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|---|--|--------------------------|
|  | <b>S J P N Trust's</b><br><b>Hirasugar Institute of Technology, Nidasoshi</b><br><i>Inculcating Values, Promoting Prosperity</i><br>Approved by AICTE, Recognized by Govt. of Karnataka and Affiliated to VTU Belagavi.<br><b>Accredited at 'A' Grade by NAAC</b><br><b>Programmes Accredited by NBA: CSE, ECE, EEE &amp; ME</b> | <b>Mech. Engg. Dept.</b> |
|   |  | <b>Course Plan</b>       |
|   |  | <b>VII SEM</b>           |
|   |  | <b>2022-23 Odd Sem</b>   |

## *Department of Mechanical Engineering*

### **COURSE PLAN 2022-23**

### **VII Semester**

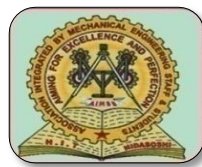
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|  |  | <b>VII SEM</b>           |
|  |  | <b>2022-23 Odd Sem</b>   |

### ***INSTITUTE VISION***

“To be a preferred institution in Engineering Education by achieving excellence in teaching and research and to remain as a source of pride for its commitment to holistic development of individual and society”

### ***INSTITUTE MISSION***

"To continuously strive for the overall development of students, educating them in a state-of-the-art-infrastructure, by retaining the best practices, people and inspire them to imbibe real time problem solving skills, leadership qualities, human values and societal commitments, so that they emerge as competent professionals"




## **DEPARTMENT OF MECHANICAL ENGINEERING**

### ***VISION***

“To be the centre of excellence in providing education in the field of Mechanical Engineering to produce technically competent and socially responsible engineering graduates”

### ***MISSION***

“Educating students to prepare them for professional competencies in the broader areas of the Mechanical Engineering field by inculcating analytical skills, research abilities and encouraging culture of continuous learning for solving real time problems using modern tools”

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### Program Educational Objectives (PEOs)

#### The Graduates will be able to


- PEO1:** Acquire core competence in Applied Science, Mathematics and Mechanical Engineering fundamentals to excel in professional career and higher study
- PEO2:** Design, demonstrate and analyze the mechanical systems which are useful to society.
- PEO3:** Maintain professional & ethical values, employability skills, multidisciplinary approach & an ability to realize engineering issues to broader social context by engaging in lifelong learning.

### Program Specific Outcomes (PSOs)

- PSO1:** Able to apply the basic principles of Mechanical Engineering in various practical fields to solve societal problems by engaging themselves in many state/national level projects.
- PSO2:** Able to analyze and design basic mechanical system using relevant tools and techniques.
- PSO3:** Able to resolve contemporary issues of industries through industry institute interaction and alumni social networks


### Program Outcomes (POs)

- PO1: Engineering knowledge-** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2: 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.
- PO3: 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.
- PO4: 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.
- PO5: 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.
- PO6: 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.
- PO7: 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.
- PO8: Ethics-** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9: Individual and team work-** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- PO10: 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.
- PO11: 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.
- PO12: 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.

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| <b>Theory Course Plan</b>                          |  |                    |
| 1  | Control Engineering                              | 18ME71/15/17ME73   |
| 2  | Computer Aided Design & Manufacturing            | 18ME72             |
| 3  | Total Quality Management -PE-2                   | 18ME734            |
| 4  | Mechatronics-PE-3/PE-IV                          | 18ME744/15/17ME753 |
| 5  | Open Elective-B (Python Application Programming) | 18CS752            |
| 6  | Energy Engineering                               | 15/17ME71          |
| 7  | Fluid Power Systems                              | 15/17ME72          |
| 8  | Tribology-PE-III                                 | 15/17ME742         |
| 09   | Project Work Phase-1                             | 18MEP78/15/17MEP78 |
| <b>Laboratory – Course Plan and Viva Questions</b> |  |                    |
| 10   | Computer Integrated Manufacturing Lab            | 18MEL76/15/17MEL77 |
| 11   | Design Lab                                       | 18MEL77/15/17MEL76 |

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## Departmental Resources


Department of Mechanical Engineering was established in the year 1996 and is housed in a total area of **2584.5 Sq. Meters**.

### Faculty Position

| Sl. No. | Category         | No. in position | Average experience |
|---------|------------------|-----------------|--------------------|
| 1       | Teaching faculty | 08              | 19                 |
| 2       | Technical staff  | 05              | 17                 |
| 3       | Helper / Peons   | 03              | 13                 |

### Major Laboratories

| S.N. | Name of the laboratory                         | Area in Sq. Meters | Amount Invested (Rs.) |
|------|--|--------------------|-----------------------|
| 1    | Basic Workshop Laboratory                      | 170                | 428093                |
| 2    | Fluid Mechanics Machinery Laboratory           | 172                | 775916.75             |
| 3    | Energy Conversion Engg. Laboratory             | 173                | 1275603.2             |
| 4    | Machine shop Laboratory                        | 170                | 1372566.5             |
| 5    | Foundry & Forging Laboratory                   | 179                | 321057.11             |
| 6    | Design Laboratory                              | 73                 | 365861.0              |
| 7    | Heat & Mass Transfer Laboratory                | 148                | 524576.0              |
| 8    | Metallography & Material Testing Laboratory    | 149                | 1102945.2             |
| 9    | Mechanical Measurements & Metrology Laboratory | 95                 | 557593.75             |
| 10   | CIM & Automation/CAMA Laboratory               | 66                 | 3720793.1             |
| 11   | Computer Aided Machine Drawing Laboratory      | 66                 | 2014136.5             |
| 12   | Computer Aided Engg Drawing Laboratory         | 66                 | 1438121.3             |
| 13   | Department/Other                               | --                 | 2031766.2             |
|      | <b>Total</b>                                   | <b>1527</b>        | <b>638297</b>         |
|      |  |                    | <b>16567326.61</b>    |

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### Teaching Faculty Details

| S.N. | Faculty Name         | Designation  | Qualification  | Area of specialization            | Teaching Exp (in years) | Contact Nos. |
|------|----------------------|--------------|----------------|-----------------------------------|-------------------------|--------------|
| 1    | Dr. S. C. Kamate     | Principal    | Ph. D          | Thermal(Cogeneration)             | 32                      | 9480849331   |
| 2    | Dr. S. N. Topannavar | Assoc. Prof. | Ph. D          | Thermal Power Engg.               | 24                      | 9482440235   |
| 3    | Prof. K. M. Akkoli   | Assoc. Prof. | Ph. D          | Thermal Power Engg.               | 19                      | 9739114856   |
| 4    | Prof. D. N. Inamdar  | Asst. Prof   | M Tech.(Ph. D) | Tool Engg                         | 20                      | 9591208980   |
| 5    | Prof.M.S.Futane      | Asst. Prof   | M Tech.        | Computer Integrated Manufacturing | 17                      | 9164105035   |
| 6    | Prof.S. A. Goudadi   | Asst. Prof   | M Tech.        | Design Engineering                | 15                      | 9448876682   |
| 7    | Prof.M.M.Shivashimpi | Asst. Prof   | M Tech.(Ph.D)  | Thermal Power Engg.               | 16                      | 9742197173   |
| 8    | Prof.M.A.Hipparagi   | Asst. Prof   | M Tech.(Ph.D)  | Production Technology             | 14                      | 7411507405   |
| 9    | Prof. G. M. Zulapi   | Asst. Prof   | M Tech.        | Product Design & Manufacturing    | 15                      | 9480213587   |






**CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2022-23 (Odd)**

| Date                     | Events   | Calendar   |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
|--------------------------|--|--|---|----|----|----|----|---|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|--|--|--|--|
| 19-09-2022               | Commencement of Classes for VII Semester   | <b>September-2022</b><br><table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr> <tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td></tr> <tr><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td></tr> <tr><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td></td></tr> </table>   | S   | M  | T  | W  | T  | F | S |   |   |   |   | 1 | 2 | 3 | 4 | 5 | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |    |    |    |  |  |  |  |  |
| S                        | M  |  | T   | W  | T  | F  | S  |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
|                          |  |  |   |    | 1  | 2  | 3  |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 4                        | 5  |  | 6   | 7  | 8  | 9  | 10 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 11                       | 12   |  | 13  | 14 | 15 | 16 | 17 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 18                       | 19   |  | 20  | 21 | 22 | 23 | 24 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 25                       | 26   |  | 27  | 28 | 29 | 30 |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 24-09-2022               | NSS Foundation Day   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 02-10-2022               | Gandhi Jayanthi  |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 10-10-2022               | Commencement of Classes for V Semester   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 24-10-2022 to 30-10-2022 | Traffic Week   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 27-10-2022 to 29-10-2022 | First Internal Assessment for VII Semester   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 31-10-2022               | Feedback -I on Teaching-Learning for VII Semester  |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 31-10-2022               | National Integration Day   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 31-10-2022               | Commencement of Classes for III Semester   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 01-11-2022               | Kannad Rajyothsava   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 03-11-2022               | Display of 1 <sup>st</sup> Internal Assessment Marks and submission of Feedback-I of VII Semester to office  | <b>October-2022</b><br><table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td>1</td></tr> <tr><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr> <tr><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td></tr> <tr><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td></tr> <tr><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td></tr> <tr><td>30</td><td>31</td><td></td><td></td><td></td><td></td><td></td></tr> </table> <p>04- Mahanavami, Ayudhapooja 05- Vijayadashami<br/>           24- Naraka Chaturdashi, 26- Balipadyami Deepavalli</p> | S   | M  | T  | W  | T  | F | S |   |   |   |   |   |   | 1 | 2 | 3 | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |  |  |  |  |  |
| S                        | M  |  | T   | W  | T  | F  | S  |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
|                          |  |  |   |    |    |    | 1  |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 2                        | 3  |  | 4   | 5  | 6  | 7  | 8  |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 9                        | 10   |  | 11  | 12 | 13 | 14 | 15 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 16                       | 17   |  | 18  | 19 | 20 | 21 | 22 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 23                       | 24   |  | 25  | 26 | 27 | 28 | 29 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 30                       | 31   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 09-11-2022 to 18-11-2022 | Environment Awareness Month  |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 22-11-2022               | World's Aids Day   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 26-11-2022               | First Assignment Submission of III Semester (PCC + IPCC)   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 28-11-2022 to 30-11-2022 | Second Internal Assessment for VII Semester & First Internal Assessment for III (PCC + IPCC) /V Semester   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 01-12-2022               | Feedback –II on Teaching-Learning for VII Semester & Feedback – I on Teaching-Learning for III/V Semester  |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 06-12-2022               | Display of 2 <sup>nd</sup> Internal Assessment Marks and submission of Feedback-II of VII Semester & Display of 1 <sup>st</sup> Internal Assessment Marks and submission of Feedback-I of III/V Semester to office |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 10-12-2022               | Human Rights Day   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 10-12-2022               | Sports Day   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 23-12-2022 & 24-12-2022  | First Lab Internal Assessment for III Semester (PCC+AEC)   | <b>November-2022</b><br><table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr> <tr><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td></tr> <tr><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td></tr> <tr><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td></tr> <tr><td>27</td><td>28</td><td>29</td><td>30</td><td></td><td></td><td></td></tr> </table> <p>01- Kannada Rajyothsava, 11- Kanakadasa Jayanti</p>   | S   | M  | T  | W  | T  | F | S |   |   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |    |    |    |    |    |  |  |  |  |  |
| S                        | M  |  | T   | W  | T  | F  | S  |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
|                          |  |  | 1   | 2  | 3  | 4  | 5  |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 6                        | 7  |  | 8   | 9  | 10 | 11 | 12 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 13                       | 14   |  | 15  | 16 | 17 | 18 | 19 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 20                       | 21   |  | 22  | 23 | 24 | 25 | 26 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 27                       | 28   |  | 29  | 30 |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 26-12-2022 & 27-12-2022  | Lab Internal Assessment for VII Semester   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 29-12-2022 to 31-12-2022 | Third Internal Assessment for VII Semester & Second Internal Assessment for III (PCC + IPCC) /V Semester   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 31-12-2022               | Last working day for VII Semester  |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 02-01-2023               | Feedback –II on Teaching-Learning for III/V Semester   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 05-01-2023               | Display of Final IA Marks of VII Semester  |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 05-01-2023               | Display of 2 <sup>nd</sup> Internal Assessment Marks and submission of Feedback-II of III/V Semester to office   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 07-01-2023               | Second Assignment Submission of III Semester (PCC + IPCC)  |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 12-01-2023               | National Youth Day   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 15-01-2023               | NSS Day  | <b>December-2022</b><br><table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td></tr> <tr><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr> <tr><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td></tr> <tr><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td></tr> <tr><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td></tr> </table>  | S   | M  | T  | W  | T  | F | S |   |   |   |   | 1 | 2 | 3 | 4 | 5 | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |    |    |  |  |  |  |  |
| S                        | M  |  | T   | W  | T  | F  | S  |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
|                          |  |  |   |    | 1  | 2  | 3  |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 4                        | 5  |  | 6   | 7  | 8  | 9  | 10 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 11                       | 12   |  | 13  | 14 | 15 | 16 | 17 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 18                       | 19   |  | 20  | 21 | 22 | 23 | 24 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 25                       | 26   |  | 27  | 28 | 29 | 30 | 31 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 20-01-2023 & 21-01-2023  | Lab Internal Assessment for V Semester   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 23-01-2023 to 25-01-2023 | Third Internal Assessment for V Semester   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 26-01-2023               | Republic Day   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 27-01-2023               | Last working day for V Semester  |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 30-01-2023 to 01-02-2023 | Second Lab Internal Assessment for III Semester (PCC+IPCC+AEC)   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 31-01-2023               | Display of Final IA Marks of V Semester  |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 06-02-2023 to 08-02-2023 | Third Internal Assessment for III Semester (PCC)   |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 11-02-2023               | Last working day for III Semester  |  |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 14-02-2023               | Display of Final IA Marks of III Semester  | <b>January-2023</b><br><table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr> <tr><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td></tr> <tr><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td></tr> <tr><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td></tr> <tr><td>29</td><td>30</td><td>31</td><td></td><td></td><td></td><td></td></tr> </table> <p>14-Makara Sankranti, 26- Republic Day</p>  | S   | M  | T  | W  | T  | F | S | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |    |    |    |    |    |    |  |  |  |  |  |
| S                        | M  |  | T   | W  | T  | F  | S  |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 1                        | 2  |  | 3   | 4  | 5  | 6  | 7  |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 8                        | 9  |  | 10  | 11 | 12 | 13 | 14 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 15                       | 16   |  | 17  | 18 | 19 | 20 | 21 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 22                       | 23   |  | 24  | 25 | 26 | 27 | 28 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 29                       | 30   |  | 31  |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
|                          |  |  | <b>February-2023</b><br><table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr><td>S</td><td>M</td><td>T</td><td>W</td><td>T</td><td>F</td><td>S</td></tr> <tr><td></td><td></td><td></td><td>1</td><td>2</td><td>3</td><td>4</td></tr> <tr><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td></tr> <tr><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td></tr> <tr><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td></tr> <tr><td>26</td><td>27</td><td>28</td><td></td><td></td><td></td><td></td></tr> </table> <p>18- Mahashivaratri</p> | S  | M  | T  | W  | T | F | S |   |   |   | 1 | 2 | 3 | 4 | 5 | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |    |    |    |    |    |  |  |  |  |  |
| S                        | M  |  |   | T  | W  | T  | F  | S |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
|                          |  |  |   |    | 1  | 2  | 3  | 4 |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 5                        | 6  | 7  |   | 8  | 9  | 10 | 11 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 12                       | 13   | 14   |   | 15 | 16 | 17 | 18 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 19                       | 20   | 21   |   | 22 | 23 | 24 | 25 |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |
| 26                       | 27   | 28   |   |    |    |    |    |   |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |  |  |  |  |  |

