | | | | | | | **8 Hours** | | | |
| Yarn cleaner controls – Knotter / splicer carriage controls – Warping machine monitors and controls – sizing machine monitors and controls – Auto reaching / drawing in and knotting machine monitors and controls – Data acquisition system in weaving preparatory and weaving – humidification systems . | | | | | | | | | | | | | | | | | | | |
| **APPLICATIONS** | | | | | | | | | | | | | | | | **4 Hours** | | | |
| CAD / CAM / CIM in spinning, Weaving, Dyeing, Printing, Apparel production – Electronics data interchange - Robotics in textile industries | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | |
| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | |
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**ELECTIVE I**

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| **U15MCE101** | | | **SOFT COMPUTING** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Implement numerical methods in soft computing. 2. Explain the fuzzy set theory. 3. Explain optimization techniques. 4. Discuss the supervised and unsupervised learning networks 5. Summarize on neuro fuzzy modeling 6. Demonstrate some applications of computational intelligence | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| |  |  | | --- | --- | |  | Nil | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **Cos** | Programme Outcomes(Pos) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 | S | M | | W |  | M | |  |  |  |  |  |  | |  | | W | |  | |
| CO2 | M | M | | W |  | M | |  |  |  |  |  |  | |  | | M | |  | |
| CO3 | S | S | | W |  | M | |  |  |  |  |  |  | |  | | M | | W | |
| CO4 |  | M | | M |  | M | |  |  |  |  |  |  | |  | | M | |  | |
| CO5 |  | M | | M |  | M | |  |  |  |  |  |  | |  | | M | |  | |
| CO6 | M | M | | M |  | M | |  |  |  |  |  |  | |  | | M | | M | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **FUZZY SET THEORY** | | | | | | | | | | | | | | | | **10 Hours** | | | | |
| Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling. | | | | | | | | | | | | | | | | | | | | |
| **OPTIMIZATION** | | | | | | | | | | | | | | | | **8 Hours** | | | | |
| Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton’s Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search. | | | | | | | | | | | | | | | | | | | | |
| **NEURAL NETWORKS** | | | | | | | | | | | | | | | | **10 Hours** | | | | |
| Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Mutilayer Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning. | | | | | | | | | | | | | | | | | | | | |
| **NEURO FUZZY MODELING** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum. | | | | | | | | | | | | | | | | | | | | |
| **APPLICATIONS OF COMPUTATIONAL INTELLIGENCE** | | | | | | | | | | | | | | | | **8 Hours** | | | | |
| Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| 1. Eberhart R, Simpson P and Dobbins R., “Computational Intelligence - PC Tools”, AP Professional, Boston, 1996. 2. Cromwell, Weibell and Pfeiffer, “Biomedical Instrumentation and Measurements”, 2nd Edition, Prentice Hall of India, 2007. | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*T*102** | | | **FUNCTIONAL PROGRAMMING** | | | | | | | | | | | | **L** | | **T** | | **P** | | **C** | |
| **3** | | **0** | | **0** | | **3** | |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | | |
| 1. Classify and make use of python programming elements to solve and debug simple logical problems. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Interpret the problem and able to identify checkpoints to create ordered programs. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Apply the concept of data structures to solve simple non deterministic problems | | | | | | | | | | | | | | | | | | | | | | |
| 1. Make use of object oriented concepts to build real time applications | | | | | | | | | | | | | | | | | | | | | | |
| 1. Use various functions to manipulate hold set of values | | | | | | | | | | | | | | | | | | | | | | |
| 1. Solve complex problems using loop functions | | | | | | | | | | | | | | | | | | | | | | |
| 1. Perform arithmetic operations and able to print output | | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | | | PSO 1 | | PSO2 | | |
| CO1 | M |  |  |  | M | |  |  |  |  |  |  |  | | | | |  | | M | | |
| CO2 | M |  |  |  | M | |  |  |  |  |  |  |  | | | | |  | | M | | |
| CO3 | M |  |  |  | M | |  |  |  |  |  |  |  | | | | |  | | M | | |
| CO4 | M |  |  |  | M | |  |  |  |  |  |  |  | | | | |  | | M | | |
| CO5 | M |  |  |  | M | |  |  |  |  |  |  |  | | | | |  | | M | | |
| CO6 | M |  |  |  | M | |  |  |  |  |  |  |  | | | | |  | | M | | |
| CO7 | M |  |  |  | M | |  |  |  |  |  |  |  | | | | |  | | M | | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | **Indirect** | | | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | Course end survey | | | | | | | | | | | | | | | | |
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| **INTRODUCTION TO FUNCTIONAL PROGRAMMING: PYTHON** | | | | | | | | | | | | | | | | **3 Hours** | | | | | | |
| Why Python is popular? - The Python Programming Language - What Is a Program? - What Is Debugging? – **Errors:** Syntax Errors, Runtime Errors and Semantic Errors - The first program- **Essentials for programming:** Values and Types, Variables, Variable Names, Keywords, Operators, Operands, Expressions, Statements- **Mode of programming**: Interactive Mode and Script Mode- Operations: Order of Operations and String Operations – Comments. | | | | | | | | | | | | | | | | | | | | | | |
| **FUNCTIONS, CONDITIONALS AND RECURSION** | | | | | | | | | | | | | | | | **6 Hours** | | | | | | |
| Function Calls - Type Conversion Functions - Math Functions – Composition - Adding New Functions - Definitions and Uses - Flow of Execution - Parameters and Arguments - Variables and Parameters Are Local- Stack Diagrams - Fruitful Functions and Void Functions - Why Functions?- Importing with from. Modulus Operator - Boolean Expressions - Logical Operators - Conditional Execution - Alternative Execution - Chained Conditionals - Nested Conditionals  - Stack Diagrams for Recursive Functions - Infinite Recursion - Keyboard Input. | | | | | | | | | | | | | | | | | | | | | | |
| **FRUITFUL FUNCTIONS AND ITERATIONS** | | | | | | | | | | | | | | | | **4 Hours** | | | | | | |
| **Significant functions** : Return Values , Incremental Development, Composition, Boolean Functions, More Recursion, Leap of Faith and checking types - **Iterations:** Multiple Assignment, Updating Variables, The while Statement, break, Square Roots and Algorithms. | | | | | | | | | | | | | | | | | | | | | | |
| **STRINGS, LISTS AND DICTIONARIES** | | | | | | | | | | | | | | | | **8 Hours** | | | | | | |
| **Strings:** A String Is a Sequence , len, Traversal with a for Loop, String Slices, Strings Are Immutable, Searching, Looping and Counting- String Methods, The in Operator and String Comparison – **Lists:** A List Is a Sequence, Lists Are Mutable, Traversing a List- List Operations - List Slices - List Methods - Map, Filter, and Reduce - Deleting Elements - Lists and Strings - Objects and Values – Aliasing - List Arguments- **Dictionaries:** Dictionary as a Set of Counters, Looping and Dictionaries, Reverse Lookup, Dictionaries and Lists, Memos, Global Variables, Long Integers. | | | | | | | | | | | | | | | | | | | | | | |
| **TUPLES AND FILES** | | | | | | | | | | | | | | | | **6 Hours** | | | | | | |
| **Tuples:** Tuples Are Immutable, Tuple Assignment, Tuples as Return Values, Variable-Length Argument Tuples, Lists and Tuples- Dictionaries and Tuples -Comparing Tuples- Sequences of Sequences- **Files:** Persistence, Reading and Writing, Format Operator, Filenames and Paths, Catching Exceptions, Databases, Pickling and Pipes. | | | | | | | | | | | | | | | | | | | | | | |
| **INTRODUCTION TO CLASSES AND OBJECTS** | | | | | | | | | | | | | | **3 Hours** | | | | | | | | |
| **Classes and Objects:** User defined types, Attributes, rectangles and copying- **Classes and Functions:** Time, Pure functions and modifiers- **Classes and Methods:** object oriented features, polymorphism and type based dispatch- **Inheritance:** Card Objects, Class Attributes, Comparing Cards, Inheritance Class Diagrams and Data Encapsulation. | | | | | | | | | | | | | | | | | | | | | | |
| **30 Hours** | | | | | | | | | | | | | | | | | | | | | | |
| **LIST OF EXPERIMENTS** | | | | | | | | | | | | | | | | | | | | | | |
| 1. Use tuples and lists to assign and hold multiple values. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Use lists to manipulate sets of values. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Use slices to obtain parts of lists and to manipulate lists. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Use range () to generate lists containing sequences of integers. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Use for loops to iterate through predefined lists of objects. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Use while loops to iterate until satisfactory exit conditions are obtained. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Use break to program more flexible loop exit conditions. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Read lines of input from the user, without giving a prompt. When the input line is **quit**, stop accepting input. As output, print the input lines in reverse order, one on each output line. The line **quit** should not be included in the output. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Write a program to Convert a Decimal number to Binary number | | | | | | | | | | | | | | | | | | | | | | |
| 1. Write a function roots that computes the roots of a quadratic equation. Check for complex roots and print an error message saying that the roots are complex. | | | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 30Hr Practical: 15 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES::** | | | | | | | | | | | | | | | | | | | | | | |
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| 1. [Steven Bird](https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Steven+Bird%22), [Ewan Klein](https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Ewan+Klein%22) and [Edward Loper](https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Edward+Loper%22), “Natural Language Processing with Python”, O'Reilly Media, Inc, 2009. | | | | | | | | | | | | | | | | | | | | | | |