Dr. B. V. Madiggond  
 Dean (Academics)


Dr. S. C. Kamate  
 Principal

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|  | <b>S J P N Trust's</b><br><b>Hirasugar Institute of Technology, Nidasoshi</b><br><i>Inculcating Values, Promoting Prosperity</i><br>Approved by AICTE, Recognized by Govt. of Karnataka and Affiliated to VTU Belagavi.<br><b>Accredited at 'A' Grade by NAAC</b><br><b>Programmes Accredited by NBA: CSE, ECE, EEE &amp; ME</b> | <b>Mech. Engg. Dept.</b><br><b>Course Plan</b><br><b>VII SEM</b><br><b>2022-23 Odd Sem</b> |
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### VTU Scheme of Teaching and Examination

| <b>VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI</b><br><b>Scheme of Teaching and Examination 2018 – 19</b><br><b>Outcome Based Education(OBE) and Choice Based Credit System (CBCS)</b><br><b>(Effective from the academic year 2018 – 19)</b> |                        |  |  |  |                      |                          |                    |                   |            |            |            |             |
|---|------------------------|--|--|--|----------------------|--------------------------|--------------------|-------------------|------------|------------|------------|-------------|
| <b>VII SEMESTER</b>   |                        |  |  |  |                      |                          |                    |                   |            |            |            |             |
| Sl. No  | Course and Course code |  | Course Title                                 | Teaching Department  | Teaching Hours /Week |                          |                    | Examination       |            |            | Credits    |             |
|   |                        |  |  |  | Theory Lecture       | Tutorial                 | Practical/ Drawing | Duration in hours | CIE Marks  | SEE Marks  |            | Total Marks |
|   |                        |  |  |  | L                    | T                        | P                  |                   |            |            |            |             |
| 1   | PCC                    | 18ME71   | Control Engineering                          |  | 3                    | --                       | --                 | 03                | 40         | 60         | 100        | 3           |
| 2   | PCC                    | 18ME72   | Computer Integrated Design and Manufacturing |  | 3                    | --                       | --                 | 03                | 40         | 60         | 100        | 3           |
| 3   | PEC                    | 18ME73X  | Professional Elective - 2                    |  | 3                    | --                       | --                 | 03                | 40         | 60         | 100        | 3           |
| 4   | PEC                    | 18ME74X  | Professional Elective - 3                    |  | 3                    | --                       | --                 | 03                | 40         | 60         | 100        | 3           |
| 5   | OEC                    | 18ME75X  | Open Elective -B                             |  | 3                    | --                       | --                 | 03                | 40         | 60         | 100        | 3           |
| 6   | PCC                    | 18MEL76  | Computer Integrated Manufacturing Lab        |  | --                   | 2                        | 2                  | 03                | 40         | 60         | 100        | 2           |
|   | PCC                    | 18MEL77  | Design Lab                                   |  | --                   | 2                        | 2                  | 03                | 40         | 60         | 100        | 2           |
| 7   | Project                | 18MEP78  | Project Work Phase - 1                       |  | --                   | --                       | 2                  | --                | 100        | --         | 100        | 1           |
| 8   | Internship             | --   | Internship                                   | (If not completed during the vacation of VI and VII semesters, it shall be carried out during the vacation of VII and VIII semesters ) |                      |                          |                    |                   |            |            |            |             |
| <b>TOTAL</b>  |                        |  |  |  | <b>15</b>            | <b>4</b>                 | <b>6</b>           | <b>18</b>         | <b>340</b> | <b>360</b> | <b>700</b> | <b>20</b>   |
| <b>Professional Elective - 2</b>  |                        |  |  |  |                      |                          |                    |                   |            |            |            |             |
| Course code under 18XX73X   |                        | Course Title                                       |  | Course code under 18XX73X  |                      | Course Title             |                    |                   |            |            |            |             |
| 18ME731   |                        | Design for Manufacture                             |  | 18ME734  |                      | Total Quality Management |                    |                   |            |            |            |             |
| 18ME732   |                        | Automation and Robotics                            |  | 18ME735  |                      | Operations Research      |                    |                   |            |            |            |             |
| 18ME733   |                        | Computational Fluid Dynamics                       |  |  |                      |                          |                    |                   |            |            |            |             |
| <b>Professional Electives - 3</b>   |                        |  |  |  |                      |                          |                    |                   |            |            |            |             |
| Course code under 18XX74X   |                        | Course Title                                       |  | Course code under 18XX74X  |                      | Course Title             |                    |                   |            |            |            |             |
| 18ME741   |                        | Additive Manufacturing                             |  | 18ME744  |                      | Mechatronics             |                    |                   |            |            |            |             |
| 18ME742   |                        | Emerging Sustainable Building Cooling Technologies |  | 18ME745  |                      | Project Management       |                    |                   |            |            |            |             |
| 18ME743   |                        | Fracture Mechanics                                 |  |  |                      |                          |                    |                   |            |            |            |             |



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|   |   |  | <b>Course Plan</b>       |
|   |   |  | <b>VII</b>               |
|   |   |  | <b>2022-23 (Odd Sem)</b> |

|                                    |                            |                   |                     |
|------------------------------------|----------------------------|-------------------|---------------------|
| <b>Subject Title</b>               | <b>CONTROL ENGINEERING</b> |                   |                     |
| <b>Subject Code</b>                | 18ME71                     | <b>IA Marks</b>   | 40                  |
| <b>Number of Lecture Hrs /</b>     | 05                         | <b>Exam Marks</b> | 60                  |
| <b>Total Number of Lecture Hrs</b> | 50                         | <b>Exam Hours</b> | 03                  |
|                                    |                            |                   | <b>CREDITS – 03</b> |

|                                       |                                     |                                     |
|---------------------------------------|-------------------------------------|-------------------------------------|
| <b>FACULTY DETAILS:</b>               |                                     |                                     |
| <b>Name:</b> Prof. S. A. Goudadi      | <b>Designation:</b> Asst. Professor | <b>Experience:</b> 15 Years         |
| <b>No. of times course taught:</b> 02 |                                     | <b>Specialization:</b> Design Engg. |

### 1.0 Prerequisite Subjects:

| Sl. No | Branch           | Semester    | Subject              |
|--------|------------------|-------------|----------------------|
| 01     | Mechanical Engg. | I/II/III/IV | Engg Mathematics     |
| 02     | Mechanical Engg. | V           | Dynamics of Machines |

### 2.0 Course Objectives

- To develop comprehensive knowledge and understanding of modern control theory, industrial automation, and systems analysis.
- To model mechanical, hydraulic, pneumatic and electrical systems.
- To represent system elements by blocks and its reduction techniques.
- To understand transient and steady state response analysis of a system.
- To carry out frequency response analysis using polar plot, Bode plot.
- To analyse a system using root locus plots.
- To study different system compensators and characteristics of linear systems.

### 3.0 Course Outcomes

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

|                                   | Course Outcome  | Cognitive Level | POs        |
|-----------------------------------|---|-----------------|------------|
| C401.1                            | Identify the type of control and control actions.   | L3              | 1,2,6,7,12 |
| C401.2                            | Develop the mathematical model of the physical systems.   | L3              | 1,2,6,7,12 |
| C401.3                            | Estimate the response and error in response of first and second order systems subjected standard input signals.                               | L3              | 1,2,6,7,12 |
| C401.4                            | Represent the complex physical system using block diagram and signal flow graph and obtain transfer function.                                 | L3              | 1,2,6,7,12 |
| C401.5                            | Analyse a linear feedback control system for stability using Hurwitz criterion, Routh's criterion and root Locus technique in complex domain. | L3              | 1,2,6,7,12 |
| C401.6                            | Analyse the stability of linear feedback control systems in frequency domain using polar plots, Nyquist and Bode plots.                       | L3              | 1,2,6,7,12 |
| <b>Total Hours of instruction</b> |   |                 | <b>50</b>  |

### 4.0 Course Content

**Module-1**

**Introduction:** Components of a control system, Open loop and closed loop systems.

**Types of controllers:** Proportional, Integral, Differential, Proportional-Integral, and Proportional- Integral-Differential controllers.

**Modelling of Physical Systems: Mathematical Models of Mechanical, Electrical, Thermal, Hydraulic Systems.**

**Module-2**

Time domain performance of control systems: Typical test signal, Unit step response and time domain specifications of first order, second order system. Steady state error, error constants.

**Module-3**

Block diagram algebra, Reduction of block diagram, Signal flow graphs, Gain formula for signal flow graphs, State diagram from differential equations.

**Module-4**

**Stability of linear control systems:** Routh's criterion, Root locus, Determination of phase margin and gain margin using root locus.

**Module-5**

Stability analysis using Polar plot, Nyquist plot, Bode plot, Determination of phase margin and gain margin using Bode plot.

## 5.0 Relevance to future subjects

| Sl No | Semester | Subject                | Topics   |
|-------|----------|------------------------|--|
| 01    | VII      | Advance Control System | Observability, Controllability, State variables. |

## 6.0 Relevance to Real World


| Sl. No | Real World Mapping                         |
|--------|--|
| 01     | Design of various components               |
| 02     | Conduct investigations of complex Problems |
| 03     | Development of prototype models            |

## 7.0 Gap Analysis and Mitigation

| Sl No | Delivery Type | Details  |
|-------|---------------|--|
| 01    | Tutorial      | Introduction, Feedback, Mathematical Models, Modelling of Mechanical Systems, Electrical Analogies of Mechanical Systems, Block Diagrams etc |
| 02    | NPTEL         | Control Engineering: The Control Problem · Different Kinds of Control Systems · History of Feedback · Modern Control Problems                |

## 8.0 Books Used and Recommended to Students

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---------|-------------------|----------------------|-----------------------|------------------|
|---------|-------------------|----------------------|-----------------------|------------------|

|   |   |                          |
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|   |   | <b>Course Plan</b>       |
|   |   | <b>VII</b>               |
|   |   | <b>2022-23 (Odd Sem)</b> |

| Textbook/s      |                             |                      |                                    |                      |
|-----------------|-----------------------------|----------------------|------------------------------------|----------------------|
| 1               | Automatic Control Systems   | Farid G., Kuo B. C   | McGraw Hill Education              | 10th Edition, 2018   |
| 2               | Control systems             | Manik D. N           | Cengage                            | 2017                 |
| Reference Books |                             |                      |                                    |                      |
| 1               | Modern control Engineering  | K. Ogeta             | Pearson                            | 5th Edition, 2010    |
| 2               | Control Systems Engineering | Norman S Nice        |                                    | Fourth Edition, 2007 |
| 3               | Modern control Systems      | Richard C Dorf       | Pearson                            | 2017                 |
| 4               | Control Systems Engineering | I J Nagrath, M Gopal | New Age International (P) Ltd      | 2018                 |
| 5               | Control Systems Engineering | S Palani             | Tata McGraw Hill Publishing Co Ltd | ISBN-13 97800706719  |

## 9.0

### Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

#### Website and Internet Contents References

VSSUT, Smartzworld, Scribd, NPTEL.

## 10.0

### Magazines/Journals Used and Recommended to Students

| Sl.No | Magazines/Journals  | website                  |
|-------|---|--------------------------|
| 1     | IEEE Xplore: IEEE Control Systems Magazine  | www.ieeeexplore.ieee.org |
| 2     | Journal of Control Theory and Applications, Journal of Real-Time Image Processing etc | www.Springer.com         |

## 11.0 Examination Note

**Assignment marks:** 10 marks.

#### Question paper pattern IA exam:

Answer two full questions Q1 or Q2 and Q3 or Q4 (15marks each). Total 30 Marks.

#### Question paper pattern Main exam:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

## 12.0 Course Delivery Plan

| Module   | Lecture No. | Content of Lecturer             | % of Portion |
|----------|-------------|---------------------------------|--------------|
| Module 1 | 1           | Introduction:                   | 20           |
|          | 2           | Components of a control system, |              |



|                 |         |  |    |
|-----------------|---------|--|----|
|                 | 3       | Open loop and closed loop systems.                                       |    |
|                 | 4       | Proportional, Integral, Differential,                                    |    |
|                 | 5       | Proportional-Integral,   |    |
|                 | 6       | Proportional- Integral-Differential controllers.                         |    |
|                 | 7       | <b>Modelling of Physical Systems:</b> Mathematical Models of Mechanical, |    |
|                 | 8       | Electrical,  |    |
|                 | 9       | Thermal,   |    |
|                 | 10      | Hydraulic Systems.   |    |
| <b>Module 2</b> | 11      | Time domain performance of control systems                               | 20 |
|                 | 12      | Typical test signal,   |    |
|                 | 13      | Unit step response   |    |
|                 | 14      | Problems   |    |
|                 | 15      | time domain specifications of first order,                               |    |
|                 | 16      | Second order system.   |    |
|                 | 17      | Steady state error,  |    |
|                 | 18      | Error constants.   |    |
|                 | 19      | Problems   |    |
|                 | 20      | Problems   |    |
| <b>Module 3</b> | 21      | Block diagram algebra,   | 20 |
|                 | 22      | Reduction of block diagram,  |    |
|                 | 23      | Problems   |    |
|                 | 24      | Signal flow graphs,  |    |
|                 | 25      | Problems   |    |
|                 | 26      | Gain formula for signal flow graphs,                                     |    |
|                 | 27      | Problems   |    |
|                 | 28      | State diagram from differential equations.                               |    |
|                 | 29      | Problems   |    |
|                 | 30      | Problems   |    |
| <b>Module 4</b> | 31      | <b>Stability of linear control systems:</b> Routh's criterion,           | 20 |
|                 | 32&33   | Root locus,  |    |
|                 | 34&35   | Problems   |    |
|                 | 36&37   | Determination of phase margin and gain                                   |    |
|                 | 38&39   | Problems   |    |
|                 | 40      | margin using root locus.   |    |
| <b>Module 5</b> | 41&42   | Stability analysis using Polar plot,                                     | 20 |
|                 | 43 & 44 | Nyquist plot,  |    |
|                 | 45 & 46 | Bode plot,   |    |
|                 | 47 & 48 | Determination of phase margin and  |    |
|                 | 49 & 50 | gain margin using Bode plot.   |    |

### 13.0 Assignments, Pop Quiz, Mini Project, Seminars

| Sl. No | Title                               | Outcome expected  | Allied study             | Week No. | Individual / Group activity | Reference: book/website /Paper        |
|--------|-------------------------------------|---|--------------------------|----------|-----------------------------|---------------------------------------|
| 1      | Assignment 1: Questions on module 1 | Students study the Topics and write the Answers. Get practice to solve questions. | Module 1 of the syllabus | 3        | Individual Activity.        | Farid G., Kuo B.C and Katsuhiko Ogata |

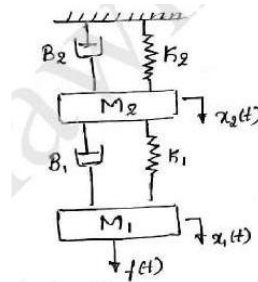


|   |                                     |  |                          |    |                      |  |
|---|-------------------------------------|--|--------------------------|----|----------------------|--|
| 2 | Assignment 2: Questions on module 2 | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 2 of the syllabus | 5  | Individual Activity. | Farid G., Kuo B. C and Katsuhiko Ogata |
| 3 | Assignment 3: Questions on module 3 | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 3 of the syllabus | 8  | Individual Activity. | Farid G., Kuo B. C and Katsuhiko Ogata |
| 4 | Assignment 4: Questions on module 4 | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 4 of the syllabus | 10 | Individual Activity. | Farid G., Kuo B. C and Katsuhiko Ogata |
| 5 | Assignment 5: Questions on module 5 | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 5 of the syllabus | 12 | Individual Activity. | Farid G., Kuo B. C and Katsuhiko Ogata |

## 14.0 QUESTION BANK

### MODULE 1

- 1) Define control system
- 2) Explain control system with block diagram and examples.
- 3) Explain Open loop control system
- 4) Explain Closed loop control system
- 5) Explain the components of control system
- 6) Explain the following controllers with block diagrams
  - i) Proportional controller
  - ii) Integral controller
  - iii) Proportional controller plus Integral controller
  - iv) Proportional controller plus Integral plus differential controller
- 7) Write the force-voltage and force-current analogous circuit for the mechanical system shown in figure.



### MODULE 3

- 1) Define the following for an under damped second order system.
  - a) Rise Time
  - b) Peak overshoot
  - c) Settling Time.
- 2) Define the following terms
  - a) Transient response
  - b) steady state response.
- 3) Derive the expression for peak time.
- 4) The loop transfer function of transfer function is given by
  - i) Determine the static error coefficients
  - ii) Determine steady state error coefficients for the input  $r(t) = 2t^2 + 5t + 10$





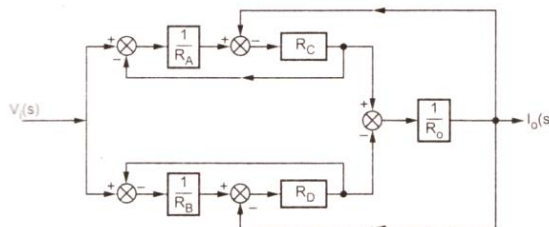
$$G(s)H(s) = \frac{100}{s^2(s+4)(s+12)}$$

- 5) Derive expressions for peak response time  $t_p$  and maximum overshoot  $M_p$  of an under damped second order control system subjected to step input
- 6) For a unity feedback control system with  $G(s) = 10(S+2) / S_2(S+1)$ . Find
  - i) The static error coefficients
  - ii) Steady state error when the input transform is

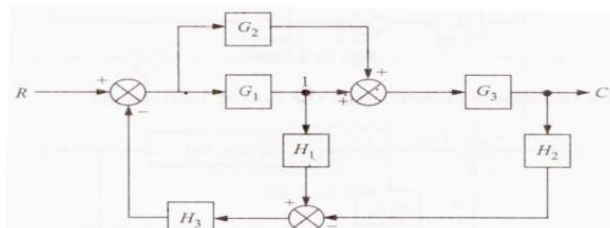
$$R(s) = \frac{3}{s} - \frac{2}{s^2} + \frac{1}{3s^2}$$

**MODULE 3**

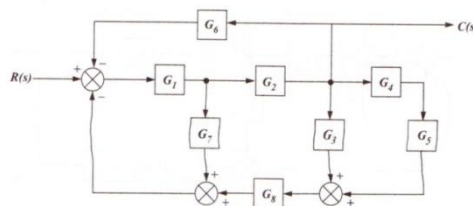
- 1) Determine the transfer function  $C(s)/R(s)$  of the system shown below by block diagram reduction method.



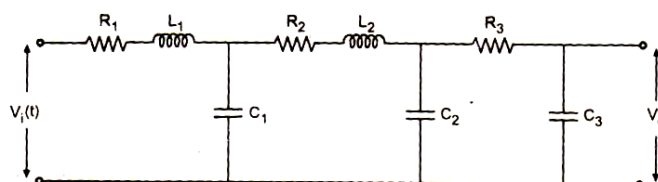
- 2) Determine the transfer function  $C(s)/R(s)$  of the system shown below by block diagram reduction method.



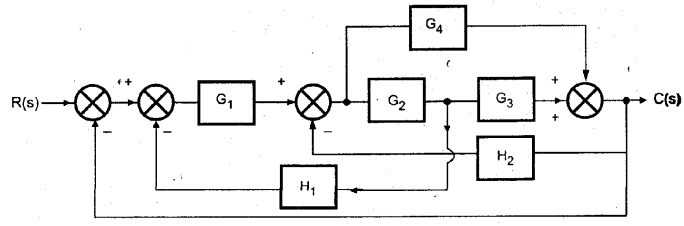
- 3) Determine the transfer function  $C(s)/R(s)$  of the system shown below by block diagram reduction method.



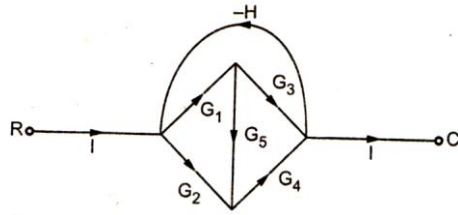
- 4) Discuss rule of block reduction technique in detail.
- 5) Draw a block diagram to describe the electrical circuit given in the Fig.



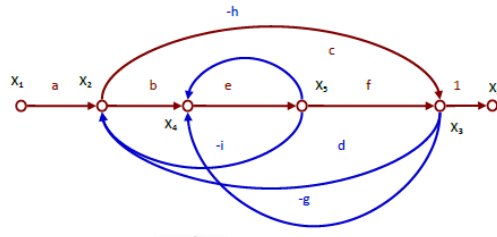
- 6) Obtain the overall transfer function for the block diagram shown below by the block diagram reduction technique.



7) Obtain MGF.

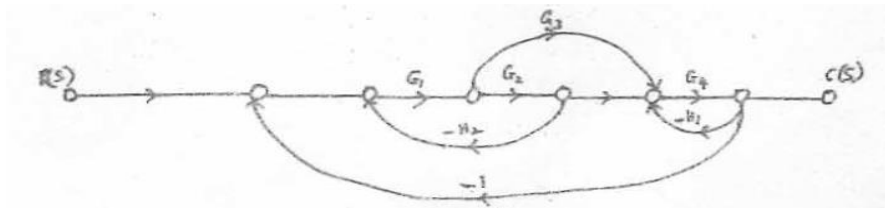


8) For the system described by the signal flow graph shown in fig, obtain the closed loop transfer function  $C(s) / R(s)$ , using Mason's gain formula.



$$\frac{C(s)}{R(s)}$$

9) For the system shown in Fig.3 below determine  $\frac{C(s)}{R(s)}$  using Mason's gain formula.



10) Obtain the closed loop transfer function of the block diagram shown in Fig. 3 (a).

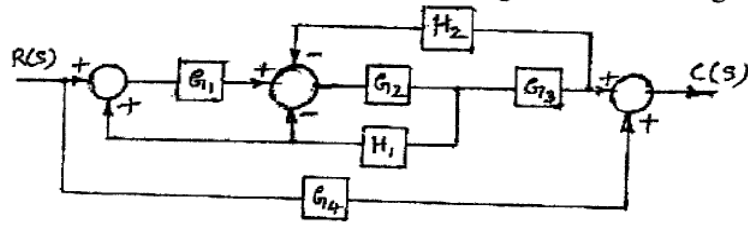


Fig. Q3 (a)

11) For the signal flow graph shown in Fig. 3 (b), determine  $C/R$  using mason's gain formula.

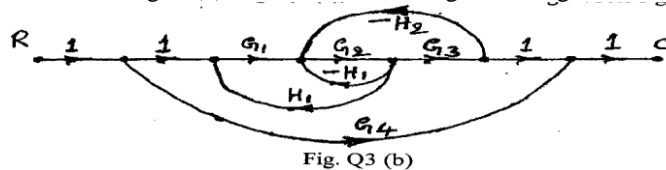


Fig. Q3 (b)




- 1) Sketch the root locus plot for the system, whose open loop transfer function is given by  $G(s)H(s) = K / (S(S+2)(S^2+8S+20))$ .
- 2) State the different rules for the construction of root locus.
- 3) Sketch the root locus diagram of a control system having unity feedback with  $G(s) = K(s+1) / (s(s-1)(s^2+4s+16))$  and Comment on the stability of the system. Also find the frequency of oscillation.
- 4) Draw the root locus plot using guidelines for the OLTF  $G(s)H(s) = K(S+2) / (S(S^2+2S+2))$  Discuss stability of the system as a function of K.
- 5) Sketch the root locus for the system having  $G(s) = k(s+1) / s^2(s+2)$ .
- 6) Sketch the Bode plot for  $G(s)H(s) = 2 / ((S+1)(1+0.2S))$  Also obtain gain margin and phase margin and crossover frequencies.
- 7) A unity feedback system has  $G(S) = K / (S(S+1)(S+10))$ .

**MODULE 5**

- 1) Draw Bode plot and determine the value of K so that the gain margin of the system is 20db.
- 2) Construct bode dig for a feedback control system having its open loop transfer function.  $GH = 100(10s+1) / (s(s+0.4)(s+1)(s+10))$ . Also determine gain margin and phase margin if the system is stable.
- 3) Sketch the polar plot for  $GH(S) = 1 / ((S+P1)(S+P2))$  where  $P1, P2 > 0$ .
- 4) The OLTF of a system is given by  $GH(S) = \frac{K(T_1S+1)}{S^2(T_2S+1)}$ ;  $K, T_1, T_2 > 0$ . Sketch the Nyquist plot for  $T1 < T2$  and ascertain system stability.
- 5) Sketch the polar plot for the transfer function  $G(S) = 10 / (S(S+1)(S+2))$
- 6) Apply Nyquist stability criterion to the system with transfer function  $G(s)H(s) = 4S+1 / ((S^2(1+S)(1+2S))$  and ascertain its stability.
- 7) Determine stability of the system with  $GH = (s+6) / ((s+2)(s-1))$  using nyquist stability criterion.
- 8) Draw polar plot for the following system  $GH = 20(s+5) / ((s+1)(s+2)(s+8))$

|                    |                   |            |                  |
|--------------------|-------------------|------------|------------------|
|                    |                   |            |                  |
| <b>Prepared by</b> | <b>Checked by</b> | <b>HOD</b> | <b>Principal</b> |

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|   |   | <b>Course Plan</b>       |
|   |   | <b>VII</b>               |
|   |   | <b>2022-23 (Odd Sem)</b> |

|   |  |                   |    |
|---|--|-------------------|----|
| <b>Subject Title</b>                            | <b>COMPUTER AIDED DESIGN &amp; MANUFACTURING</b> |                   |    |
| <b>Subject Code</b>                             | 18ME72   | <b>CIA Marks</b>  | 40 |
| <b>No of Lecture Hrs + Practical Hrs / Week</b> | 04   | <b>Exam Marks</b> | 60 |
| <b>Total No of Lecture + Practical Hrs</b>      | 50   | <b>Exam Hours</b> | 03 |
| <b>CREDITS – 04</b>                             |  |                   |    |

|   |  |                            |
|---|--|----------------------------|
| <b>FACULTY DETAILS:</b>                     |  |                            |
| <b>Name:</b> Prof. M S Futane               | <b>Designation:</b> Asst. Professor                      | <b>Experience:</b> 17Years |
| <b>No. of times course taught:</b> 11 Times | <b>Specialization:</b> Computer Integrated Manufacturing |                            |

## 1.0 Prerequisite Subjects:

| Sl. No | Branch                 | Semester | Subject                     |
|--------|------------------------|----------|-----------------------------|
| 1      | Common to all          | I/II     | Elements of Mechanical Engg |
| 2      | Mechanical Engineering | III/IV   | MCW, MCF                    |


## 2.0 Course Objectives

- To impart knowledge of CIM and Automation and different concepts of automation by developing mathematical models.
- To make students to understand the Computer Applications in Design and Manufacturing [CAD / CAM) leading to Computer integrated systems. Enable them to perform various transformations of entities on display devices.
- To expose students to automated flow lines, assembly lines, Line Balancing Techniques, and Flexible Manufacturing Systems.
- To expose students to computer aided process planning, material requirement planning, capacity planning etc.
- To expose the students to CNC Machine Tools, CNC part programming, and industrial robots.
- To introduce the students to concepts of Additive Manufacturing, Internet of Things, and Industry 4.0 leading to Smart Factory.