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| **U15MCE103** | | | **INTRODUCTION TO ANDROID PROGRAMMING** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Explain about the architecture of android programming | | | | | | | | | | | | | | | | | | | | |
| 1. Explain about java and xml based coding | | | | | | | | | | | | | | | | | | | | |
| 1. Use android studio components | | | | | | | | | | | | | | | | | | | | |
| 1. Apply android studio function and layout for simple application | | | | | | | | | | | | | | | | | | | | |
| 1. Develop systematically sequenced application using android studio. | | | | | | | | | | | | | | | | | | | | |
| 1. Create real time applications using hardware. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| |  |  | | --- | --- | |  | Nil | | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | M | |  | |
| CO2 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | M | |  | |
| CO3 | M |  | | S |  | S | |  |  |  |  |  |  | |  | | M | |  | |
| CO4 | M |  | |  |  | S | |  |  |  |  |  |  | |  | | M | |  | |
| CO5 | M |  | |  |  |  | |  |  |  |  |  |  | |  | | M | | M | |
| CO6 | M |  | |  |  | S | |  |  |  |  |  |  | |  | | M | | M | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **INTRODUCTION** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Architecture Fundamentals** – Linux Kernel – Android Libraries – Android Runtime – Android Application framework – Android Application.  **Fundamentals of Android Application** – Android SDK – Eclipse and ADT - JRE and JDK – Android Studio | | | | | | | | | | | | | | | | | | | | |
| **BASICS OF PROGRAMMING** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Basics of JAVA –** Java Identifiers – Keywords – Literals – Variables – Code Blocks – Comments – Operators and Expressions – Statements, Physical line and Logical Line  **Basics of XML –** XML writing – content and markup – elements, openings closing and empty element tags – attribute. | | | | | | | | | | | | | | | | | | | | |
| **ANDROID’S APPLICATION COMPONENTS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Components –** Services – Activities – Content Providers – Broadcast receivers – views – fragments – intents – layouts – manifest – resources | | | | | | | | | | | | | | | | | | | | |
| **ANDROID STUDIO** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Android studio features** – Toolbar – tool button – project tool window – status bar – navigation bar – tab bar – android studios workspace – palette – component tree – context menu – layout view window – properties windows – source code / XML editor  **Program Structure –** Java Packages – Using packages – file structure of android project – application resources – android device navigation – deigning effective navigation. | | | | | | | | | | | | | | | | | | | | |
| **APPLICATION DEVELOPMENT AND DEPLOYMENT** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| **Application Navigation:** navigation with Up and Back – switch views – sibling screens - indirect notification  **Action Bar And Navigation Drawers:** action bar - action button - prioritize actions - navigation drawer - navigation hub  **User Information and Location:** retrieve a contact list - Location awareness  **Deployment:** Emulator – android device - testing your android app– USB Debugging mode | | | | | | | | | | | | | | | | | | | | |
| **CASE STUDY:** Design of the Passenger comfort logging system using android. | | | | | | | | | | | | | | | | | | | | |
| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| 1. Charles F Goldfarb, Paul Prescod “The XML Handbook” 3rd edition, Pearson Education, 2001. | | | | | | | | | | | | | | | | | | | | |