## 3.0 Course Outcomes

Having successfully completed this course, the student will be able to

| CO                                | Course Outcome  | Cognitive Level | POs                                |
|-----------------------------------|---|-----------------|------------------------------------|
| CO1                               | Define Automation, CIM, CAD, CAM and explain the differences between these concepts. And Explain the basics of automated manufacturing industries through mathematical models and analyze different types of automated flow lines | L1, L2          | PO1,PO6, PO10, PO11, PO12          |
| CO2                               | Solve simple problems of transformations of entities on computer screen and Categorize CAPP, MRP, PPC and CRP in Manufacturing system   | L1,L2, L3       | PO2,PO5, PO10, PO12                |
| CO3                               | Understand the overall FMS and Solve the manual assembly line balancing problem   | L2, L3          | PO1,PO2,PO3, PO5, PO11, PO12       |
| CO4                               | Explain the use of different computer applications in manufacturing, and prepare part programs for simple jobs on CNC machine tools and robot programming.  | L2, L3          | PO1,PO2,PO3, PO5, PO10, PO11, PO12 |
| CO5                               | Visualize and appreciate the modern trends in Manufacturing like additive manufacturing, Industry 4.0 and applications of Internet of Things leading to Smart Manufacturing   | L1, L2          | PO1,PO2,PO3, PO5, PO10, PO11, PO12 |
| <b>Total Hours of instruction</b> |   |                 | <b>50</b>                          |

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|   |   | <b>Course Plan</b>       |
|   |   | <b>VII</b>               |
|   |   | <b>2022-23 (Odd Sem)</b> |

## 4.0 Course Content

### Module - 1

#### 1. Introduction to CIM and Automation:

Automation in Production Systems, automated manufacturing systems- types of automation, reasons for automating, Computer Integrated Manufacturing, computerized elements of a CIM system, CAD/CAM and CIM. Mathematical models and matrices: production rate, production capacity, utilization and availability, manufacturing lead time, work-in- process, numerical problems. **5 Hours**

**2. Automated Production Lines and Assembly Systems:** Fundamentals, system configurations, applications, automated flow lines, buffer storage, control of production line, analysis of transfer lines, analysis of flow lines without storage, partial automation, analysis of automated flow lines with storage buffer, fundamentals of automated assembly systems, numerical problems. **5 Hours**

### Module – 2

**3. CAD and Computer Graphics Software:** The design process, applications of computers in design, software configuration, functions of graphics package, constructing the geometry. Transformations: 2D transformations, translation, rotation and scaling, homogeneous transformation matrix, concatenation, numerical problems on transformations. **5 Hours**

**4. Computerized Manufacture Planning and Control System:** Computer Aided Process Planning, Retrieval and Generative Systems, benefits of CAPP, Production Planning and Control Systems, typical activities of PPC System, computer integrated production management system, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control. **5 Hours**

### Module - 3

**5. Flexible Manufacturing Systems:** Fundamentals of Group Technology and Flexible Manufacturing Systems, types of FMS, FMS components, Material handling and storage system, applications, benefits, computer control systems, FMS planning and design issues, Automated Storage and Retrieval Systems, AS/RS and Automatic parts identification systems and data capture. **5 Hours**

**6. Line Balancing:** Line balancing algorithms, methods of line balancing, numerical problems on largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights method, Mixed Model line balancing, computerized line balancing methods. **5 Hours**

### Module - 4.

**7. Computer Numerical Control:** Introduction, components of CNC, CNC programming, manual part programming, G Codes, M Codes, programming of simple components in turning, drilling and milling systems, programming with canned cycles. Cutter radius compensations. **5 Hours**

**8. Robot Technology:** Robot anatomy, joints and links, common robot configurations, robot control systems, accuracy and repeatability, end effectors, sensors in robotics. Robot programming methods: on-line and off-line methods. Robot industrial applications: material handling, processing and assembly and inspection. **5 Hours**

### Module – 5

**9. Additive Manufacturing Systems:** Basic principles of additive manufacturing, slicing CAD models for AM, advantages and limitations of AM technologies, Additive manufacturing processes: Photo polymerization, material jetting, binder jetting, material extrusion, Powder bed sintering techniques, sheet lamination, direct energy deposition techniques, applications of AM. Recent trends in manufacturing, Hybrid manufacturing. **5 Hours**

**10. Future of Automated Factory:** Industry 4.0, functions, applications and benefits. Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing, Big-Data and Cloud Computing for IOT, IOT for smart manufacturing, influence of IOT on predictive maintenance, industrial automation, supply chain optimization, supply-chain & logistics, cyber-physical manufacturing systems. **5 Hours**

## 5.0 Relevance to future subjects

| SL. No | Semester | Subject                | Topics / Relevance                       |
|--------|----------|------------------------|--|
| 01     | V        | Additive Manufacturing | all                                      |
| 02     | VIII     | Project Work           | Implementation of Mechanisms, automation |





## 6.0 Relevance to Real World

| SL. No | Real World Mapping                                   |
|--------|--|
| 01     | Industrial design & mechanisms of various components |
| 02     | Various setups for analysis                          |
| 03     | Development of a software applications               |

## 7.0 Gap Analysis and Mitigation

| Sl. No | Delivery Type | Details   |
|--------|---------------|---|
| 01     | Tutorial      | Topic: Automated Transfer lines and Assembly system |

## 7.0 Books Used and Recommended to Students

### Text Books

1. Automation, Production Systems and Computer-Integrated Manufacturing, by Mikell P Groover, 4th Edition, 2015, Pearson Learning.
2. CAD / CAM Principles and Applications by P N Rao, 3rd Edition, 2015, Tata McGraw-Hill.
3. CAD/CAM/CIM, Dr. P. Radhakrishnan, 3rd edition, New Age International Publishers, New Delhi.

### Reference Books

1. "CAD/CAM" by Ibrahim Zeid, Tata McGraw Hill.
2. "Principles of Computer Integrated Manufacturing", S.Kant Vajpayee, 1999, Prentice Hall of India, New Delhi.
3. "Work Systems And The Methods, Measurement And Management of Work", Groover M. P., Pearson/Prentice Hall, Upper Saddle River, NJ, 2007.
4. "Computer Automation in Manufacturing", Boucher, T. O., Chapman & Hall, London, UK, 1996.
5. "Introduction to Robotics: Mechanics And Control", Craig, J. J., 2nd Ed., Addison-Wesley Publishing Company, Reading, MA, 1989.
6. Internet of Things (IoT): Digitize or Die: Transform your organization. Embrace the digital evolution. Rise above the competition, by Nicolas Windpassinger, Amazon.
7. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
8. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 2nd Ed. (2015), Ian Gibson, David W. Rosen, Brent Stucker
9. "Understanding Additive Manufacturing", Andreas Gebhardt, Hanser Publishers, 2011
10. Industry 4.0: The Industrial Internet of Things, Apress, 2017, by Alasdair Gilchrist


### Additional Study material & e-Books

1. Nptel.ac.in
2. VTU, E- learning

## 8.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

### Website and Internet Contents References

1. <http://www.nptel.ac.in>
2. [www.journals.elsevier.com](http://www.journals.elsevier.com)
3. [www.youtube.com](http://www.youtube.com)
4. <https://www.researchgate.net/journal>
5. <https://books.google.co.in/books?isbn>

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## 9.0 Magazines/Journals Used and Recommended to Students

| Sl.No | Magazines/Journals   | website  |
|-------|--|--|
| 1     | Robotics and Computer-Integrated Manufacturing - ScienceDirect.com | <a href="http://www.sciencedirect.com/science/journal/07365845">www.sciencedirect.com/science/journal/07365845</a>             |
| 2     | Manufacturing, Modelling, Management and Control 2004              | <a href="https://books.google.co.in/books?isbn=0080445624">https://books.google.co.in/books?isbn=0080445624</a>                |
| 3     | International Journal of Computer Integrated Manufacturing         | <a href="http://www.tandfonline.com/toc/tcim20">www.tandfonline.com/toc/tcim20</a>   |
| 4     | Computer Integrated Manufacturing                                  | <a href="http://manufacturing-science.asmedigitalcollection.asme.org">manufacturing-science.asmedigitalcollection.asme.org</a> |

## 10.0 Examination Note

### Internal Assessment: 40 Marks

Theoretical aspects as well as relevant sketches should be drawn neatly for questions asked in Internal Assessments

### Scheme of Evaluation for Internal Assessment

Internal Assessment test in the same pattern as that of the main examination :40marks.

### SCHEME OF EXAMINATION:

There are five modules two questions from each module

Student has to answer any five question choosing at least one questions from each module.

Max. Marks: 100Marks



## 11.0 Course Delivery Plan

| Module No. | Lecture No. | Content of Lecture   | % of Portion |
|------------|-------------|--|--------------|
| <b>1</b>   |             | <b>Introduction to CIM and Automation &amp; Automated Production Lines and Assembly Systems</b>  | <b>20</b>    |
|            | 1           | Automation definition, advantages of automation, types of automation.  |              |
|            | 2           | Levels of Automation, Automation strategies.   |              |
|            | 3           | CIM processing in manufacturing.   |              |
|            | 4           | Mathematical Models- CT, Production rate, Production capacity, MLT,,WIP, & TIP ratio   |              |
|            | 5           | Problems using mathematical models   |              |
|            | 6           | Introduction, Automated flow line, objectives  |              |
|            | 7           | Flow line configurations, work part transport methods  |              |
|            | 8           | Work part transfer mechanisms  |              |
|            | 9           | Need for buffer storage, Automation for machining  |              |
|            | 10          | Quality ,Automation for machining operation  |              |
| <b>2</b>   |             | <b>CAD and Computer Graphics Software &amp; Computerized Manufacture Planning and Control System</b>                                       | <b>20</b>    |
|            | 11          | The design process.  |              |
|            | 12          | software configuration, functions of graphics package  |              |
|            | 13          | Transformations: 2D transformations, translation, rotation and scaling   |              |
|            | 14          | homogeneous transformation matrix, concatenation   |              |
|            | 15          | numerical problems on transformations  |              |
|            | 16          | Velocity Analysis by Instantaneous Center Method: Definition, Kennedy's theorem,   |              |
|            | 17          | Introduction, CAPP, Retrieval CAPP   |              |
|            | 18          | Generative CAPP, Advantages/Benefits of CAPP,MRP concepts & Terminology  |              |
|            | 19          | Stricture/Flow chart of MRP, Inputs to MRP   |              |
|            | 20          | MRP system output, BOM, Parameters in MRP system   |              |
| <b>3</b>   |             | <b>Flexible Manufacturing Systems &amp; Line Balancing</b>   | <b>20</b>    |
|            | 21          | Fundamentals of Group Technology and Flexible Manufacturing Systems  |              |
|            | 22          | types of FMS, FMS components, Material handling and storage system,  |              |
|            | 23          | FMS planning and design issues   |              |
|            | 24          | Automated Storage and Retrieval Systems, AS/RS   |              |
|            | 25          | Automatic parts identification systems and data capture  |              |
|            | 26          | Line balancing algorithms  |              |
|            | 27          | Different terms involved in Assembly line balancing problem: Precedence diagram, Balance delay, Balance efficiency                         |              |
|            | 28          | Assembly line balancing by largest candidate rule method   |              |
|            | 29          | Assembly line balancing by Kilbridge & Westers method  |              |
|            | 30          | Assembly line balancing by Ranked positional weight method, computerized line balancing  |              |
| <b>4</b>   |             | <b>Computer Numerical Control &amp; Robot Technology</b>   | <b>20</b>    |
|            | 31          | NC terminology, Basic components of NC system  |              |
|            | 32          | NC coordinate systems. NC motion control systems,  |              |
|            | 33          | Applications of NC system, Advantages & Limitations of NC systems  |              |
|            | 34          | CNC, need for CNC, different functions of CNC system, Advantages of CNC systems. CNC Machining centres steps in CNC programming.           |              |
|            | 35          | Different codes used in the development of NC part programming. The fundamental steps involved in the development of milling part program. |              |
|            | 36          | Basic Robot motions  |              |
|            | 37          | Technical features of Robots, Power supply or drive systems for robots   |              |
|            | 38          | End effectors, Work cell control   |              |
|            | 39          | Robot programming, Robot programming languages   |              |
|            | 40          | Robot Applications ,Application areas for Robots   |              |
| <b>5</b>   |             | <b>Additive Manufacturing Systems &amp; Future of Automated Factory</b>  | <b>20</b>    |
|            | 41          | Basic principles of additive manufacturing, slicing CAD models for AM, advantages and limitations of AM technologies,                      |              |



|    |   |
|----|---|
| 42 | Additive manufacturing processes: Photo polymerization, material jetting, binder jetting, |
| 43 | material extrusion, Powder bed sintering techniques, sheet lamination,                    |
| 44 | direct energy deposition techniques, applications of AM.                                  |
| 45 | Recent trends in manufacturing, Hybrid manufacturing                                      |
| 46 | Industry 4.0, functions, applications and benefits  |
| 47 | Components of Industry 4.0, Internet of Things (IOT), IOT applications in manufacturing,  |
| 48 | Big-Data and Cloud Computing for IOT, IOT for smart manufacturing,                        |
| 49 | influence of IOT on predictive maintenance, industrial automation,                        |
| 50 | supply chain optimization, supply-chain & logistics, cyber-physical manufacturing system  |

## 12.0 Assignments, Pop Quiz, Mini Project, Seminars

| Sl.No. | Title  | Outcome expected: students able to   | Allied study | Week No. | Individual / Group activity | Reference: book/website /Paper         |
|--------|--|--|--------------|----------|-----------------------------|--|
| 1      | <i>Assignment -1:</i><br>Questions on Introduction to CIM and Automation & Automated Production Lines and Assembly Systems     | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 1     | 2        | Individual Activity.        | Books or Website of the Reference list |
| 2      | <i>Assignment-2:</i><br>Questions on CAD and Computer Graphics Software & Computerized Manufacture Planning and Control System | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 2     | 4        | Individual Activity.        | Books or Website of the Reference list |
| 3      | <i>Assignment-3:</i><br>Questions on Flexible Manufacturing Systems & Line Balancing   | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 3     | 6        | Individual Activity.        | Books or Website of the Reference list |
| 4      | <i>Assignment-4:</i><br>Questions on Computer Numerical Control & Robot Technology   | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 4     | 8        | Individual Activity.        | Books or Website of the Reference list |
| 5      | <i>Assignment-5:</i><br>Questions on Additive Manufacturing Systems & Future of Automated Factory                              | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 5     | 8        | Individual Activity.        | Books or Website of the Reference list |

## 13.0 QUESTION BANK

### MODULE-1:

- 1) Define Automation.
- 2) What are the benefits of Automation?
- 3) Differentiate between Fixed Automation & Programmable Automation.
- 4) Explain Flexible Automation, write down its applications.
- 5) Explain the different levels of Automation.
- 6) Briefly explain the Automation strategies.
- 7) Write a note on Automation approach.
- 8) In manufacturing activity how the cycle time is calculated?
- 9) Explain in detail production rate & batch processing time with mathematical equations
- 10) Explanation Production capacity with mathematical equations
- 11) With a neat diagram explain the Information processing in Manufacturing.



12) The average part produced in a certain batch manufacturing plant must be processed through an average six machines. 20 new batches are launched each week. Average operation time is 6 min, average set-up time is 5 h, average batch size is 25 parts, and average non-operation time per batch is 10 h/machine. There are 18 machines in the plant. The plant operates an average of 70 production hours per week. Scarp rate is negligible. Determine:

a) Manufacturing lead time for an average part. b) Production rate c) Plant capacity d) Plant utilization e) WIP f) WIP ratio g) TIP ratio

13) A certain part is produced in the batch size of 100 units. The batch must be routed through 5 operations to complete the proceeding of the plant. Average setup time is 3hrs per operation & avg operation time is 6mins. Avg. non-operation time due to handling, delays, inspections etc is 7hrs for each operation. Determine how many days it will take to complete the batch, assuming the plant runs one 8hrs shift per day.

14) An average 20 new orders are started each month in a factory. On an avg. an order consist of 50 parts to be processed through 10 m/cs. Avg. Operation time is 15min, avg setup time is 4hrs, average non operation time per order is 8hr per m/c. There are 25 m/c in the plant. 80% of which are operational at any time (20% in repair) the plant operates an average of 160 production hrs per month. However the plant manager complaints that a total of 100 over time m/c hrs must be authorized each month in order to keep up with the production schedule. Determine MLT for an average order, PC & why overtime is authorized, U, average level of WIP, the operation time per m/c for each part=15min.

15) Explain the following terms related to manufacturing: i) WIP & TIP ratio, ii) Production rate & MLT, iii) Utilization & Availability.

16) Define cycle time, draw the sketch showing all the details, write down the mathematical equation to calculate the cycle time

17) How line efficiency of a flow line is calculated?

18) What is meant by cost per piece & production rate

19) Explain Upper bound approach in detail

20) Explain Lower bound approach in detail

21) A machine tool builder submits a proposal for a 20 station transfer line to machine a certain component produced by conventional methods. The proposal starts that the line will operate at a production rate of 50 pieces per hour at 100% efficiency. On similar transfer lines, the probability of station break downs per cycle is equal for all stations &  $p=0.005$  breakdowns/ cycle. It is also estimated that average down time per line stop will be 8 min. The starting casting that is machined on the line costs \$3 per part. The line operates of \$75 per hour. The 20 cutting tools (one tool per station) last for 50 parts each, & the average cost per tool \$2 per cutting edge. Based on this data, compute i) production rate ii) line efficiency & iii) cost per unit piece produced

22) What is meant by blocking or starving in the flow line

23) A 10 station automated flow line has 2 stages of 5 stations each. The ideal cycle time of each stage is 1.5min. The average constant down time is 10min. 7 all the stations have the same probability of stopping, which is 0.005. Determine i) line efficiency ii) production rates with buffer storage capacity of a)  $b=0$  b)  $b= \square$  iii)  $b=50$ .

A 20 station transfer flow line is divided into 2 stages of 10 stations each. The ideal cycle of each stage is  $T_c = 1.2$  min. All of stations in the line have the same probability of stopping,  $p=0.005$ . We assume the down time is constant when a break down occurs,  $T_d=8$  min. Compute the line efficiency for the following buffer capacities i)  $b=0$  ii)  $b= \square$  iii)  $b=10$  iv)  $b=100$ .

24) Using the lower bound approach analyze the transfer lines with & without storage cases.

25) With suitable assumptions, determine the line performance for the single & three stages cases.

| Station | $P_1$ | Station | $P_1$ |
|---------|-------|---------|-------|
| 1       | 0.01  | 9       | 0.03  |
| 2       | 0.02  | 10      | 0.01  |
| 3       | 0.01  | 11      | 0.02  |
| 4       | 0.03  | 12      | 0.02  |
| 5       | 0.02  | 13      | 0.02  |
| 6       | 0.04  | 14      | 0.01  |
| 7       | 0.01  | 15      | 0.03  |
| 8       | 0.01  | 16      | 0.01  |

26) Give the reasons for the down time, on an automated production line.

27) Discuss the limits of storage buffer effectiveness.


28) Discuss the striving & blocking of stations with respect to automated flow lines.

29) Compare on the basis of cost/ unit & suggest whether the performance of 10 stations transfer line having 6 automated & 4 manual stations with an automated station. Cost for the existing line: i)  $C_m = \text{Rs } 0.5/\text{unit}$ , ii)  $T_c = 30$  seconds, iii)  $C_o = \text{Rs } 0.15/\text{minute}$ , iv)  $\text{Rs } 0.10/\text{minute}$ , v)  $C_{at} = \text{Rs } 0.10/\text{minute}$  & vi)  $C_t = \text{Rs } 0.08/\text{minute}$ .

30) What is the purpose of buffer storage? Mention 2 extreme cases of buffer effectiveness automated flow lines.

31) What are the 2 reasons for partial automation? Analyze the performance of partial automation along the suitable assumptions.



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32) Differentiate between upper bound & lower bound approach.

#### MODULE-2:

- 1) **Explain in detail** functions of graphics package
- 2) What is 2D transformations? Explain the procedure of translation, rotation and scaling
- 3) **What is** homogeneous transformation matrix
- 4) What is CAPP? Explain briefly.
- 5) Explain Retrieval CAPP with a neat sketch.
- 6) Explain Generative CAPP with a neat sketch.
- 7) Write down the advantages/Benefits of CAPP.
- 8) What is MRP? Explain briefly.
- 9) Explain the important terminology used in MRP.
- 10) Explain with a neat sketch Flow chart of MRP system.
- 11) Explain the main inputs to MRP.
- 12) Sketch the typical MRP report & explain its important uses.
- 13) What is BOM.
- 14) Explain Intended BOM with a block diagram.
- 15) List the parameters of BOM & explain Calculation of demand with an example.
- 16) What is capacity Requirements Planning, How Rated capacity is calculated?
- 17) Explain briefly Long Range Decisions.
- 18) Draw the flow chart showing the details of CRP system.
- 19) Write a note on Infinite & Finite Loading.
- 20) A work centre operates 6 days a week on a 2-shift per day basis with each shift of 8 hrs. It has 5 machines of same capacity. If machines utilized 80% of the time of a system efficiency of 95%, determine the rated capacity in standard hrs/week.

#### MODULE-3:


- 1) Explain the Fundamentals of Group Technology and Flexible Manufacturing Systems
- 2) **Explain in detail** types of FMS & FMS components
- 3) What is Automated Storage and Retrieval Systems ( AS/RS ), explain.
- 4) **Explain the procedure of** Automatic parts identification systems and data capture
- 5) Define the following with mathematical equations i) Total work content time ii) Work station process time iii) Cycle time iv) line efficiency) Precedence constrains vi) Precedence diagram vii) Balance delay
- 6) Explain the methods with different steps involved in the Assembly line balancing.
- 7) Example with an example any one method of line balancing.
- 8) Write a note on computerized line balancing.
- 9) Explain the reasons for partially automating the production line.
- 10) The table below shows precedence relations & element time for a new part, Ideal cycle time is 10 seconds. Construct the precedence diagram, using all methods, compute the balance delay & line efficiency.

| Element No. | Predecessors Element | Time (sec) | Element No. | Predecessors Element | Time (sec) |
|-------------|----------------------|------------|-------------|----------------------|------------|
| 1           | -                    | 5          | 7           | 6                    | 2          |
| 2           | 1                    | 3          | 8           | 7                    | 6          |
| 3           | 2                    | 4          | 9           | 6                    | 1          |
| 4           | 1                    | 3          | 10          | 6                    | 4          |
| 5           | 4                    | 6          | 11          | 10                   | 4          |
| 6           | 3,5                  | 5          | 12          | 8,9,11               | 7          |

- 11) Explain with mathematical expression the different terms in line balancing.

#### MODULE-4:


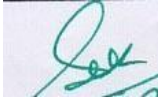
- 1) Draw the block diagram showing the basic components of NC system & explain each in detail.
- 2) Sketch & explain NC coordinate system for drilling & milling.
- 3) Sketch & explain NC coordinate system for turning.
- 4) Explain fixed zero & floating zero method.
- 5) Explain Absolute coordinate system with a sketch.
- 6) What is NC motion control systems & explain contouring system with a neat sketch.


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- 7) List the different Applications of NC system.
- 8) What are the advantages & limitations of NC system?
- 9) What is CNC
- 10) What are the different functions of CNC system & explain Diagnostics in detail.
- 11) Explain vertical machining centre (VMC) with a neat sketch.
- 12) With a block diagram explain the steps involved in part programming.
- 13) What is word address format, briefly explain it.
- 14) Write down the different G & M codes with their function.
- 15) What is canned cycle explain it with an appropriate example.
- 16) Define an industrial Robot.
- 17) Sketch & explain the physical configurations of Robot.
- 18) What is degree of freedom, sketch & explain showing the degrees of freedom of robot.
- 19) Explain point to point method.
- 20) Explain continuous path method.
- 21) Show the different joints in Robot.
- 22) What is degree of freedom, sketch & explain showing the degrees of freedom of robot.
- 23) Explain point to point method .
- 24) Explain continuous path method.
- 25) Show the different joints in Robot.
- 26) Explain the function to be performed by the work cell controller of an industrial robot.
- 27) Explain the basic power sources or drive system of an industrial Robot
- 28) List the important types of sensors used in robot. Explain each in detail.
- 29) Explain briefly what End effector is, sketch & explain the different types of grippers.
- 30) Explain briefly Robot programming.
- 31) List the various Robot programming methods.
- 32) Explain briefly Walkthrough method.
- 33) Write down commonly used monitor commands.
- 34) Write in brief about lead through & offline programming used in Robots.
- 35) Briefly explain General applications of an industrial robot.
- 36) List the different industrial applications of an industrial Robot & explain any 4 applications briefly

#### MODULE-5:

- 1) What is the Basic principles of additive manufacturing
- 2) List the advantages and limitations of AM technologies
- 3) Explain the process of Photo polymerization, material jetting
- 4) Explain the process of Powder bed sintering techniques, sheet lamination
- 5) Explain the process of binder jetting & direct energy deposition technique
- 6) What is Industry 4.0? Explain its functions.
- 7) List the applications and benefits of Industry 4.0 .
- 8) Explain the Components of Industry 4.0.
- 9) What is Internet of Things (IOT),
- 10) List the IOT applications in manufacturing,
- 11) What is Big-Data and Cloud Computing for IOT,
- 12) Explain in detail the IOT for smart manufacturing,
- 13) What are the influences of IOT on predictive maintenance,
- 14) What is industrial automation?
- 15) What is supply chain management ? optimize it.
- 16) Write a short note on supply-chain & logistics.
- 17) What is cyber-physical manufacturing systems

|                      |                                 |  |   |
|----------------------|---------------------------------|--|---|
| <b>Prepared by</b>   | <b>Checked by</b>               |  |  |
|                      | -Sd-                            |  |   |
| Faculty :M S Futane  | Module coordinator              | HOD  | Principal   |
| <b>Subject Title</b> | <b>TOTAL QUALITY MANAGEMENT</b> |  |   |
| <b>Subject Code</b>  | 18ME734                         | <b>IA Marks</b>  | 40  |

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|                                     |    |                   |    |
|-------------------------------------|----|-------------------|----|
| <b>Number of Lecture Hrs / Week</b> | 03 | <b>Exam Marks</b> | 60 |
| <b>Total Number of Lecture Hrs</b>  | 40 | <b>Exam Hours</b> | 03 |

**CREDITS – 03**

|                                       |                                     |  |
|---------------------------------------|-------------------------------------|--|
| <b>FACULTY DETAILS:</b>               |                                     |  |
| <b>Name:</b> Prof. M. A. Hipparagi    | <b>Designation:</b> Asst. Professor | <b>Experience:</b> 13                        |
| <b>No. of times course taught:</b> 02 |                                     | <b>Specialization:</b> Production Technology |

## 1.0 Prerequisite Subjects:

| Sl. No | Branch                 | Semester | Subject                       |
|--------|------------------------|----------|-------------------------------|
| 1      | Mechanical Engineering | V        | Management & Entrepreneurship |

## 2.0 Course Objectives

1. Understand various approaches to TQM
2. Understand the characteristics of quality leader and his role.
3. Develop feedback and suggestion systems for quality management.
4. Enhance the knowledge in Tools and Techniques of quality management

## 3.0 Course Outcomes

The student, after successful completion of the course, will be able to

| CO     | Course Outcome   | Cognitive | POs         |
|--------|--|-----------|-------------|
| C406.1 | Explain the various approaches of TQM                              | L1,L2     | 1,5,6,11,12 |
| C406.2 | Infer the customer perception of quality                           | L2,L3     | 1,5,6,11,12 |
| C406.3 | Analyze customer needs and perceptions to design feedback systems. | L2,L3     | 1,5,6,11,12 |
| C406.4 | Apply statistical tools for continuous improvement of systems      | L2,L3     | 1,5,6,11,12 |
| C406.5 | Apply the tools and technique for effective implementation of TQM. | L2,L3     | 1,5,6,11,12 |

## 4.0 Course Content

### Module - 1

Principles and Practice: Definition, basic approach, gurus of TQM, TQM Framework, awareness, defining quality, historical review, obstacles, benefits of TQM. Quality Management Systems: Introduction, benefits of ISO registration, ISO 9000 series of standards, ISO 9001 requirements. **(08 hours)**

### Module - 2


Leadership: Definition, characteristics of quality leaders, leadership concept, characteristics of effective people, ethics, the Deming philosophy, role of TQM leaders, implementation, core values, concepts and framework, strategic planning communication, decision making. **(08 hours)**

### Module - 3

Customer Satisfaction and Customer Involvement: Customer Satisfaction: customer and customer perception of quality, feedback, using customer complaints, service quality, translating needs into requirements, customer retention, case studies. Employee Involvement – Motivation, employee surveys, empowerment, teams, suggestion system, recognition and reward, gain sharing, performance appraisal, unions and employee involvement, case studies. **(08 hours)**

### Module - 4

Continuous Process Improvement: process, the Juran trilogy, improvement strategies, types of problems, the PDCA Cycle, problem-solving methods, Kaizen, reengineering, six sigma, case studies.

|   |   |                          |
|---|---|--------------------------|
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Statistical Process Control : Pareto diagram, process flow diagram, cause and effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies. **(08 hours)**

#### Module - 5

Total Productive Maintenance (TPM): Definition, Types of Maintenance, Steps in introduction of TPM in an organization, Pillars of TPM – 5S, Jishu Hozen, Quality Maintenance, Planned Maintenance. Quality by Design (QbD): Definition, Key components of QbD, Role of QbD in Pharmaceutical Industry, Benefits and Challenges of QbD. Environmental Management Systems (EMS): Definition, Basic EMS, EMS under ISO 14001, Costs and Benefits of EMS. **(08 hours)**

### 5.0 Relevance to future subjects/Area

| SL. No | Semester | Subject                   | Topics / Relevance     |
|--------|----------|---------------------------|------------------------|
| 1      | 8        | Operations management     | Problem solving skills |
| 2      | 7        | Human resource management | HRM Skills             |

### 6.0 Relevance to Real World

| SL. No | Real World Mapping  |
|--------|---|
| 01     | Industry, Educational institutions, Public and Private sectors and Government Organizations |

### 7.0 Books Used and Recommended to Students


| Text Books  |
|---|
| 1. Total Quality Management: Dale H. Besterfield, Publisher - Pearson Education India, ISBN: 8129702606                                 |
| 2. Total Quality Management for Engineers: M. Zairi, ISBN - 1855730243 Publisher - Woodhead Publishing                                  |
| Reference Books   |
| 1. Managing for Quality and Performance Excellence by James R. Evans and William M. Lindsay, 9th edition, Publisher Cengage Learning.   |
| 2. A New American TQM, four revolutions in management, Shoji Shiba, Alan Graham, David Walden, Productivity Press, Oregon, 1990         |
| 3. Organizational Excellence through TQM, H. Lal, New Age Publications, 2008  |
| 4. Engineering Optimization Methods and Applications, A. Ravindran, K.M. Ragsdell, Wiley India Private Limited, 2nd Edition, 2006       |
| 5. Introduction to Operations Research - Concepts and Cases F.S. Hillier. G.J. Lieberman Tata McGraw Hill Tata McGraw Hill              |
| Additional Study material & e-Books   |
| <ul style="list-style-type: none"> <li>• Nptel.ac.in</li> <li>• VTU, E-learning</li> <li>• MOOCs</li> <li>• Open course ware</li> </ul> |

### 8.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

| Website and Internet Contents References  |
|---|
| <ul style="list-style-type: none"> <li>• <a href="http://www.nptel.ac.in">http://www.nptel.ac.in</a></li> </ul> |

### 9.0 Magazines/Journals Used and Recommended to Students

| Sl.No | Magazines/Journals                         | website  |
|-------|--|--|
| 1     | International Journal for Quality Research | <a href="http://www.ijqr.net/journal/v4-n2/8.pdf">www.ijqr.net/journal/v4-n2/8.pdf</a> |

|   |   |                          |
|---|---|--------------------------|
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|   |  |                                       |
|---|--|---------------------------------------|
| 2 | Emerald The TQM Journal information - Emerald Group Publishing | www.emeraldgroupublishing.com/tqm.htm |
|---|--|---------------------------------------|

## 10.0 Examination Note

### Internal Assessment: 40 Marks

Theoretical aspects as well as relevant sketches should be drawn neatly for questions asked in Internal Assessments

### Scheme of Evaluation for Internal Assessment

Internal assessment test in the same pattern as that of the main examination (Average of three tests) 30 Marks.