**ELECTIVE Ii**

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| **U15MC*E*201** | | | **MACHINE VISION SYSTEM** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Summarize acquisition and processing methods of digital image along with their applications | | | | | | | | | | | | | | | | | | | | |
| 1. Design filters for image enhancement. | | | | | | | | | | | | | | | | | | | | |
| 1. Compare image enhancement in spatial domain with frequency domain | | | | | | | | | | | | | | | | | | | | |
| 1. Describe about image segmentation techniques | | | | | | | | | | | | | | | | | | | | |
| 1. Choose appropriate segmentation techniques for different applications 2. Provide solution to complex problems involving image processing | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 |  | W | |  |  |  | |  |  |  |  |  |  | |  | | W | |  | |
| CO2 | M | M | | S |  | M | |  |  |  |  |  |  | |  | | W | |  | |
| CO3 | M | M | | S |  | M | |  |  |  |  |  |  | |  | | W | |  | |
| CO4 | M | M | |  |  |  | |  |  |  |  |  |  | |  | | S | | M | |
| CO5 |  |  | | S |  | M | |  |  |  |  |  |  | |  | | S | | M | |
| CO6 | M | M | | S | M | M | |  |  |  |  |  |  | |  | | S | | S | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **INTRODUCTION** | | | | | | | | | | | | | | | | **7 Hours** | | | | |
| Digital image representation; fundamental steps in image processing; elements of digital image processing systems: image acquisition: Vision System: Basic Components – Elements of visual perception, Lenses: Pinhole cameras, Gaussian Optics – Cameras – Camera-Computer interfaces, storage, processing and display. | | | | | | | | | | | | | | | | | | | | |
| **DIGITAL IMAGE FUNDAMENTALS** | | | | | | | | | | | | | | | | **6 Hours** | | | | |
| Structure of the human eye; image formation; brightness adaptation and discrimination; a simple image model; uniform and non-uniform sampling and quantization; some basic relationships between pixels; neighbors of a pixel; Connectivity; Labeling. Distance measures; imaging geometry. | | | | | | | | | | | | | | | | | | | | |
| **IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Basic gray level transformations-histogram processing-Enhancement using arithmetic/logic operations-Basics of spatial filtering-comparison between smoothing and sharpening spatial filters. | | | | | | | | | | | | | | | | | | | | |
| **IMAGE ENHANCEMENT IN THE FREQUENCY DOMAIN** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| 1D Fourier transform-2D Fourier transform and its Inverse-Smoothing & sharpening.  Frequency domain filters (Ideal, Butterworth, Gaussian)-homomorphic filtering. | | | | | | | | | | | | | | | | | | | | |
| **MACHINE VISION** | | | | | | | | | | | | | | | | **7 Hours** | | | | |
| Segmentation – Thresholding, Edge detection and Region growing. Binary Morphology and grey morphology operations. Feature Extraction, Object recognition, Depth measurement. | | | | | | | | | | | | | | | | | | | | |
| **APPLICATIONS** | | | | | | | | | | | | | | | | **7 Hours** | | | | |
| Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| **U15MC*E*202** | | | **MEDICAL MECHATRONICS** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Explain different measurement techniques used in physiological parameters measurement. 2. Describe the different sensors and transducer principles used in bio medical application | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the signal conditioning circuits used in biomedical engineering. | | | | | | | | | | | | | | | | | | | | |
| 1. Comment on various measurement systems used in diagnostics. 2. Comment on various monitoring systems used in diagnostics | | | | | | | | | | | | | | | | | | | | |
| 1. Differentiate the working of recorders and explain the advanced systems used in medicine. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| |  |  | | --- | --- | |  | Nil | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 | M |  | |  |  |  | |  |  |  |  |  |  | |  | |  | | M | |
| CO2 | M |  | |  | W |  | |  |  |  |  |  |  | |  | |  | | M | |
| CO3 | M |  | |  | M |  | |  |  |  |  |  |  | |  | |  | | M | |
| CO4 | M | W | |  |  |  | |  |  |  |  |  |  | |  | |  | | M | |
| CO5 | M | W | |  |  |  | |  |  |  |  |  |  | |  | |  | | M | |
| CO6 | M |  | |  |  | M | |  |  |  |  |  |  | |  | |  | | M | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **INTRODUCTION** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| 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 – three equipment failures and trouble shooting. | | | | | | | | | | | | | | | | | | | | |
| **BIO-MEDICAL SENSORS AND TRANSDUCERS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| 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. | | | | | | | | | | | | | | | | | | | | |
| **SIGNAL CONDITIONING AND DISPLAY** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Input isolation, DC amplifier, instrumentation, charge amplifier, power amplifier, and differential amplifier – feedback, op-Amp-electrometer amplifier, carrier Amplifier – instrument power supply, basis of signal conversion and digital filtering, data reduction technique – time and frequency domain technique. | | | | | | | | | | | | | | | | | | | | |
| **MEDICAL MEASUREMENT AND MONITORING SYSTEMS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| 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. | | | | | | | | | | | | | | | | | | | | |
| **RECORDERS AND ADVANCED SYSTEMS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Oscillagraphic – galvanometric - thermal array recorder, photographic recorder, storage oscilloscopes, electron microscope.Biotelemetry, Diathermy,Audiometers, Dialysers, Lithotripsy. **CASE STUDIES: Hot wire Anemometry for respiratory flow measurements.** | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| **U15MC*E*203** | | | **DIGITAL SIGNAL PROCESSING** | | | | | | | | | | | **L** | **T** | **P** | | **C** |
| **3** | **0** | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | |
| 1. Explain the characteristics of discrete-time signals and discrete systems | | | | | | | | | | | | | | | | | | |
| 1. Explain the Properties of Z transform and DFT 2. Analyze the discrete time systems using mathematical tools. | | | | | | | | | | | | | | | | | | |
| 1. Illustrate efficient computation of DFT 2. Describe Filters and their structures 3. Illustrate the design of FIR and IIR filters 4. Discuss advanced features and architecture of generic P-DSP | | | | | | | | | | | | | | | | | | |
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| **Pre-requisite** | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | PSO 1 | | PSO2 | |
| CO1 | M | W | |  |  |  |  |  |  |  |  |  |  | | W | |  | |
| CO2 | M | M | | W |  |  |  |  |  |  |  |  |  | | W | |  | |
| CO3 | M | M | | W | W |  |  |  |  |  |  |  |  | | M | |  | |
| CO4 | W | M | |  |  |  |  |  |  |  |  |  |  | | W | |  | |
| CO5 |  |  | | M |  |  |  |  |  |  |  |  |  | | M | |  | |
| CO6 |  |  | | M |  |  |  |  |  |  |  |  |  | | M | |  | |
| CO7 |  |  | | W | M |  |  |  |  |  |  |  |  | | M | | W | |
|  | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | |
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| **DISCRETE TIME SIGNALS AND SYSTEMS** | | | | | | | | | | | | | | **9 Hours** | | | | |
| Representation of a CT signal by samples – Sampling theorem – Reconstruction of a signal from its samples – Aliasing – DT Signals – Impulse, Step, Pulse, Sine, Exponential – Properties of DT signals - Transformation of independent variable – Shifting, scaling, folding - Discrete Time LTI systems – Properties – Impulse response – Convolution sum – Properties of Convolution. | | | | | | | | | | | | | | | | | | |
| **Z-TRANSFORM AND SYSTEM ANALYSIS** | | | | | | | | | | | | | | **9 Hours** | | | | |
| DTFT – Properties - Z transform – Forward Transform - Inverse Transform using Partial Fractions - Properties – Pole-Zero plot– Difference Equations - Transfer function - Analysis of Discrete Time systems using DTFT and Z Transform. | | | | | | | | | | | | | | | | | | |
| **DISCRETE FOURIER TRANSFORM** | | | | | | | | | | | | | | **9 Hours** | | | | |
| Introduction to DFT – Properties of DFT – Efficient computation of DFT – FFT algorithms – Introduction to Radix - n algorithms – Radix – 2 FFT – Decimation-in-Time and Decimation–in-Frequency algorithms – Butterfly diagram. | | | | | | | | | | | | | | | | | | |
| **DESIGN OF DIGITAL FILTERS** | | | | | | | | | | | | | | **9 Hours** | | | | |
| FIR filter design: Linear phase characteristics - Windowing Technique –Rectangular, Hamming, Hanning, Blackmann windows – IIR filter design: Analog filter design - Butterworth and Chebyshev approximations – Impulse invariance and Bilinear transformations - FIR and IIR filter structures – Direct form I and II - cascade and parallel forms – Finite Precision effects. | | | | | | | | | | | | | | | | | | |
| **ADVANCED TOPICS AND PROGRAMMABLE DSP CHIPS** | | | | | | | | | | | | | | **9 Hours** | | | | |
| Concepts of multi-rate signal processing – Decimation and interpolation by integer factor – Sampling rate conversion – Introduction to DSP architecture - Von Neumann, Harvard, Modified Harvard architectures – MAC unit–Multiple ALUs Modified Bus structures and memory access schemes in P-DSP – Multiple access memory – Multi-ported memory – VLIW architecture –Pipelining – Special addressing modes | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | |
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| **U15MC*E*204** | | | **MICRO ELECTRO MECHANICAL SYSTEMS** | | | | | | | | | | | | **L** | | **T** | **P** | | **C** |
| **3** | | **0** | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the evolution of micro and smart system. | | | | | | | | | | | | | | | | | | | | |
| 1. Illustrate about various sensors and actuating system. | | | | | | | | | | | | | | | | | | | | |
| 1. Classify the Micro machining techniques in MEMS. | | | | | | | | | | | | | | | | | | | | |
| 1. Evaluate a proper scaling method. | | | | | | | | | | | | | | | | | | | | |
| 1. Determine packaging techniques in MEMS and smart system. 2. Discuss various applications of MEMS. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **Cos** | Programme Outcomes(Pos) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | PSO 1 | | PSO2 | |
| CO1 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | |  | |
| CO2 | M |  | |  |  |  | |  |  |  |  |  |  |  | | |  | |  | |
| CO3 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | |  | |
| CO4 |  | S | |  |  |  | |  |  |  |  |  |  |  | | | S | |  | |
| CO5 | S |  | |  |  |  | |  |  |  |  |  |  |  | | | S | |  | |
| CO6 | S | M | | M |  |  | |  |  |  |  |  |  |  | | | S | | M | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **INTRODUCTION** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Overview - Microsystems and microelectronics - definition-MEMS materials-scaling laws scaling in geometry-scaling in rigid body dynamics- scaling in electrostatic forces- scaling in electricity- scaling in fluid mechanics- scaling in heat transfer. | | | | | | | | | | | | | | | | | | | | |
| **MICRO SENSORS AND ACTUATORS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Working principle of Microsystems - micro actuation techniques - micro sensors-types –Micro actuators – types – micro pump – micro motors – micro – valves – micro grippers –micro Accelerometers | | | | | | | | | | | | | | | | | | | | |
| **FABRICATION PROCESS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Substrates-single crystal silicon wafer formation-Photolithography-Ion implantation-Diffusion –Oxidation-CVD-Physical vapor deposition-Deposition by epitaxy-etching process. | | | | | | | | | | | | | | | | | | | | |
| **MICRO SYSTEM MANUFACTURING** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Bulk Micro manufacturing- surface micro machining – LIGA – SLIGA - Micro system packaging-materials - die level-device level-system level-packaging techniques - die preparation - surface bonding -wire bonding - sealing. | | | | | | | | | | | | | | | | | | | | |
| **MICRO SYSTEM DESIGN** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Design considerations-process design-mask layout design- mechanical design-applications of micro systems in automotive industry, bio medical, aero space and telecommunications. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| 1. Julian W Gardner, Vijay K Varadan, Osama O Awadel Karim, “Microsensors MEMS and Smart Devices”, John Wily and sons Ltd., 2001. | | | | | | | | | | | | | | | | | | | | |
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| 1. Francis E H Tay and W O Choong, “Microfludics and BioMEMS Applications”, Springer, 2002. | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*E*205** | | | **MOBILE ROBOTICS** | | | | | | | | | | | | **L** | | **T** | **P** | | **C** |
| **3** | | **0** | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Explain robot locomotion | | | | | | | | | | | | | | | | | | | | |
| 1. Apply kinematics models and constraints | | | | | | | | | | | | | | | | | | | | |
| 1. Implement vision algorithms for robotics | | | | | | | | | | | | | | | | | | | | |
| 1. Implement robot localization techniques | | | | | | | | | | | | | | | | | | | | |
| 1. Explain robot mapping techniques | | | | | | | | | | | | | | | | | | | | |
| 1. Describe SLAM algorithms 2. Explain planning and navigation in robotics | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **Cos** | Programme Outcomes(Pos) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | PSO 1 | | PSO2 | |
| CO1 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | | M | |
| CO2 | S |  | | M |  | M | |  |  |  |  |  |  |  | | |  | | M | |
| CO3 | S |  | |  |  | M | |  |  |  |  |  |  |  | | |  | | M | |
| CO4 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | | M | |
| CO5 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | | M | |
| CO6 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | | M | |
| CO7 | S |  | |  |  |  | |  |  |  |  |  |  |  | | |  | | M | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **LOCOMOTION AND KINEMATICS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Introduction to Robotics – key issues in robot locomotion – legged robots – wheeled mobile robots – aerial mobile robots – introduction to kinematics – kinematics models and constraints – robot maneuverability | | | | | | | | | | | | | | | | | | | | |
| **ROBOT PERCEPTION** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Sensors for mobile robots – vision for robotics – cameras – image formation – structure from stereo – structure from motion – optical flow – color tracking – place recognition – range data | | | | | | | | | | | | | | | | | | | | |
| **MOBILE ROBOT LOCALIZATION** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Introduction to localization – challenges in localization – localization and navigation – belief representation – map representation – probabilistic map-based localization – Markov localization – EKF localization – UKF localization – Grid localization – Monte Carlo localization – localization in dynamic environments | | | | | | | | | | | | | | | | | | | | |
| **MOBILE ROBOT MAPPING** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Autonomous map building – occupancy grip mapping – MAP occupancy mapping – SLAM – extended Kalman Filter SLAM – graph-based SLAM – particle filter SLAM – sparse extended information filter – fastSLAM algorithm | | | | | | | | | | | | | | | | | | | | |
| **PLANNING AND NAVIGATION** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Introduction to planning and navigation – planning and reacting – path planning – obstacle avoidance techniques – navigation architectures – basic exploration algorithms | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
| 1. Roland Seigwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, “Introduction to autonomous mobile robots”, Second Edition, MIT Press, 2011. 2. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, “Probabilistic Robotics”, MIT Press, 2005. 3. Howie Choset, Kevin M. Lynch , Seth Hutchinson , George A. Kantor , Wolfram Burgard , Lydia E. Kavraki , Sebastian Thrun , “Principles of Robot Motion: Theory, Algorithms, and Implementations”, A Bradford Book, 2005. 4. Gregory Dudek and Michael Jenkin, “Computational Principles of Mobile Robotics”, Second Edition, Cambridge University Press, 2010. 5. Maja J. Mataric, “The Robotics Primer”, MIT Press, 2007. | | | | | | | | | | | | | | | | | | | | |

**ELECTIVE Iii**

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| **U15MC*E*301** | | | **FINITE ELEMENT ANALYSIS** | | | | | | | | | | | **L** | | | | **T** | | **P** | | **C** |
| **3** | | | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | | |
| 1. Develop the governing equations for a continuum. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Model and assemble the stiffness matrices for 1D, 2D elements. 2. Fit distributions to data 3. Apply Axisymmetric formulation and Isoparametric formulation concepts | | | | | | | | | | | | | | | | | | | | | | |
| 1. Choose the appropriate element type for a particular application. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Apply the FEM for plate bending and thermal analysis. | | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | | PSO 1 | | PSO2 | |
| **CO1** | S |  | |  | W |  | |  |  |  |  |  |  | |  | | | |  | |  | |
| **CO2** | S |  | |  |  |  | |  |  |  |  |  |  | |  | | | |  | |  | |
| **CO3** | S |  | |  |  |  | |  |  |  |  |  |  | |  | | | |  | |  | |
| **CO4** | S |  | |  |  |  | |  |  |  |  |  |  | |  | | | |  | |  | |
| **CO5** | S |  | |  |  | M | |  |  |  |  |  |  | |  | | | | W | |  | |
| **CO6** | S |  | |  |  | M | |  |  |  |  |  |  | |  | | | | W | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | | | |
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| **INTRODUCTION** | | | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Historical background – Introduction to FEA – Review of Matrix Algebra and Gaussian elimination – Governing equations for continuum – Spring assemblage – Stiffness method & Potential Energy Approach – Galerkin’s weighted residual method | | | | | | | | | | | | | | | | | | | | | | |
| **ONE DIMENSIONAL ELEMENTS – BAR, PLANE TRUSS & BEAM** | | | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Bar element - Stiffness Matrix in local and global coordinates, Computation of Stress – Potential Energy and Galerkin’s residual method – Solution of Plane Truss – Beam element – Stiffness and assembly of stiffness matrices - Potential energy and Galerkin’s approach | | | | | | | | | | | | | | | | | | | | | | |
| **PLANE STRESS & PLANE STRAIN – CST & LST APPROACH** | | | | | | | | | | | | | | | | | **8 Hours** | | | | | |
| Binomial, Poisson and Normal distributions – properties- Fitting of Binomial, Poisson and normal distributions to data | | | | | | | | | | | | | | | | | | | | | | |
| **AXISYMMETRIC ELEMENTS AND ISOPARAMETRIC FORMULATION** | | | | | | | | | | | | | | | | | **10 Hours** | | | | | |
| Axisymmetric formulation – Stiffness Matrix – Pressure Vessel Analysis – Applications – Isoparametric formulation – Formulation for Bar and Plane Elements – Numerical Integration – Gaussian & Newton-Cotes Quadrature – Evaluation of Stiffness Matrix by Gaussian Quadrature. | | | | | | | | | | | | | | | | | | | | | | |
| **PLATE BENDING AND THERMAL ANALYSIS** | | | | | | | | | | | | | | | | **9 Hours** | | | | | | |
| Basic Concepts of Plate Bending – Element Stiffness Matrix and Equations – Heat Transfer – Basic Differential Equation and Units – 1d and 2d formulation | | | | | | | | | | | | | | | | | | | | | | |
| **CASE STUDY:** Finite Element Analysis on Bicycle Frame, Finite Element Analysis on V-belt pulley of a fodder crushing machine | | | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | | |
| 1. Daryl L Logan, “A First course in the Finite Element Method”, 4th edition, Thomson Learning, 2007. | | | | | | | | | | | | | | | | | | | | | | |
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| **U15MC*E*302** | | | **DESIGN OF MATERIAL HANDLING SYSTEMS** | | | | | | | | | | | **L** | | | | **T** | | **P** | | **C** |
| **3** | | | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | | |
| 1. Recognize the need and types of the Material Handling Equipments | | | | | | | | | | | | | | | | | | | | | | |
| 1. Calculate the power requirements for a given belt conveyor | | | | | | | | | | | | | | | | | | | | | | |
| 1. Select the components for the belt conveyors | | | | | | | | | | | | | | | | | | | | | | |
| 1. Select and design the conveyors for the particular application 2. Differentiate the conveyors and elevators and design the bucket and cage elevators 3. Design the various elements of the hoists | | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | | PSO 1 | | PSO2 | |
| **CO1** |  |  | |  |  |  | |  |  |  |  |  |  | |  | | | |  | |  | |
| **CO2** | M |  | |  |  |  | |  |  |  |  |  |  | |  | | | |  | |  | |
| **CO3** | M |  | | M |  |  | |  |  |  |  |  |  | |  | | | | M | |  | |
| **CO4** | M | W | | S |  |  | | W |  |  |  |  |  | |  | | | | M | | W | |
| **CO5** | M | W | | M |  |  | |  |  |  |  |  |  | |  | | | | M | |  | |
| **CO6** | M |  | | M |  |  | |  |  |  |  |  |  | |  | | | | M | |  | |
|  | | | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | | |
| **MATERIAL HANDLING EQUIPMENTS (MHE)** | | | | | | | | | | | | | | | | | | **4 Hours** | | | | |
| Materials and Bulk materials – Types of material handling equipments – selection and applications of MHE. | | | | | | | | | | | | | | | | | | | | | | |
| **BELT CONVEYORS** | | | | | | | | | | | | | | | | | **12 Hours** | | | | | |
| General components of belt conveyors - Selection of belt speed and belt width – Drive unit design: Power requirement – coupling types and selection – Speed reduction: gearbox types and selection – Shaft and Pulley design – selection of Idlers and Idlers spacing – Safety devises for belt conveyors | | | | | | | | | | | | | | | | | | | | | | |
| **DESIGN OF OTHER CONVEYORS** | | | | | | | | | | | | | | | | | **10 Hours** | | | | | |
| Apron conveyors, Screw conveyors, Cleat conveyors and Pneumatic conveyors | | | | | | | | | | | | | | | | | | | | | | |
| **ELEVATORS** | | | | | | | | | | | | | | | | | **11 Hours** | | | | | |
| Conveyors and Elevators – Bucket elevators: centrifugal type and continuous type bucket elevators – Design of bucket elevators – Safety devices for bucket elevators  Cage elevators: Shaft way, guides, counter weights – safety devises | | | | | | | | | | | | | | | | | | | | | | |
| **HOIST** | | | | | | | | | | | | | | | | **10 Hours** | | | | | | |
| Design of Hoisting elements: Welded and roller chains – Hemp wire and ropes – Design of ropes – Pulley – sprockets and drums | | | | | | | | | | | | | | | | | | | | | | |
| Load handling attachments – Forged and Eye hooks – crane grabs – lifting magnets – Grabbing attachments – arresting gears and brakes | | | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | | |
| 1. Rudenko N., “Materials handling equipment”, ELnvee Publishers, 1970. | | | | | | | | | | | | | | | | | | | | | | |
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| 1. David V Hutton “Fundamentals of Finite Element Analysis”, McGraw-Hill International Edition, 2004. | | | | | | | | | | | | | | | | | | | | | | |
| 1. Alexandrov M, Materials Handling Equipments, MIR Publishers, 1981 | | | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*e*303** | | | **COMPUTER INTEGRATED MANUFACTURING** | | | | | | | | | | | **L** | | | **T** | | **P** | | **C** |
| **3** | | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the concept of automation and rapid prototyping processes | | | | | | | | | | | | | | | | | | | | | |
| 1. Classify the different types of material handling & storage system with principles and applications | | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the importance of group technology and cellular manufacturing | | | | | | | | | | | | | | | | | | | | | |
| 1. Summarize the fundamentals of flexible manufacturing systems | | | | | | | | | | | | | | | | | | | | | |
| 1. Make use of computers to prepare the product and process plan | | | | | | | | | | | | | | | | | | | | | |
| 1. Discuss the importance of MRP, Inventory control, JIT and lean manufacturing techniques | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | PSO 1 | | PSO2 | |
| **CO1** | M |  | |  |  |  | |  |  |  |  |  |  | |  | | | W | |  | |
| **CO2** | M |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  | |
| **CO3** | M | W | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  | |
| **CO4** | M |  | |  |  |  | |  |  |  |  |  |  | |  | | | W | |  | |
| **CO5** |  | W | |  |  |  | |  |  |  |  | M |  | |  | | |  | |  | |
| **CO6** | M |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | | |
| **INTRODUCTION TO AUTOMATION AND PROTOTYPING** | | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Automation: Introduction, automation principles and strategies, basic elements of advanced functions, levels modeling of manufacturing systems  Definitions, evolution, CAD for RPT, Product design and rapid product development, conceptual design, detail design, prototyping, Fundamentals of RP systems, 3D solid modeling software and their role in RPT, creation of STL file | | | | | | | | | | | | | | | | | | | | | |
| **RAPID PROTOTYPING PROCESSES** | | | | | | | | | | | | | | | | | **5 Hours** | | | | |
| Stereo lithography - Solid Ground Curing - Fusion Deposition Modeling - Laminated Object Manufacturing - Selective Laser sintering -3D Printing | | | | | | | | | | | | | | | | | | | | | |
| **MATERIAL HANDLING SYSTEMS** | | | | | | | | | | | | | | | | **6 Hours** | | | | | |
| Introduction, material handling systems, principles and design, material transport system: transfer mechanisms automated feed cut of components, performance analysis, uses of various types of handling systems including Automated Guided Vehicles and its various guiding technologies. | | | | | | | | | | | | | | | | | | | | | |
| **STORAGE SYSTEMS** | | | | | | | | | | | | | | | | **3 Hours** | | | | | |
| Performance, location strategies, conventional storage methods and equipment’s, automated storage systems. | | | | | | | | | | | | | | | | | | | | | |
| **AUTOMATED MANUFACTURING SYSTEMS** | | | | | | | | | | | | | | | | **7 Hours** | | | | | |
| Components, classification, overview, group technology and cellular manufacturing, parts classification and coding, product flow analysis, cellular manufacturing, application considerations in Group Technology | | | | | | | | | | | | | | | | | | | | | |
| **FLEXIBLE MANUFACTURING SYSTEMS** | | | | | | | | | | | | | | | | **5 Hours** | | | | | |
| Introduction, components, application, benefits, planning and implementation, transfer lines and fundamentals of automated production lines, application. | | | | | | | | | | | | | | | | | | | | | |
| **MANUFACTURING SUPPORT SYSTEMS** | | | | | | | | | | | | | | | | **10 Hours** | | | | | |
| Process planning and concurrent engineering- process planning, CAPP, CE and design for manufacturing, advanced manufacturing planning, production planning and control system, master production schedule, MRP- Capacity planning, shop floor control, inventory control, MRP-II, J.I.T production systems -Lean and agile manufacturing. | | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | |
| 1. Groover M P., “Automation, Production Systems and Computer Integrated manufacturing”, 2nd Edition, Pearson Education, 2004. | | | | | | | | | | | | | | | | | | | | | |
| 1. Radhakrishnan P, Subramanyan S and Raju V., “CAD/CAM/CIM”, 2nd edition, New Age International (P) Ltd., New Delhi, 2008. | | | | | | | | | | | | | | | | | | | | | |
| 1. Yoremkoren, “Computer Integrated Manufacturing System”, McGraw-Hill, 2007. | | | | | | | | | | | | | | | | | | | | | |
| 1. Pham D T and Dimov S S, “Rapid manufacturing”, Springer-Verlag, London, 2011. | | | | | | | | | | | | | | | | | | | | | |
| 1. Chee Kai Chua, Kah Fai Leong, Chu Sing Lim, “Rapid Prototyping: principles and applications” Wiley, 2010. | | | | | | | | | | | | | | | | | | | | | |
| 1. Ibrahim Zeid, Sivasubramanian R, “CAD/CAM: Theory & Practice” 2nd edition, McGraw Hill, Singapore, 2009. | | | | | | | | | | | | | | | | | | | | | |