Assignment Marks: 10

Total Internal Marks: 40

### SCHEME OF EXAMINATION:


There are five modules two questions from each module

Student has to answer any five question choosing at least one questions from each module.

Max. Marks: 100 Marks

## 11.0 Course Delivery Plan

| Unit No. | Lecture No. | Content of Lecture  | % of Portion    |
|----------|-------------|---|-----------------|
| 1        | 1           | <b>Principles And Practices:</b> Definition, basic approach,                          | 20%<br>(8 Hrs)  |
|          | 2           | Gurus of TQM,   |                 |
|          | 3           | TQM Framework, Awareness of TQM   |                 |
|          | 4           | Defining quality, historical review,  |                 |
|          | 5           | Obstacles, benefits of TQM  |                 |
|          | 6           | Quality Management Systems: Introduction, benefits of ISO registration                |                 |
|          | 7           | ISO 9000 series of standards,   |                 |
|          | 8           | ISO 9001 requirements.  |                 |
| 2        | 9           | <b>Leadership:</b> Definition, characteristics of quality leaders.                    | 40%<br>(8 Hrs)  |
|          | 10          | Leadership concept, characteristics of effective people                               |                 |
|          | 11          | Ethics  |                 |
|          | 12          | Deming philosophy, role of TQM leaders.   |                 |
|          | 13          | Implementation, core values,  |                 |
|          | 14          | concepts and frame work Strategic planning,   |                 |
|          | 15          | communication,  |                 |
|          | 16          | decision making   |                 |
| 3        | 17          | <b>Customer satisfaction and employee involvement:</b>                                | 60%<br>(8 Hrs)  |
|          | 18          | <b>Customer Satisfaction:</b> customer and customer perception of quality,            |                 |
|          | 19          | Feedback, using customer complaints, service quality,                                 |                 |
|          | 20          | Translating needs into requirements, customer retention, and case studies.            |                 |
|          | 21          | Employee Involvement: Motivation, employee surveys empowerment.                       |                 |
|          | 22          | Teams, suggestion system,   |                 |
|          | 23          | recognition and reward  |                 |
|          | 24          | Gain sharing, performance appraisal   |                 |
| 4        | 25          | <b>Continuous Process Improvement:</b> process, Juran Trilogy, improvement strategies | 80%<br>(8Hrs)   |
|          | 26          | Types of problems, PDSA cycle,  |                 |
|          | 27          | Problem solving methods, Kaizen, Reengineering, Six sigma, case studies.              |                 |
|          | 28          | <b>Statistical Process Control :</b> Pareto diagram, process flow diagram             |                 |
|          | 29          | cause and effect diagram, check sheets, histograms,                                   |                 |
|          | 30          | statistical fundamentals, Control charts, state of control, out of control process,   |                 |
|          | 31          | control charts for variables, control charts for attributes                           |                 |
|          | 32          | Scatter diagrams, case studies  |                 |
| 5        | 33          | <b>Total Productive Maintenance (TPM):</b> Definition, Types of Maintenance,          | 100%<br>(8 Hrs) |
|          | 34          | Steps in introduction of TPM in an organization                                       |                 |

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|    |   |
|----|---|
| 35 | Pillars of TPM – 5S, JishuHozen, Quality Maintenance, Planned Maintenance |
| 36 | <b>Quality by Design (QbD):</b> Definition, Key components of QbD,        |
| 37 | Role of QbD in Pharmaceutical Industry                                    |
| 38 | Benefits and Challenges of QbD.   |
| 39 | <b>Environmental Management Systems (EMS):</b> Definition, Basic EMS      |
| 40 | EMS under ISO 14001, Costs and Benefits of EMS.                           |

## 12.0 Assignments, Pop Quiz, Mini Project, Seminars

| Sl.No. | Title   | Outcome expected: students able to                                 | Allied study | Week No. | Individual / Group activity | Reference: book/website /Paper |
|--------|---|--|--------------|----------|-----------------------------|--------------------------------|
| 1      | <i>Assignment -1:</i> Principles and Practice & QMS   | Explain the various approaches of TQM                              | Module 1     | 2        | Individual Activity.        | Text Book                      |
| 2      | <i>Assignment-2:</i> Leadership   | Infer the customer perception of quality                           | Module 2     | 4        | Individual Activity.        | Text Book                      |
| 3      | <i>Assignment-3:</i> Customer Satisfaction and Customer Involvement                                       | Analyse customer needs and perceptions to design feedback systems. | Module 3     | 6        | Individual Activity.        | Text Book                      |
| 4      | <i>Assignment-4:</i> Continuous Process Improvement   | Apply statistical tools for continuous improvement of systems      | Module 4     | 8        | Individual Activity.        | Text Book                      |
| 5      | <i>Assignment-5:</i> Total Productive Maintenance, Quality by Design and Environmental Management Systems | Apply the tools and technique for effective implementation of TQM. | Module 5     | 10       | Individual Activity.        | Text Book                      |

## 13.0 Question Bank

| Sample Questions | Questions   |
|------------------|---|
| <b>I</b>         | <b>Module 1</b><br>1) Explain TQM frame work with the help of neat sketch.<br>2) Define quality and explain contributions of gurus of TQM<br>3) List out six basic concepts of TQM and briefly explain them.<br>4) List out tangible and intangible benefits of TQM.<br>5) Discuss ISO 9000 and ISO 9001 Series of standards.   |
| <b>II</b>        | <b>Module 2</b><br>1. List & Explain the characteristics of Quality Leaders<br>2. Briefly explain the seven steps to strategic planning.<br>3. Why quality council is established? What are the duties of quality council?<br>4. Explain in brief i) Vision Statement ii) Mission Statement iii) Quality Policy<br>5. List out seven characteristics or habits of effective people. |
| <b>III</b>       | <b>Module 3</b><br>1. Who is a customer? What is his role in developing organization?<br>2. What actions organization takes to handle customer complaints?<br>3. Define the term team? Why team work?<br>4. Define customer, what are the two types of customer. Explain with an example.<br>5. How does employee involvement can assist in growth of an organization?              |

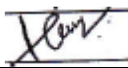
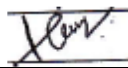

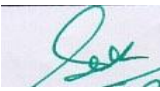




|           |   |
|-----------|---|
| <b>IV</b> | <b>Module 4</b><br>1 Explain Juran Trilogy with a neat sketch.<br>2 Explain the concept of quality function deployment.<br>3 List and explain 7 tools of Quality and benefits of QFD.<br>4 Explain the process of Re-engineering, Kaizen and its benefits and applications<br>5 Discuss the meaning of Six Sigma and as a tool to improve the quality and 5S Principles.<br>6 Discuss the process of Bench marking and its advantages<br>7 Write a short note on control charts for variables and attributes. |
| <b>V</b>  | <b>Module 5</b><br>1 What is bench marking? Explain.<br>2 Write a note on QMS and EMS<br>3 What is QFD? Explain the house of quality with neat sketch.<br>4 Discuss quality by design and TPM concepts.<br>5 With an example explain FMEA concept.  |

## 15.0 University Result

| Year                   | S+,S,A (FCD) | B (FC) | C,D,E (SC) | %age of passing |
|------------------------|--------------|--------|------------|-----------------|
| August/ September 2021 | 27           | 00     | 00         | 100             |

| Prepared by   | Checked by  |  |   |
|---|---|--|---|
|  |  |  |  |
| Prof. M A Hipparagi<br>Faculty  | Prof. M A Hipparagi<br>Module coordinator   | HOD  | Principal   |




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**Programmes Accredited by NBA: CSE, ECE, EEE & ME.**

**Mech. Engg. Dept.**

**Course Plan**

**VII**

**2022-23 (Odd Sem)**

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|   |   |  | <b>2022-23 (Odd Sem)</b> |

|                                |                     |                  |    |
|--------------------------------|---------------------|------------------|----|
| <b>SubjectTitle</b>            | <b>Mechatronics</b> |                  |    |
| <b>SubjectCode</b>             | 18ME744             | <b>IAMarks</b>   | 40 |
| <b>NumberofLectureHrs/Week</b> | 03                  | <b>ExamMarks</b> | 60 |
| <b>TotalNumberofLectureHrs</b> | 40                  | <b>ExamHours</b> | 03 |
| <b>CREDITS-03</b>              |                     |                  |    |

#### **FACULTYDETAILS:**

|                                       |  |                       |
|---------------------------------------|--|-----------------------|
| <b>Name:</b> Prof. M A Hipparagi      | <b>Designation:</b> Asst. Professor          | <b>Experience:</b> 13 |
| <b>No. of times course taught:</b> 06 | <b>Specialization:</b> Production Technology |                       |

### **1.0 Prerequisite Subjects:**

| <b>Sl. No</b> | <b>Branch</b>          | <b>Semester</b> | <b>Subject</b>        |
|---------------|------------------------|-----------------|-----------------------|
| 01            | Mechanical Engineering | I/II            | Basics of electronics |
| 02            | Mechanical Engineering | I/II            | C Programming         |


### **2.0 Course Objectives**

1. To acquire a strong foundation in science and focus in mechanical, electronics, control, software, and computer engineering, and a solid command of the newest technologies.
2. To understand the evolution and development of Mechatronics as a discipline.
3. To substantiate the need for interdisciplinary study in technology education.
4. To understand the applications of microprocessors in various systems and to know the functions of each element.
5. To demonstrate the integration philosophy in view of Mechatronic technology.
6. To be able to work efficiently in multidisciplinary teams.

### **3.0 Course Outcomes**

Having successfully completed this course, the student will be able to

|                                   | <b>Course Outcome</b>   | <b>Cognitive Level</b> | <b>POs</b>     | <b>RBT level</b> |
|-----------------------------------|---|------------------------|----------------|------------------|
| <b>C411.1</b>                     | Illustrate various components of Mechatronics systems.  | U                      | PO1, PO7, PO10 | L2               |
| <b>C411.2</b>                     | Assess various control systems used in automation.  | U                      | PO1, PO7, PO10 | L2               |
| <b>C411.3</b>                     | Design and conduct experiments to evaluate the performance of a mechatronic system or component with respect to specifications, as well as to analyse and interpret data. | U                      | PO1, PO7, PO10 | L2               |
| <b>C411.4</b>                     | Apply the principles of Mechatronics design to product design.  | U                      | PO1, PO7, PO10 | L1               |
| <b>C411.5</b>                     | Function effectively as members of multidisciplinary teams.   | U                      | PO1, PO7, PO10 | L2               |
| <b>Total Hours of instruction</b> |   |                        | <b>40</b>      |                  |

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## 4.0 CourseContent

### MODULE-1

**Introduction:** Scope and elements of mechatronics, mechatronics design process, measurement system, requirements and types of control systems, feedback principle, Basic elements of feedback control systems, Classification of control system. Examples of Mechatronics Systems such as Automatic Car Park system, Engine management system, Antilock braking system (ABS) control, Automatic washing machine.

**Transducers and sensors:** Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, Potentiometers, LVDT, Capacitance sensors, force and pressure sensors, Strain gauges, temperature sensors, proximity switches and Hall Effect sensors.

### MODULE-2

**Signal Conditioning:** Introduction – Hardware – Digital I/O, Analog to digital conversions, resolution, Filtering Noise using passive components – Registers, capacitors, amplifying signals using OPamps. Digital Signal Processing – Digital to Analog conversion, Low pass, high pass, notch filtering. Data acquisition systems (DAQS), data loggers, Supervisory control and data acquisition (SCADA), Communication methods.

**ElectroMechanical Drives:** Relays and Solenoids – Stepper Motors – DC brushed motors – DC brushless motors – DC servomotors – 4-quadrant servodrives, PWM's – Pulse Width Modulation.

### MODULE-3

**Microprocessor & Microcontrollers:** Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers.

**Microprocessor Architecture:** Microprocessor architecture and terminology - CPU, memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data Registers, Program Counter, Flags, Fetch cycle, write cycle, state, bus interrupts. Intel's 8085A Microprocessor.

### MODULE-4


**Programmable Logic Controller:** Introduction to PLCs, Basic structure of PLC, Principle of operation, input and output processing, PLC programming language, ladder diagram, ladder diagrams circuits, timer counters, internal relays, master control, jump control, shift registers, data handling, and manipulations, analogue input and output, selection of PLC for application.

**Application of PLC control:** Extending and retracting a pneumatic piston using latches, control of two pneumatic pistons, control of process motor, control of vibrating machine, control of process tank, control of conveyer motor etc.

### MODULE-5

**Mechatronics in Computer Numerical Control (CNC) machines:** Design of modern CNC machines - Machine Elements: Different types of guideways, Linear Motion guideways. Bearings: anti-friction bearings, Updated on 16.04.2020/28092020 hydrostatic bearing and hydrodynamic bearing. Re-circulating ball screws. Typical elements of open and closed loop control systems. Adaptive controllers for machine tools.