**ELECTIVE IV**

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| **U15MCE401** | | | **MODELING AND SIMULATION** | | | | | | | | | | | **L** | | **T** | | | **P** | **C** |
| **3** | | **0** | | | **0** | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Define the simulation and its importance in creation of models for real time systems. | | | | | | | | | | | | | | | | | | | | |
| 1. Describe the different types of systems and models. 2. Discuss the properties of random numbers, techniques for generating pseudo random numbers. 3. Test the random numbers to check whether it is suitable for simulation of real time systems. | | | | | | | | | | | | | | | | | | | | |
| 1. Generate the random variables using sampling techniques of continuous and discrete distributions. 2. Analyze and evaluate the simulation models using goodness of fit tests. | | | | | | | | | | | | | | | | | | | | |
| 1. Design and analyze the model using simulation software packages. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | PSO 1 | | PSO2 |
| **CO1** | M |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  |
| **CO2** | M |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  |
| **CO3** | M |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  |
| **CO4** | M |  | |  |  |  | |  |  |  |  |  |  | |  | | | M | | M |
| **CO5** | M |  | |  |  |  | |  |  |  |  |  |  | |  | | | M | | M |
| **CO6** | M | M | |  | W |  | |  |  |  |  |  |  | |  | | | M | | M |
| **CO7** | M | M | |  |  | M | |  | ` |  |  |  |  | |  | | | M | | M |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **SYSTEM AND SYSTEM ENVIRONMENT** | | | | | | | | | | | | | | | | | **9 Hours** | | | |
| Component of a System – Continuous and discrete systems – Types of model; Steps in Simulation study; Simulation of an event occurrence using random number table – Single server queue –two server queue – inventory system. | | | | | | | | | | | | | | | | | | | | |
| **RANDOM NUMBER GENERATION** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Properties of random numbers – Generation of Pseudo – random numbers – techniques of generating pseudo random numbers; Test for random numbers: the Chisquare test-the kolmogrov Smirnov test – Runs test – Gap test – poker test. | | | | | | | | | | | | | | | | | | | | |
| **RANDOM – VARIATE GENERATION** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Inverse transform technique for Exponential, Uniform, triangular, weibull, Empirical, Uniform and discrete distribution, Acceptance rejection method for Poisson and gamma distribution, Direct Transformation for normal distribution. | | | | | | | | | | | | | | | | | | | | |
| **ANALYSIS AND EVALUATION OF MODEL** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Data collection, identifying the distribution, Parameter estimation, goodness of fit tests, verification and validation of simulation models. | | | | | | | | | | | | | | | | | | | | |
| **SIMULATION SOFTWARE PACKAGES** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Comparison and selection of General Purpose Simulation System (GPSS), SIMSCRIPT, SLAM, Arena simulation language, Modeling basic operations using Arena – An Electronic Assembly and testing system, Development of simulation models using Arena simulation package for queuing system, Production system, inventory system, Arena Integration and customization. Simulation Case Study of a Metal-Parts Manufacturing Facility. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| 1. Narsingh Deo., “System Simulation with Digital Computer”, Prentice Hall of India, 2003. | | | | | | | | | | | | | | | | | | | | |

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Analyze and apply appropriate inventory techniques in domain specific situations. 6. Analyze and apply appropriate queuing theories in domain specific situations | | | | | | | | | | | | | | | | | | | | | | | **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | | | Nil | | | | | | | | | | | | | | | | | | | | | | |  | | | | | | | | | | | | | | | | | | | | | | | **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | | | **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | | | PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | | PSO 1 | | PSO2 | | | **CO1** | S | S | |  | S |  | |  |  |  |  |  |  |  | | | | W | |  | | | **CO2** | S | S | |  | S |  | |  |  |  |  |  |  |  | | | | W | |  | | | **CO3** | S | S | |  | S |  | |  |  |  |  | S |  |  | | | | W | |  | | | **CO4** | S | S | |  | S |  | |  |  |  |  |  |  |  | | | | W | |  | | | **CO5** | S | S | |  | S |  | |  |  |  |  |  |  |  | | | | W | |  | | | **CO6** | S | S | |  | S |  | |  |  |  |  |  |  |  | | | | W | |  | | |  | | | | | | | | | | | | | | | | | | | | | | | **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | | | **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | | | Assignment  Internal test  Group Presentation  End semester Examination | | | | | | | Course end survey | | | | | | | | | | | | | | | |  | | | | | | | | | | | | | | | | | | | | | | | **LINEAR MODEL** | | | | | | | | | | | | | | | | | **9 Hours** | | | | | | The phases of OR study – formation of an L.P model – graphical solution – simplex algorithm – artificial variables technique (Big M method, two phase method), duality in simplex. | | | | | | | | | | | | | | | | | | | | | | | **TRANSPORTATION AND ASSIGNMENT PROBLEM** | | | | | | | | | | | | | | | | **9 Hours** | | | | | | | Transportation model – Initial solution by North West corner method – least cost method – VAM. Optimality test – MODI method and stepping stone method. Assignment model – formulation – balanced and unbalanced assignment problems. | | | | | | | | | | | | | | | | | | | | | | | **PROJECT MANAGEMENT BY PERT & CPM** | | | | | | | | | | | | | | | | **9 Hours** | | | | | | | Basic terminologies – Constructing a project network – Scheduling computations – PERT - CPM – Resource smoothening, Resource leveling, PERT cost. | | | | | | | | | | | | | | | | | | | | | | | **REPLACEMENT AND SEQUENCING MODELS** | | | | | | | | | | | | | | | | **9 Hours** | | | | | | | Replacement policies - Replacement of items that deteriorate with time (value of money not changing with time) – Replacement of items that deteriorate with time (Value of money changing with time) – Replacement of items that fail suddenly (individual and group replacement policies).  Sequencing models- n job on 2 machines – n jobs on 3 machines – n jobs on m machines, Traveling salesman problem. | | | | | | | | | | | | | | | | | | | | | | | **INVENTORY AND QUEUING THEORY** | | | | | | | | | | | | | | | **9 Hours** | | | | | | | | Variables in inventory problems, EOQ, deterministic inventory models, order quantity with price break, techniques in inventory management.  Queuing system and its structure – Kendall’s notation – Common queuing models - M/M/1: FCFS/∞/∞ - M/M/1: FCFS/n/∞ - M/M/C: FCFS/∞/∞ - M/M/1: FCFS/n/m | | | | | | | | | | | | | | | | | | | | | | |  | | | | | | | | | | | | | | | | | | | | | | | **Theory: 45Hours Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | | |  | | | | | | | | | | | | | | | | | | | | | | | **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | | | 1. Taha H A., “Operation Research”, Pearson Education, 2007. 2. Hira and Gupta “Introduction to Operations Research”, S.Chand and Co.2002 3. Hira and Gupta “Problems in Operations Research”, S.Chand and Co.2008 4. Wagner, “Operations Research”, Prentice Hall of India, 2000 5. S.Bhaskar, “Operations Research”, Anuradha Agencies, Second Edition, 2004. | | | | | | | | | | | | | | | | | | | | | |   **U15MAT701** | | | **PROBABILITY AND APPLIED STATISTICS** | | | | | | | | | | **L** | | | **T** | | **P** | | **C** |
| **3** | | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Compute measures of central tendencies and dispersions. | | | | | | | | | | | | | | | | | | | | |
| 1. Correlate the dependent variables. | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze random or unpredictable experiments and investigate salient features of random experiments. | | | | | | | | | | | | | | | | | | | | |
| 1. Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze sample data and interpret the same for population. | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze the experimental designs for one way, two way and three way classified data. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | | PSO 1 | | PSO2 | |
| **CO1** | S | S |  |  |  | |  |  |  | M | M |  |  | | | |  | |  | |
| **CO2** | S | S |  |  |  | |  |  |  | M | M |  |  | | | |  | |  | |
| **CO3** | S | S |  |  |  | |  |  |  | M | M |  |  | | | |  | |  | |
| **CO4** | S | S |  |  |  | |  |  |  | M | M |  |  | | | |  | |  | |
| **CO5** | S | S |  |  |  | |  |  |  | M | M |  |  | | | |  | |  | |
| **CO6** | S | S |  |  |  | |  |  |  | M | M |  |  | | | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | Course end survey | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **STATISTICAL MEASURES** | | | | | | | | | | | | | | | | **5 Hours** | | | | |
| Measures of central tendency: Mean, Median and Mode **–** Measures of variation: Range, Mean deviation, standard deviation and coefficient of variation. | | | | | | | | | | | | | | | | | | | | |
| **CORRELATION AND REGRESSION** | | | | | | | | | | | | | | | **4 Hours** | | | | | |
| Correlation: Karl Pearson’s coefficient of correlation – Spearman’s Rank Correlation – Regression lines. | | | | | | | | | | | | | | | | | | | | |
| **PROBABILITY AND RANDOM VARIABLES** | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Axioms of probability - Conditional probability – Total probability – Baye’s theorem - Random variables – Distribution function – properties – Probability mass function – Probability density function – moments. | | | | | | | | | | | | | | | | | | | | |
| **STANDARD DISTRIBUTIONS** | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Binomial, Poisson and Normal distributions – Moments, Moment Generating functions and properties for the above distributions - Fitting of Binomial and Poisson distributions. | | | | | | | | | | | | | | | | | | | | |
| **TESTING OF HYPOTHESIS** | | | | | | | | | | | | | | **9 Hours** | | | | | | |
| Testing of hypothesis for large samples (single mean, difference of means, single proportion, difference of proportions) – Small samples tests based on t and F distributions (single mean, difference of means, paired *t*- test and variance ratio test) – Chi-square test for independence of attributes and goodness of fit. | | | | | | | | | | | | | | | | | | | | |
| **DESIGN OF EXPERIMENTS** | | | | | | | | | | | | | | **9 Hours** | | | | | | |
| Analysis of Variance (ANOVA): Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD) - Factorial Design: 22design. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| 1. Walpole R E., Myers S L. and Keying Ye, “Probability and Statistics for Engineers and Scientists”, Pearson Education Inc, 2002. | | | | | | | | | | | | | | | | | | | | |
| 1. Gupta S.C. and Kapoor.V.K., “Fundamentals of Applied Statistics”, Sultan Chand, New Delhi, 4th Edition, 2014. | | | | | | | | | | | | | | | | | | | | |

**ELECTIVE V**

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| **U15MC*E*501** | | | **ENGINEERING ECONOMICS AND PROJECT MANAGEMENT** | | | | | | | | | | | **L** | | **T** | | **P** | **C** |
| **3** | | **0** | | **0** | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | |
| 1. Define the principles of engineering economy followed by basic methods for carrying out economic studies considering the time value of money | | | | | | | | | | | | | | | | | | | |
| 1. Differentiate between the macro and micro economics | | | | | | | | | | | | | | | | | | | |
| 1. Explain the various functions of finance and accounting process | | | | | | | | | | | | | | | | | | | |
| 1. Explain on how to estimate a cost involved in a project | | | | | | | | | | | | | | | | | | | |
| 1. Explain the various risks that are involved in a project | | | | | | | | | | | | | | | | | | | |
| 1. Explain and illustrate on how to manage various functions of the project | | | | | | | | | | | | | | | | | | | |
| 1. Describe on the function of financial systems in India | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | PSO 1 | PSO2 |
| **CO1** |  |  | |  |  |  | | S | M |  |  |  | S | |  | | |  |  |
| **CO2** |  |  | |  |  |  | | S | M |  |  |  | S | |  | | |  |  |
| **CO3** |  |  | |  |  |  | | S | S |  |  |  | S | |  | | |  |  |
| **CO4** |  |  | |  |  |  | | S | S |  |  |  | S | |  | | |  |  |
| **CO5** |  |  | |  |  |  | | S | S |  |  |  | S | |  | | |  |  |
| **CO6** |  |  | |  |  |  | | S | S |  |  |  | S | |  | | |  |  |
| **CO7** |  |  | |  |  |  | | S |  |  |  |  | S | |  | | |  |  |
|  | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | |
| Assignment  Internal Test  Group Presentation  End semester Examination | | | | | | | Course end survey | | | | | | | | | | | | |
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| **PRINCIPLES OF ENGINEERING ECONOMICS** | | | | | | | | | | | | | | | | | **9 Hours** | | |
| Basic principles – Time value of money, Quantifying alternatives for decision making, Cash flow diagrams. Arithmetic gradient, Geometric gradient – Theory of demand and supply – price mechanisms – factors of production – land, labour, capital and organization – National income – Difficulties in estimation – Micro and Macro Economics. | | | | | | | | | | | | | | | | | | | |
| **INTRODUCTION TO FINANCIAL MANAGEMENT AND ACCOUNTING** | | | | | | | | | | | | | | | | | **9 Hours** | | |
| Scope & Functions of Finance – Role of Finance Manager – Goals of Financial Management – Profit Maximization Vs. Wealth Maximization – Organization of the Finance Function.  Accounting Principles and Conventions – Double Entry system – Journal, Ledger, Trial Balance and Preparation of Final Account. | | | | | | | | | | | | | | | | | | | |
| **PROJECT RISK AND MANAGEMENT** | | | | | | | | | | | | | | | | | **9 Hours** | | |
| Project Risk – Sensitivity Analysis – Scenario Analysis – Risk Analysis – Procedure for Developing an NPW Distribution – Expected Value and Variance – Decision Rule.  Engineers, Projects, and Project Management – Project Planning – Project Scheduling – Staffing and Organizing – Team Building – Project Control – Estimating and Contracting. | | | | | | | | | | | | | | | | | | | |
| **EQUIPMENT ECONOMICS** | | | | | | | | | | | | | | | | | **9 Hours** | | |
| Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis. Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, parametric estimate, and Life cycle cost. | | | | | | | | | | | | | | | | | | | |
| **INDIAN FINANCIAL SYSTEM** | | | | | | | | | | | | | | | | | **9 Hours** | | |
| Reserve bank of India – Functions – Commercial banking system –Development financial institutions – IDBI –ICICI – SIDBI – IRBI – NABARD– Investment institutions – UTI – Insurance companies – Indian capital market – Stock market – Functions – Role of the public sector – Privatization – Multinational corporations and their impact on the Indian economy. | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | |
| 1. Agarwal A N., “Indian Economy”, New Age International Pub. (P) Limited, 1978 | | | | | | | | | | | | | | | | | | | |
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| 1. Ostwald, P. F., “Construction Cost Analysis and Estimating”, Prentice Hall, Upper Saddle River, New Jersey, 2001. | | | | | | | | | | | | | | | | | | | |