**Mechatronics Design process:** Stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Automatic car park barrier.

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## 5.0 Relevancetofuturesubjects

| Sl No | Semester | Subject            | Topics         |
|-------|----------|--------------------|----------------|
| 01    | VIII     | Projectwork        | Sensors        |
| 02    | VIII     | ControlEngineering | Controlsystems |

## 6.0 RelevancetoRealWorld


| SL.No | RealWorldMappi<br>ng    |
|-------|-------------------------|
| 01    | AutomationandRobotics   |
| 02    | SensingandControlsystem |
| 03    | ServoMechanics          |

## 7.0 GapAnalysisandMitigation

| Sl. No | DeliveryType | Details  |
|--------|--------------|--|
| 01     | Tutorial     | Topic:Electricalsystems,Mechanicalswitches,solid-stateswitches,solenoids |

## 8.0 BooksUsedandRecommendedtoStudents

| TextBooks  |
|--|
| <ol style="list-style-type: none"> <li>1. 'Mechatronics', W. Bolton, Longman, 2Ed, Pearson Publications, 2007.</li> <li>2. Microprocessor Architecture, Programming And Applications With 8085/8085A, R. S. Ganokar, Wiley Eastern</li> <li>3. Nitaigour Premchand Mahalik, Mechatronics- Principles, Concepts and Applications, Tata McGraw Hill, 1st Edition, 2003 ISBN. No. 0071239243, 9780071239240.</li> </ol>   |
| ReferenceBooks   |
| <ol style="list-style-type: none"> <li>1. Mechatronics by HMT Ltd. – Tata McGraw Hill, 1st Edition, 2000. ISBN: 9780074636435.</li> <li>2. Mechatronics: Integrated Mechanical Electronic Systems, K. P. Ramachandran, G. K. Vijayaraghavan, M. S. Balasundaram, Wiley India Pvt. Ltd. New Delhi, 2008</li> <li>3. Introduction to Mechatronics and Measurement Systems, David G. Aldatore, Michael B. Histan, McGraw-Hill Inc USA, 2003</li> <li>4. Introduction to Robotics: Analysis, Systems, Applications., Saeed B. Niku, Person Education, 2006</li> <li>5. Mechatronics System Design, Devdas Shetty, Richard A. Kolk, Cengage publishers, second edition</li> </ol> |
| Additional Studymaterial & e-Books   |
| <ol style="list-style-type: none"> <li>1. Mechatronics by KRGopalkrishna &amp; Mahalik</li> </ol>  |

|   |   |                          |
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**9.0**

## **Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended**

### **Website and Internet Contents References**


- 1) <http://www.vtuupdates.com/2016/09/download-vtu-mech-mam-notes-question-papers.html>
- 2) <http://www.mechatronics2u.in/2014/05/microprocessor-overall-notes-for-all-5.html>
- 3) <http://www.slideshare.net/AbhijithAugustine/microprocessors-and-microcontrollers-short-answer-questions-and-answers>

**10.0**

## **Magazines/Journals Used and Recommended to Students**

| <b>Sl.No</b> | <b>Magazines/Journals</b>                                 | <b>website</b>  |
|--------------|---|---|
| 1            | <i>Journal of Mechatronics</i>                            | <a href="https://www.journals.elsevier.com/mechatronics">https://www.journals.elsevier.com/mechatronics</a>                             |
| 2            | <b>IEEE/ASME<br/>Transaction<br/>on Mechatronics</b>      | <a href="http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=3516">http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=3516</a> |
| 3            | <i>Journal of mechanical and mechatronics engineering</i> | <a href="http://ait.libguides.com/c.php?g=280063&amp;p=1866373">http://ait.libguides.com/c.php?g=280063&amp;p=1866373</a>               |



|   |   |                          |
|---|---|--------------------------|
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|   |   | <b>Course Plan</b>       |
|   |   | <b>VII</b>               |
|   |   | <b>2022-23 (Odd Sem)</b> |

## 11.0 Examination Note

**Internal Assessment: 40 Marks**  
 Assignment marks = 10  
 Internal Assessment Marks = 30

### Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
- Each full question will have a sub-question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

### INSTRUCTION FOR MECHATRONICS AND MICROPROCESSOR (10ME65) EXAMINATION

1. Draw neat sketches for relevant theory. The total duration is 3 hours.
2. Draw the Block diagrams required for control systems.

## 2.0 Course Delivery Plan

| Module No. | Lecture No. | Content of Lecture  | % of Portion |
|------------|-------------|---|--------------|
|            |             | <b>PART-A</b>   |              |
| 1          | 1           | Definition, Multidisciplinary Scenario.   | 20%          |
|            | 2           | Evolution of Mechatronics,  |              |
|            | 3           | Design of Mechatronic system  |              |
|            | 4           | Objectives of Mechatronic system  |              |
|            | 5           | Advantages and disadvantages of Mechatronics.   |              |
|            | 6           | Definition and classification of transducers and sensor   |              |
|            | 7           | Definition and classification of sensors  |              |
|            | 8           | Principle of working and applications of light sensors  |              |
|            | 9           | Principle of working and applications of proximity switches.                                      |              |
|            | 10          | Principle of working and applications of Hall Effect sensors                                      |              |
| 2          | 11          | Introduction – Hardware – Digital I/O, Analog to digital conversions                              | 20%          |
|            | 12          | Filtering Noise using passive components – Registers, capacitors, amplifying signals using OPamps |              |
|            | 13          | Digital Signal Processing   |              |
|            | 14          | Data acquisition systems (DAQS), data loggers, Supervisory control and data acquisition (SCADA)   |              |
|            | 15          | Communication methods   |              |
|            | 16          | Relays and Solenoids  |              |
|            | 17          | Stepper Motors – DC brushed motors  |              |
|            | 18          | DC servomotors – 4-quadrant servodrives   |              |
|            | 19          | PWM's – Pulse Width Modulation  |              |



|    |   |  |     |
|----|---|--|-----|
| 3  | 20  | <i>DCbrushlessmotors</i>   | 20% |
|    | 21  | <i>Intel's8085AMicroprocessor.</i>   |     |
|    | 22  | <i>IntroductionofMicroprocessorsystems,Basicelementsofcontrolsystems,Microcontrollers</i>                |     |
|    | 23  | <i>DifferencebetweenMicroprocessorandMicrocontrollers.</i>   |     |
|    | 24  | <i>Microprocessorarchitectureandterminology</i>  |     |
|    | 25  | <i>AboutCPU,memoryandaddress,I/OandPeripheraldevices</i>   |     |
|    | 26  | <i>ExplanationofALU,InstructionandProgram</i>  |     |
|    | 27  | <i>Assembler,Registers</i>   |     |
|    | 28  | <i>ExplanationofProgramCounter,Flags</i>   |     |
|    | 29  | <i>Fetchcycle,writecycle</i>   |     |
| 4  | 30  | <i>Explanationofbusinterrupts.</i>   | 20% |
|    | 31  | <i>IntroductiontoPLCs,BasicstructureofPLC</i>  |     |
|    | 32  | <i>Principleofoperation,inputandoutputprocessing</i>   |     |
|    | 33  | <i>PLCprogramminglanguage,ladderdiagram,ladderdiagramscircuits</i>                                       |     |
|    | 34  | <i>timercounters,internalrelays,mastercontrol,jumpcontrol</i>  |     |
|    | 35  | <i>shiftregisters,datahandling,andmanipulations,,</i>  |     |
|    | 36  | <i>analogueinputandoutput</i>  |     |
|    | 37  | <i>selectionofPLCforapplication.</i>   |     |
|    | 38  | <i>ApplicationofPLCcontrolExtendingandretractingapneumaticpistonusinglatches</i>                         |     |
|    | 39  | <i>controloftwopneumaticpistons,controlofprocessmotor</i>  |     |
| 5  | 40  | <i>controlofvibratingmachine,controlofprocesstank,controlofconveyermotoretc.</i>                         | 20% |
|    | 41  | <i>IntroductionofMechatronicsinComputerNumericalControl(CNC)machines</i>                                 |     |
|    | 42  | <i>DesignofmodernCNCmachines-</i>  |     |
|    | 43  | <i>MachineElements:Differenttypesofguideways,</i>  |     |
|    | 44  | <i>LinearMotionguideways.</i>  |     |
|    | 45  | <i>Bearings:anti-frictionbearings,hydrostaticbearingandhydrodynamicbearing.Re-circulatingballscrews.</i> |     |
|    | 46  | <i>Typicalelementsofopenandclosedloopcontrolsystems.</i>   |     |
|    | 47  | <i>Adaptivecontrollersformachinetools.</i>   |     |
|    | 48  | <i>MechatronicsDesignprocess,Stagesofdesignprocess</i>   |     |
|    | 49  | <i>TraditionalandMechatronicsdesignconcepts</i>  |     |
| 50 | <i>CasestudiesofMechatronicssystems-PickandplaceRobot-Automaticcar parkbarrier.</i> |  |     |



| Sl.No. | Title   | Outcome expected  | Allied study | Week No. | Individual/Group activity | Reference: book/website /Paper                                |
|--------|---|---|--------------|----------|---------------------------|---|
| 1      | Assignment 1: Transducers and sensors           | Students study the Topics and write the Answers.<br><br>Get practice to solve university questions. | Module 1     | 3        | Individual Activity.      | Book 1, of the referencelist. Website of the Referencelist    |
| 2      | Assignment 2: Signal Conditioning               | Students study the Topics and write the Answers.<br><br>Get practice to solve university questions. | Module 2     | 6        | Individual Activity.      | Book 1, 2 of the referencelist. Website of the Referencelist  |
| 3      | Assignment 3: Microprocessor & Microcontrollers | Students study the Topics and write the Answers.<br><br>Get practice to solve university questions. | Module 3     | 12       | Individual Activity.      | Book 1, of the referencelist. Website of the Referencelist    |
| 4      | Assignment 4: Programmable logic controller     | Students study the Topics and write the Answers.<br><br>Get practice to solve university questions. | Module 4     | 15       | Individual Activity.      | Book 1, 2 of the referencelist. Website of the Referencelist  |
| 5      | Assignment 5: Mechatronics in CNC               | Students study the Topics and write the Answers.<br><br>Get practice to solve university questions. | Module 5     | 18       | Individual Activity.      | Book 1, 2, of the referencelist. Website of the Referencelist |



## 14.0


## QUESTIONBANK

### MODULE-1

1. What are the objectives of Mechatronics?
2. Explain five areas of application of mechatronics.
3. What are the advantages and disadvantages of Mechatronics systems?
4. Write a note on microprocessor based controllers.
5. Explain the mechatronic based engine management system with a block diagram.
6. Define sequential controller and explain with a block diagram the working of a domestic washing machine.
7. State the functions of basic elements of a closed loop control system with a block diagram.
8. With a neat sketch explain any one of the best examples of the closed loop control system.
9. With a block diagram briefly explain the generalized measurement system.
10. Enumerate the differences between open loop and closed loop control systems.
11. Explain how microprocessors are useful in automatic cameras.
12. Explain the working of an eddy current proximity sensor.
13. List the different types of internal and external sensors used in mechatronics systems and briefly explain.
14. State in general, the principle of operation of transducers and highlight their difference with sensors.
15. Briefly explain any two types of transducers.
16. Explain the following terminology related to transducers. (a) Accuracy (b) Repeatability (c) Stability (d) Sensitivity (e) Drift (f) Speed of response
17. What is the basic principle of a light sensor?
18. Explain the different types of sensors.
19. Explain the following: (a) Primary and secondary transducer (b) Active and passive transducer (c) Analog and digital transducer
20. Explain how a proximity sensor can be used in a closed loop to detect the presence of an object.
21. Distinguish between (a) Input transducers and Output transducers (b) Mechanical transducers and Electrical transducers

### MODULE-2

1. Explain briefly Analog to digital converter
2. Explain with sketch Registers & capacitors
3. Explain with sketch Low pass, high pass, notch filtering
4. Explain Data acquisition systems (DAQS)
5. Explain Supervisory control and data acquisition (SCADA)
6. What are Relays
7. Explain Solenoids

|   |   |                          |
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|   |   | <b>Course Plan</b>       |
|   |   | <b>VII</b>               |
|   |   | <b>2022-23 (Odd Sem)</b> |

8. StepperMotors
9. ExplainDCbrushedmotors&DCbrushlessmotors
10. Writenoteon4-quadrantservodrives
11. DiscussaboutthePulseWidthModulation.

#### MODULE-3

12. Explainbrieflyevolutionofmicroprocessor
13. Listanyfiveapplicationareasofmicroprocessor
14. WritethetruthtablesofOR,NOR,AND&NANDgates
15. Whatismeanbymulticoredesign?Whatareitsfeatures&advantages.
16. ExplainthelawsofBooleanalgebrawithillustration.
17. State&explainDemorgantheorem.Writeitstruthtable
18. Whatarelogicgates?Whatisitsfunction?
19. Explainmemoryrepresentationofpositiveandnegativeintegers.
20. Whatisfloatingpointnotation?Explainaccuracyandrangeinfoatingpointrepresentation.
21. Writethearchitectureof8085m
22. Whatismicrocontroller?
23. Writenoteonclassificationof.
24. Discussaboutthememory&addressrelatedtothemicrocontroller.
25. Explainthefollowing1)Fetchcycle2)State3)Bus

#### MODULE-4

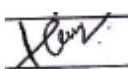
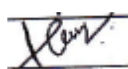
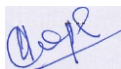
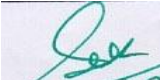
1. WhatisPLC?
2. ExplainthePLCstructure..
3. Explainbrieflytheladderdiagram..
4. DiscussPLCprogramminglanguage
5. Writeanoteontimercounters,internalrelays,mastercontrol
6. Writeanoteonjumpcontrol,shiftregisters,datahandling,andmanipulations
7. ExplainbrieflytheselectionofPLCforapplication.


#### MODULE-5

1. ExplainDifferenttypesofguideways.
2. Writeanoteonanti-frictionbearings,hydrostaticbearingandhydrodynamicbearing
3. WithaneatsketchexplainRe-circulatingballscrews
4. DiscussAdaptivecontrollersformachinetools
5. ExplainStagesofdesignprocess
6. ExplainbrieflyTraditionalandMechatronicsdesignconcepts
7. ExplainanyoneCasestudiesofMechatronicssystems

## 16.0 UniversityResult

| Examination | S+ | S  | A  | B  | C  | D  | E | %Passing |
|-------------|----|----|----|----|----|----|---|----------|
| 2021-22     | 00 | 04 | 21 | 48 | 27 | 06 | 2 | 100      |

| Prepared by  | Checked by  |  |   |
|--|---|--|---|
| <br><b>Prof. M A Hipparagi</b><br>Faculty | <br><b>Prof. M A Hipparagi</b><br>Module coordinator | <br><b>HOD</b> | <br><b>Principal</b> |

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|   |   |  | <b>Course Plan</b>       |
|   |   |  | <b>VII</b>               |
|   |   |  | <b>2022-23 (Odd Sem)</b> |

|                                |                     |                  |    |
|--------------------------------|---------------------|------------------|----|
| <b>SubjectTitle</b>            | <b>Mechatronics</b> |                  |    |
| <b>SubjectCode</b>             | 18ME744             | <b>IAMarks</b>   | 40 |
| <b>NumberofLectureHrs/Week</b> | 03                  | <b>ExamMarks</b> | 60 |
| <b>TotalNumberofLectureHrs</b> | 40                  | <b>ExamHours</b> | 03 |
| <b>CREDITS-03</b>              |                     |                  |    |

#### **FACULTYDETAILS:**

|                                       |  |                       |
|---------------------------------------|--|-----------------------|
| <b>Name:</b> Prof. M A Hipparagi      | <b>Designation:</b> Asst. Professor          | <b>Experience:</b> 13 |
| <b>No. of times course taught:</b> 06 | <b>Specialization:</b> Production Technology |                       |

### **1.0 Prerequisite Subjects:**

| <b>Sl. No</b> | <b>Branch</b>          | <b>Semester</b> | <b>Subject</b>        |
|---------------|------------------------|-----------------|-----------------------|
| 01            | Mechanical Engineering | I/II            | Basics of electronics |
| 02            | Mechanical Engineering | I/II            | C Programming         |

### **2.0 Course Objectives**


7. To acquire a strong foundation in science and focus in mechanical, electronics, control, software, and computer engineering, and a solid command of the newest technologies.
8. To understand the evolution and development of Mechatronics as a discipline.
9. To substantiate the need for interdisciplinary study in technology education.
10. To understand the applications of microprocessors in various systems and to know the functions of each element.
11. To demonstrate the integration philosophy in view of Mechatronic technology.
12. To be able to work efficiently in multidisciplinary teams.