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| **U15GS*T*002** | | | **TOTAL QUALITY MANAGEMENT** | | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | | |
| 1. Apply & analyze quality concepts and philosophies of TQM | | | | | | | | | | | | | | | | | | | | | |
| 1. Apply concepts of continuous improvement | | | | | | | | | | | | | | | | | | | | | |
| 1. Apply TQM concepts to enhance customer satisfaction and deal with customer related aspects. 2. Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality 3. Apply and analyze the TQM tools as a means to improve quality 4. Understand quality systems, procedures for its implementation, documentation and auditing | | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | | PSO 1 | | PSO2 | |
| **CO1** |  | M | |  | M |  | |  |  |  |  |  | M |  | | | |  | |  | |
| **CO2** |  | M | |  | M |  | |  |  |  |  |  | M |  | | | |  | |  | |
| **CO3** |  | M | |  | M |  | |  |  |  |  |  | M |  | | | |  | |  | |
| **CO4** |  |  | |  |  | S | |  |  |  |  |  | M |  | | | |  | |  | |
| **CO5** |  | M | |  |  | S | |  |  |  |  |  | M |  | | | |  | |  | |
| **CO6** |  |  | |  |  | W | |  |  |  |  |  | M |  | | | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | | |
| Assignment  Internal Test  Group Presentation  End semester Examination | | | | | | | Course end survey | | | | | | | | | | | | | | |
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| **INTRODUCTION** | | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Definition of Quality, Dimensions of Quality, Quality costs, Top Management Commitment, Quality Council, Quality Statements, Barriers to TQM Implementation, Contributions of Deming, Juran and Crosby, Team Balancing | | | | | | | | | | | | | | | | | | | | | |
| **TQM PRINCIPLES** | | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Continuous Process Improvement,5S, Kaizen, Just-In-Time and TPS | | | | | | | | | | | | | | | | | | | | | |
| **STATISTICAL PROCESS CONTROL** | | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| The seven tools of quality, New seven Management tools, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Concept of six sigma. | | | | | | | | | | | | | | | | | | | | | |
| **TQM TOOLS** | | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Quality Policy Deployment (QPD), Quality Function Deployment (QFD), Benchmarking, Taguchi Quality Loss Function, Total Productive Maintenance (TPM), FMEA | | | | | | | | | | | | | | | | | | | | | |
| **QUALITY SYSTEMS** | | | | | | | | | | | | | | | | **9 Hours** | | | | | |
| Need for ISO 9000 and Other Quality Systems, ISO 9001:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 14001:2004. | | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | | |
| 1. Dale H.Besterfiled, “Total Quality Management”, Pearson Education India, 2011. | | | | | | | | | | | | | | | | | | | | | |
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| 1. Narayana V. and Sreenivasan, N.S. “Quality Management – Concepts and Tasks”, New Age International, 2007. | | | | | | | | | | | | | | | | | | | | | |
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| **U15GS*T*003** | | | **PRINCIPLES OF MANAGEMENT** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Apply the concepts of management and administration and analyze the evolution of management thoughts. | | | | | | | | | | | | | | | | | | | | |
| 1. Apply the concepts of planning, forecasting and decision making. | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze organizational structures and apply staffing concepts. 2. Analyze the motivational and leadership theories. 3. Apply & analyze the communication and controlling processes. 4. Analyze the various international approaches to management | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| **CO1** |  |  | |  |  |  | |  |  |  |  |  | M | |  | |  | |  | |
| **CO2** |  |  | |  |  |  | |  |  |  |  |  | M | |  | |  | |  | |
| **CO3** |  |  | |  |  |  | |  |  |  |  |  | M | |  | |  | |  | |
| **CO4** |  |  | |  |  |  | |  |  |  | M |  | M | |  | |  | |  | |
| **CO5** |  |  | |  |  |  | |  |  |  |  | M | M | |  | |  | |  | |
|  |  |  | |  |  |  | |  |  |  |  |  | M | |  | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Assignment  Internal Test  Group Presentation  End semester Examination | | | | | | | Course end survey | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **MANAGEMENT CONCEPTS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Management – Definition – Importance – Functions – Skills required for managers - Roles and functions of managers – Science and Art of Management –Management and Administration.  Evolution of Classical, Behavioral and Contemporary management thoughts. | | | | | | | | | | | | | | | | | | | | |
| **PLANNING** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Nature & Purpose – Steps involved in Planning – Forms of Planning – Types of plans – Plans at Individual, Department and Organization level - Managing by Objectives. Forecasting – Purpose – Steps and techniques. Decision-making – Steps in decision making. | | | | | | | | | | | | | | | | | | | | |
| **ORGANISING** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Nature and Purpose of Organizing - Types of Business Organization - Formal and informal organization – Organization Chart – Structure and Process – Strategies of Departmentation– Line and Staff authority – Benefits and Limitations. Centralization Vs De-Centralization and Delegation of Authority. Staffing – Manpower Planning – Recruitment – Selection – Placement – Induction. | | | | | | | | | | | | | | | | | | | | |
| **DIRECTING & CONTROLLING** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Nature & Purpose – Manager Vs. Leader - Motivation - Theories and Techniques of Motivation.  Leadership – Styles and theories of Leadership.  Communication – Process – Types – Barriers – Improving effectiveness in Communication.  Controlling – Nature – Significance – Tools and Techniques. | | | | | | | | | | | | | | | | | | | | |
| **CONTEMPORARY ISSUES IN MANAGEMENT** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Corporate Governance Social responsibilities – Ethics in business – Recent issues.  American approach to Management, Japanese approach to Management, Chinese approach to Management and Indian approach to Management. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| **U15gs*T*007** | | | **PROFESSIONAL ETHICS** | | | | | | | | | | | | **L** | | **T** | **P** | | **C** |
| **3** | | **0** | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze the various concepts and theories of engineering ethics. | | | | | | | | | | | | | | | | | | | | |
| 1. Apply concepts of ethics and analyze its impact on society. | | | | | | | | | | | | | | | | | | | | |
| 1. Apply and analyze the concept of safety and risk in the light of engineering ethics. | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze and evaluate the rights & responsibilities of engineers. | | | | | | | | | | | | | | | | | | | | |
| 1. Analyze the ethical issues engineers are to consider while operating globally. 2. Applying and analyzing the responsibilities of engineers in management and leadership roles. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | | | PSO 1 | | PSO2 | |
| CO1 |  |  | |  |  |  | | M |  | S |  |  |  |  | | |  | |  | |
| CO2 |  |  | |  |  |  | | M |  | S |  |  |  | M | | |  | |  | |
| CO3 |  |  | |  |  |  | | M |  | S |  |  |  |  | | |  | |  | |
| CO4 |  |  | |  |  |  | | M |  | S |  |  |  |  | | |  | |  | |
| CO5 |  |  | |  |  |  | | M |  | S |  |  |  |  | | |  | |  | |
| CO6 |  |  | |  |  |  | | M |  | S |  |  |  |  | | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Assignment  Internal test  Group Presentation  End semester Examination | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **ENGINEERING ETHICS AND THEORIES** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Definition, Moral issues, Types of inquiry, Morality and issues of morality, Kohlberg and Gilligan’s theories, consensus and controversy, Professional and professionalism, moral reasoning and ethical theories, virtues, professional responsibility, integrity, self respect, duty ethics, ethical rights, self interest, egos, moral obligations. | | | | | | | | | | | | | | | | | | | | |
| **SOCIAL ETHICS AND ENGINEERING AS SOCIAL EXPERIMENTATION** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Engineering as social experimentation, codes of ethics, Legal aspects of social ethics, the challenger case study, Engineers duty to society and environment. | | | | | | | | | | | | | | | | | | | | |
| **SAFETY** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – the Three Mile Island and Chernobyl case studies. Bhopal gas tragedy. | | | | | | | | | | | | | | | | | | | | |
| **RESPONSIBILITIES AND RIGHTS OF ENGINEERS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – Intellectual Property Rights (IPR) – discrimination. | | | | | | | | | | | | | | | | | | | | |
| **GLOBAL ISSUES AND ENGINEERS AS MANAGERS, CONSULTANTS AND LEADERS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Multinational Corporations – Environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership – Engineers as trend setters for global values. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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**ELECTIVE vi**

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| **U15MC*E*601** | | | **RENEWABLE ENERGY SOURCES** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **3** | | **0** | | **0** | | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Discuss on the available solar energy and the current solar energy collectors and utilization processes. 2. Calculate the performance and testing of solar collectors for different applications. | | | | | | | | | | | | | | | | | | | | |
| 1. Identify available wind energy resources and techniques to utilize them effectively. 2. Describe on bio energy, bio fuels, various resources and chemical conversion technologies and assess the competitiveness of these technologies under different scenarios. | | | | | | | | | | | | | | | | | | | | |
| 1. Describe on biomass, waste preparation and utilization technologies and assess the competitiveness of these technologies under different scenarios. | | | | | | | | | | | | | | | | | | | | |
| 1. Summarize the significance of hydrogen and fuel cells principles, storage and uses. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
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| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 | M |  | |  |  |  | |  | M |  |  |  |  | |  | |  | |  | |
| CO2 |  |  | |  | M |  | |  |  |  |  |  |  | |  | | W | |  | |
| CO3 |  |  | |  |  |  | | W | M |  |  |  |  | |  | |  | |  | |
| CO4 | M |  | |  |  |  | | W | M |  |  |  |  | |  | |  | |  | |
| CO5 |  |  | |  |  |  | | W |  |  |  |  |  | |  | |  | |  | |
| CO6 | S |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  | |
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| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **SOLAR ENERGY** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Sun as Source of Energy, Availability of Solar Energy, Nature of Solar Energy, Solar Energy & Environment. Various Methods of using solar energy – Photothermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy.  Solar collectors- types of collectors - characteristics and design principles of different type of collectors, performance and testing of collectors - Solar water and air heaters - performance and applications- solar cooling - solar drying - solar ponds - solar tower concept - solar furnace. | | | | | | | | | | | | | | | | | | | | |
| **WIND ENERGY** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Basics & Power Analysis, Wind resource assessment, Power Conversion Technologies and applications, Wind Power estimation techniques, Principles of Aerodynamics of wind turbine blade, Various aspects of wind turbine design.  Wind Turbine Generators: Induction, Synchronous machine, constant V & F and variable V & F generations, Reactive power compensation. Site Selection, Concept of wind form & project cycle, Cost economics & viability of wind farm. | | | | | | | | | | | | | | | | | | | | |
| **BIO-ENERGY** | | | | | | | | | | | | | | | | **6 Hours** | | | | |
| Photosynthesis process, Bio-fuels, Biomass resources Bio based chemicals and materials Thermo-chemical Conversion: Pyrolysis, Combustion, Gasification, Liquification. Bio-Chemical Conversion: Aerobic and Anaerobic conversion, Fermentation etc. | | | | | | | | | | | | | | | | | | | | |
| **BIOMASS** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Generation and utilization, Properties of biomass, Agriculture Crop & Forestry residues used as fuels. Biochemical and Thermo-chemical Conversion, Combustion, Gasification, Biomass gasifiers and types etc. Applications of Gasifiers to thermal power and Engines, Biomass as a decentralized power generation source for villages. | | | | | | | | | | | | | | | | | | | | |
| **HYDROGEN ENERGY** | | | | | | | | | | | | | | | | **9 Hours** | | | | |
| Hydrogen as a renewable energy source, Sources of Hydrogen, Fuel for Vehicles.  Hydrogen Production: Direct electrolysis of water, thermal decomposition of water, biological and biochemical methods of hydrogen production.  Storage of Hydrogen: Gaseous, Cryogenic and Metal hydride. | | | | | | | | | | | | | | | | | | | | |
| **FUEL CELL** | | | | | | | | | | | | | | | | **3 Hours** | | | | |
| Fuel cell – Principle of working, construction and applications. | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| 1. Khan B H., “Non Convention Energy Resources”, 2nd edition, Tata McGraw Hill, 2009. | | | | | | | | | | | | | | | | | | | | |
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| 1. George W Sutton-(Editor), “Direct Energy Conversion”, Lathur University, Electronic Series Vol 3, McGraw Hill, 2002. | | | | | | | | | | | | | | | | | | | | |

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| **U15MC*E6*02** | | | **COMPOSITE MATERIALS AND SUSTAINABLE DEVELOPMENT** | | | | | | | | | | | **L** | | **T** | | | **P** | **C** |
| **3** | | **0** | | | **0** | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| 1. Recognize the need and characteristics of the composite materials | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the manufacturing processes of composite materials | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the quality inspection methods involved in the manufacturing of composite materials | | | | | | | | | | | | | | | | | | | | |
| 1. Calculate the Engineering constants for an angle lamina. | | | | | | | | | | | | | | | | | | | | |
| 1. Characterize the laminates by finding static mechanical characteristics. | | | | | | | | | | | | | | | | | | | | |
| 1. Explain the applications of composites and its sustainability | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | | PSO 1 | | PSO2 |
| CO1 | W |  | |  |  |  | |  |  |  |  |  |  | |  | | |  | |  |
| CO2 |  |  | |  |  |  | |  |  |  |  |  |  | |  | | | W | |  |
| CO3 |  | W | |  |  |  | |  |  |  |  |  |  | |  | | | W | |  |
| CO4 | W | W | |  |  |  | |  |  |  |  |  |  | |  | | | W | |  |
| CO5 | M |  | |  | W |  | |  |  |  |  |  |  | |  | | |  | |  |
| CO6 |  |  | |  |  |  | |  | M |  |  |  |  | |  | | |  | |  |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | | |
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| **INTRODUCTION TO COMPOSITE MATERIALS** | | | | | | | | | | | | | | | | | **9 Hours** | | | |
| Need and general characteristics of composite materials- mechanical advantages and limitations  Characteristics of fibers and matrixes – classification of composites – Prepregs – Lamina, Laminate and sandwich construction. | | | | | | | | | | | | | | | | | | | | |
| **MANUFACTURING AND QUALITY INSPECTION** | | | | | | | | | | | | | | | | | **9 Hours** | | | |
| Fundamentals of curing – Bag molding process – compression and vacuum molding – filament winding – Quality inspection methods for raw materials – cure cycle monitoring – cured composite parts. | | | | | | | | | | | | | | | | | | | | |
| **ANALYSIS OF LAMINA** | | | | | | | | | | | | | | | | **10 Hours** | | | | |
| Fiber matrix interactions – Hook’s law for different types of materials – relationship of compliance and stiffness matrix to engineering constants of a lamina – angle lamina: Engineering constants | | | | | | | | | | | | | | | | | | | | |
| **ANALYSIS OF LAMINATES AND ITS PERFORMANCE** | | | | | | | | | | | | | | | | **11 Hours** | | | | |
| Laminate code – stress – strain relations for a laminate – In-plane and flexural modulus of a laminate – lamination theory – Performance – static mechanical properties | | | | | | | | | | | | | | | | | | | | |
| **APPLICATIONS OF COMPOSITES AND SUSTAINABILITY** | | | | | | | | | | | | | | | | | **6 Hours** | | | |
| Applications of composites - Natural fibers needs and its significance - Recycling of composites  **Topics of interest (Not for evaluation purpose)**  Crack propagation in composites  De-lamination prediction in composites  NDT for composites  Joining of sandwich structures | | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | | |
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| **REFERENCES:** | | | | | | | | | | | | | | | | | | | | |
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| **U15MC*e6*03** | | | **ENGINEERING METROLOGY** | | | | | | | | | | | **L** | **T** | | | **P** | **C** |
| **3** | **0** | | | **0** | **3** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | |
| 1. Summarize various linear measuring devices used to check dimensions. 2. Summarize various angular measuring devices used to check dimensions | | | | | | | | | | | | | | | | | | | |
| 1. Describe the methods and instruments used in gear parameters measurements | | | | | | | | | | | | | | | | | | | |
| 1. Describe the methods and instruments used in screw parameters measurements | | | | | | | | | | | | | | | | | | | |
| 1. Explain the automated systems used in Metrology. | | | | | | | | | | | | | | | | | | | |
| 1. Choose latest measuring tools for the modern Industrial environment. | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 |
| CO1 | W |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  |
| CO2 | M |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  |
| CO3 | W |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  |
| CO4 | M |  | |  |  |  | |  |  |  |  |  |  | |  | |  | |  |
| CO5 |  |  | |  |  | W | |  |  |  |  |  |  | |  | |  | | W |
| CO6 | M |  | |  |  | M | |  |  |  |  |  |  | |  | |  | | M |
|  | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | |
| Internal test I  Internal test II  End semester Examination  Assignment | | | | | | | Course end survey | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | |
| **LINEAR metrology** | | | | | | | | | | | | | | | | **9 Hours** | | | |
| Definition of metrology – Linear measuring instrument : Vernier, micrometer measurement, dial indicator, Slip gauges and classification, interferometer, optical flats - limit gauges, Comparators - Mechanical, pneumatic, optical and electric types, applications | | | | | | | | | | | | | | | | | | | |
| **ANGULAR METROLOGY** | | | | | | | | | | | | | | | | **5 Hours** | | | |
| Sine bar, Vernier bevel protractor, optical bevel protractor, auto collimator, angle gauges, Clinometer, angle Decker – taper measurements. | | | | | | | | | | | | | | | | | | | |
| **SCREW THREAD AND GEAR METROLOGY** | | | | | | | | | | | | | | | **6 Hours** | | | | |
| Screw thread terminology – Measurement of various elements of Thread - Measurement of Major and minor diameter - Measurement of Thread angle by Two Ball Method - Pitch Measurement. Types of Gear-Gear Terminology-Spur gear measurement -Run out ,Pitch ,Concentricity ,profile ,lead ,alignment ,Back lash- Chordal thickness Method-Constant chord method-Parkinson gear tester. | | | | | | | | | | | | | | | | | | | |
| **SURFACE MEASUREMENT** | | | | | | | | | | | | | | | **3 Hours** | | | | |
| Surface evaluation, Stylus method, Numerical values for surface assessment, Surface texture specimens, straightness, flatness and roundness measurement. | | | | | | | | | | | | | | | | | | | |
| **AdvanceD techniques in Metrology** | | | | | | | | | | | | | | | | **7 Hours** | | | |
| Coordinate measuring machine – constructional features – types and application, digital devices – computer aided inspection –– machine vision systems, Profile projector, Universal Measuring Machine, Laser principles – Laser interferometer – application in linear, angular measurement and machine tool metrology. | | | | | | | | | | | | | | | | | | | |
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| **Theory: 45 Hrs Total Hours: 45** | | | | | | | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | |
| **REFERENCES:** | | | | | | | | | | | | | | | | | | | |
| 1. Jain R K “Engineering Metrology” Khanna Publishers, 2009. | | | | | | | | | | | | | | | | | | | |
| 1. Manohar Mahajan, “A textbook of Metrology”, Dhanpat Rai and Co (P) LTD., 2008. | | | | | | | | | | | | | | | | | | | |
| 1. Alan S Morris “The Essence of Measurement” Prentice Hall of India, 1997. | | | | | | | | | | | | | | | | | | | |
| 1. Connie Dotson, Ronger Harlow and Richard L Thomson, “Fundamentals of Dimensional Metrology”, 4th edition, Thompson – Delmar, 2006. | | | | | | | | | | | | | | | | | | | |
| 1. Gupta S C, “Engineering Metrology“, Dhanpat Rai Publications, 2005. | | | | | | | | | | | | | | | | | | | |

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| **U15MCINX** | | | **CERTIFICATION PROGRAM** | | | | | | | | | | | **L** | | **T** | | **P** | | **C** |
| **1** | | **0** | | **0** | | **1** |
| **Course Outcomes** | | | | | | | | | | | | | | | | | | | | |
| **After successful completion of this course, the students should be able to** | | | | | | | | | | | | | | | | | | | | |
| **CO1:** Program / design / analysis / control mechatronics systems using modern tools which are used in industry. | | | | | | | | | | | | | | | | | | | | |
| **Pre-requisite** | | | | | | | | | | | | | | | | | | | | |
| Nil | | | | | | | | | | | | | | | | | | | | |
| **CO/PO Mapping**  (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak | | | | | | | | | | | | | | | | | | | | |
| **COs** | Programme Outcomes(POs) | | | | | | | | | | | | | | | | | | | |
| PO1 | PO2 | | PO3 | PO4 | PO5 | | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | | PO12 | | PSO 1 | | PSO2 | |
| CO1 |  |  | |  |  | S | |  |  |  |  |  |  | |  | | S | | S | |
|  | | | | | | | | | | | | | | | | | | | | |
| **Course Assessment methods:** | | | | | | | | | | | | | | | | | | | | |
| **Direct** | | | | | | | **Indirect** | | | | | | | | | | | | | |
| Authorized Certificate from the agency | | | | | | |  | | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | | | | |
| The following certification courses are considered for one credit course. The main objective of this course is to make the students employable, industry ready and to help them to pursue higher education. This course is optional, self study and self funded course. The student can choose any one of these courses (U15MCIN01) from the following list to earn one credit from 3rd to 8th semester. The students can opt only one certification course as additional course in any one of the semester mentioned above. It is restricted to maximum of three courses during their study. The program should be minimum of 15 hours and the certificate should be provided after conducting the examination by the concerned agency.   |  |  |  |  | | --- | --- | --- | --- | | **S.No.** | **Course code** | **Name of the course** | **Certification agency** | |  | U15 MCIN01 | Labview Associate Developer | National Instruments | |  | U15 MCIN02 | Robot Certification | Fanuc Robotics, ABB Robotics, KUKA Robotics | |  | U15 MCIN03 | CAD software Certification | Autodesk, Catia, Soldworks, ProE | |  | U15 MCIN04 | PLC certification | Siemens, Allen-Bradley, Fanuc | | | | | | | | | | | | | | | | | | | | | |