### **3.0 Course Outcomes**

Having successfully completed this course, the student will be able to

|                                   | <b>Course Outcome</b>   | <b>Cognitive Level</b> | <b>POs</b>     | <b>RBT level</b> |
|-----------------------------------|---|------------------------|----------------|------------------|
| <b>C411.1</b>                     | Illustrate various components of Mechatronics systems.  | U                      | PO1, PO7, PO10 | L2               |
| <b>C411.2</b>                     | Assess various control systems used in automation.  | U                      | PO1, PO7, PO10 | L2               |
| <b>C411.3</b>                     | Design and conduct experiments to evaluate the performance of a mechatronic system or component with respect to specifications, as well as to analyse and interpret data. | U                      | PO1, PO7, PO10 | L2               |
| <b>C411.4</b>                     | Apply the principles of Mechatronics design to product design.  | U                      | PO1, PO7, PO10 | L1               |
| <b>C411.5</b>                     | Function effectively as members of multidisciplinary teams.   | U                      | PO1, PO7, PO10 | L2               |
| <b>Total Hours of instruction</b> |   |                        | <b>40</b>      |                  |



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|   |   | <b>Course Plan</b>       |
|   |   | <b>VII</b>               |
|   |   | <b>2022-23 (Odd Sem)</b> |

## 4.0 CourseContent

### MODULE-1

**Introduction:** Scope and elements of mechatronics, mechatronics design process, measurement system, requirements and types of control systems, feedback principle, Basic elements of feedback control systems, Classification of control system. Examples of Mechatronics Systems such as Automatic Car Park system, Engine management system, Antilock braking system (ABS) control, Automatic washing machine.

**Transducers and sensors:** Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, Potentiometers, LVDT, Capacitance sensors, force and pressure sensors, Strain gauges, temperature sensors, proximity switches and Hall Effect sensors.

### MODULE-2

**Signal Conditioning:** Introduction – Hardware – Digital I/O, Analog to digital conversions, resolution, Filtering Noise using passive components – Registers, capacitors, amplifying signals using OPamps. Digital Signal Processing – Digital to Analog conversion, Low pass, high pass, notch filtering. Data acquisition systems (DAQS), dataloggers, Supervisory control and data acquisition (SCADA), Communication methods.

**ElectroMechanical Drives:** Relays and Solenoids – Stepper Motors – DC brushed motors – DC brushless motors – DC servomotors – 4-quadrant servodrives, PWM's – Pulse Width Modulation.

### MODULE-3

**Microprocessor & Microcontrollers:** Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers.

**Microprocessor Architecture:** Microprocessor architecture and terminology – CPU, memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data Registers, Program Counter, Flags, Fetch cycle, write cycle, state, bus interrupts. Intel's 8085A Microprocessor.

### MODULE-4

**Programmable Logic Controller:** Introduction to PLCs, Basic structure of PLC, Principle of operation, input and output processing, PLC programming language, ladder diagram, ladder diagrams circuits, timer counters, internal relays, master control, jump control, shift registers, data handling, and manipulations, analogue input and output, selection of PLC for application.


**Application of PLC control:** Extending and retracting a pneumatic piston using latches, control of two pneumatic pistons, control of process motor, control of vibrating machine, control of process tank, control of conveyer motor etc.

### MODULE-5

**Mechatronics in Computer Numerical Control (CNC) machines:** Design of modern CNC machines – Machine Elements: Different types of guideways, Linear Motion guideways. Bearings: anti-friction bearings, Updated on 16.04.2020/28092020 hydrostatic bearing and hydrodynamic bearing. Re-circulating ball screws. Typical elements of open and closed loop control systems. Adaptive controllers for machine tools.

**Mechatronics Design process:** Stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Automatic car park barrier.

## 5.0 Relevancetofuturesubjects

|   |   |                          |
|---|---|--------------------------|
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|   |   | <b>Course Plan</b>       |
|   |   | <b>VII</b>               |
|   |   | <b>2022-23 (Odd Sem)</b> |

| Sl No | Semester | Subject            | Topics         |
|-------|----------|--------------------|----------------|
| 01    | VIII     | Projectwork        | Sensors        |
| 02    | VIII     | ControlEngineering | Controlsystems |

## 6.0 RelevancetoRealWorld

| SL.No | RealWorldMapping        |
|-------|-------------------------|
| 01    | AutomationandRobotics   |
| 02    | SensingandControlsystem |
| 03    | ServoMechanics          |

## 7.0 GapAnalysisandMitigation

| Sl. No | DeliveryType | Details  |
|--------|--------------|--|
| 01     | Tutorial     | Topic:Electricalsystems,Mechanicalswitches,solid-stateswitches,solenoids |

## 8.0 BooksUsedandRecommendedtoStudents

### TextBooks

- 'Mechatronics', W. Bolton, Longman, 2Ed, Pearson Publications, 2007.
- Microprocessor Architecture, Programming And Applications With 8085/8085A, R.S. Ganokar, Wiley Eastern
- Nitaigour Premchand Mahalik, Mechatronics- Principles, Concepts and Applications, Tata McGraw Hill, 1st Edition, 2003 ISBN. No. 0071239243, 9780071239240.

### ReferenceBooks

- Mechatronics by HMT Ltd. - Tata McGraw Hill, 1st Edition, 2000. ISBN: 9780074636435.
- Mechatronics: Integrated Mechanical Electronic Systems, K.P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram, Wiley India Pvt. Ltd. New Delhi, 2008
- Introduction to Mechatronics and Measurement Systems, David G. Aldatore, Michael B. Histan, McGraw-Hill Inc USA, 2003
- Introduction to Robotics: Analysis, Systems, Applications., Saeed B. Niku, Person Education, 2006
- Mechatronics System Design, Devdas Shetty, Richard A. Kolk, Cengage publishers, second edition

### Additional Studymaterial & e-Books

- Mechatronics by KRGopalkrishna & Mahilik


## 9.0 RelevantWebsites(ReputedUniversitiesandOthers)forNotes/Animation/VideosRecommended

### WebsiteandInternetContentsReferences

- <http://www.vtuupdates.com/2016/09/download-vtu-mech-mam-notes-question-papers.html>
- <http://www.mechatronics2u.in/2014/05/microprocessor-overall-notes-for-all-5.html>
- <http://www.slideshare.net/AbhijithAugustine/microprocessors-and-microcontrollers-short-answer-questions-and-answers>

## 10.0 Magazines/JournalsUsedandRecommendedtoStudents

| Sl.No | Magazines/Journals    | website   |
|-------|-----------------------|---|
| 1     | JournalofMechatronics | <a href="https://www.journals.elsevier.com/mechatronics">https://www.journals.elsevier.com/mechatronics</a> |

|   |   |                          |
|---|---|--------------------------|
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|   |   | <b>Course Plan</b>       |
|   |   | <b>VII</b>               |
|   |   | <b>2022-23 (Odd Sem)</b> |

|   |   |   |
|---|---|---|
| 2 | <b>IEEE/ASME<br/>Transaction<br/>on Mechatronics</b>  | <a href="http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=3516">http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=3516</a> |
| 3 | <i>Journalsofmechanicalandmechatronicsengineering</i> | <a href="http://ait.libguides.com/c.php?g=280063&amp;p=1866373">http://ait.libguides.com/c.php?g=280063&amp;p=1866373</a>               |

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**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub-questions) from each module.
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INSTRUCTION FOR MECHATRONICS AND MICROPROCESSOR (10ME65) EXAMINATION

3. Draw neat sketches for relevant theory. The total duration is 3 hours.
4. Draw the Block diagrams required for control systems.

## 2.0 Course Delivery Plan

| Module No. | Lecture No. | Content of Lecture   | % of Portion |
|------------|-------------|--|--------------|
|            |             | <b>PART-A</b>  |              |
| 1          | 1           | Definition, Multidisciplinary Scenario.  | 20%          |
|            | 2           | Evolution of Mechatronics,   |              |
|            | 3           | Design of Mechatronic system   |              |
|            | 4           | Objectives of Mechatronic system   |              |
|            | 5           | Advantages and disadvantages of Mechatronics.  |              |
|            | 6           | Definition and classification of transducers and sensor  |              |
|            | 7           | Definition and classification of sensors   |              |
|            | 8           | Principle of working and applications of light sensors   |              |
|            | 9           | Principle of working and applications of proximity switches.                                       |              |
|            | 10          | Principle of working and applications of Hall Effect sensors                                       |              |
| 2          | 11          | Introduction – Hardware – Digital/O, Analog to digital conversions                                 | 20%          |
|            | 12          | Filtering Noise using passive components – Registers, capacitors, amplifying signals using OP Amps |              |
|            | 13          | Digital Signal Processing  |              |
|            | 14          | Data acquisition systems (DAQS), dataloggers, Supervisory control and data acquisition (SCADA)     |              |
|            | 15          | Communication methods  |              |
|            | 16          | Relays and Solenoids   |              |
|            | 17          | Stepper Motors – DC brushed motors   |              |
|            | 18          | DC servomotors – 4-quadrant servodrives  |              |
|            | 19          | PWM's – Pulse Width Modulation   |              |



|    |  |   |     |
|----|--|---|-----|
| 3  | 20   | DCbrushlessmotors   | 20% |
|    | 21   | Intel's8085AMicroprocessor.   |     |
|    | 22   | IntroductionofMicroprocessorsystems,Basicelementsofcontrolsystems,Microcontrollers                |     |
|    | 23   | DifferencebetweenMicroprocessorandMicrocontrollers.   |     |
|    | 24   | Microprocessorarchitectureandterminology  |     |
|    | 25   | AboutCPU,memoryandaddress,I/OandPeripheraldevices   |     |
|    | 26   | ExplanationofALU,InstructionandProgram  |     |
|    | 27   | Assembler,Registers   |     |
|    | 28   | ExplanationofProgramCounter,Flags   |     |
|    | 29   | Fetchcycle,writecycle   |     |
|    | 30   | Explanationofbusinterrupts.   |     |
| 4  | 31   | IntroductiontoPLCs,BasicstructureofPLC  | 20% |
|    | 32   | Principleofoperation,inputandoutputprocessing   |     |
|    | 33   | PLCprogramminglanguage,ladderdiagram,ladderdiagramscircuits                                       |     |
|    | 34   | timercounters,internalrelays,mastercontrol,jumpcontrol  |     |
|    | 35   | shiftregisters,datahandling,andmanipulations,,  |     |
|    | 36   | analogueinputandoutput  |     |
|    | 37   | selectionofPLCforapplication.   |     |
|    | 38   | ApplicationofPLCcontrolExtendingandretractingapneumaticpistonusinglatches                         |     |
|    | 39   | controloftwopneumaticpistons,controlofprocessmotor  |     |
| 40 | controlofvibratingmachine,controlofprocesstank,controlofconveyermotoret.c.   |   |     |
| 5  | 41   | IntroductionofMechatronicsinComputerNumericalControl(CNC)machines                                 | 20% |
|    | 42   | DesignofmodernCNCmachines-  |     |
|    | 43   | MachineElements:Differenttypesofguideways,  |     |
|    | 44   | LinearMotionguideways.  |     |
|    | 45   | Bearings:anti-frictionbearings,hydrostaticbearingandhydrodynamicbearing.Re-circulatingballscrews. |     |
|    | 46   | Typicalelementsofopenandclosedloopcontrolsystems.   |     |
|    | 47   | Adaptivecontrollersformachinetools.   |     |
|    | 48   | MechatronicsDesignprocess,Stagesofdesignprocess   |     |
|    | 49   | TraditionalandMechatronicsdesignconcepts  |     |
| 50 | CasestudiesofMechatronicssystems-PickandplaceRobot-Automaticcar parkbarrier. |   |     |

## 13.0

## Assignments, PopQuiz, MiniProject, Seminars

| Sl.No. | Title                                 | Outcome expected   | Allied study | Week No. | Individual/Group activity | Reference: book/website /Paper                             |
|--------|---------------------------------------|--|--------------|----------|---------------------------|--|
| 1      | Assignment 1: Transducers and sensors | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 1     | 3        | Individual Activity.      | Book 1, of the referencelist. Website of the Referencelist |



|   |  |  |         |    |                     |   |
|---|--|--|---------|----|---------------------|---|
| 2 | Assignment<br>2:SignalConditioning               | StudentsstudytheTopics and write theAnswers.<br><br>Getpracticetosolveuniversityquestions. | Module2 | 6  | IndividualActivity. | Book1,2ofthereferencelist.Websiteof the Referencelist   |
| 3 | Assignment<br>3:Microprocessor& Microcontrollers | StudentsstudytheTopics and write theAnswers.<br><br>Getpracticetosolveuniversityquestions. | Module3 | 12 | IndividualActivity. | Book 1,of thereferencelist. Websiteofthe Referencelist  |
| 4 | Assignment<br>4:Programmablelogiccontroller      | StudentsstudytheTopics and write theAnswers.<br><br>Getpracticetosolveuniversityquestions. | Module4 | 15 | IndividualActivity. | Book1,2ofthereferencelist.Websiteof the Referencelist   |
| 5 | Assignment<br>5:Mechatronics inCNC               | StudentsstudytheTopics and write theAnswers.<br><br>Getpracticetosolveuniversityquestions. | Module5 | 18 | IndividualActivity. | Book1,2,ofthereferencelist.Website of the Referencelist |

## 14.0

## QUESTIONBANK

### MODULE-1

1. What are the objectives of Mechatronics?
2. Explain five areas of application of mechatronics.
3. What are the advantages and disadvantages of Mechatronics systems?
4. Write a note on microprocessor based controllers.
5. Explain the mechatronic based engine management system with a block diagram.
6. Define sequential controller and explain with a block diagram the working of a domestic washing machine.
7. State the functions of basic elements of a closed loop control system with a block diagram.
8. With neat sketches explain any one of the best examples of the closed loop control system.
9. With a block diagram briefly explain the generalized measurement system.
10. Enumerate the differences between open loop and closed loop control systems.
11. Explain how microprocessors are useful in automatic cameras.
12. Explain the working of a eddy current proximity sensor.
13. List the different types of internal and external sensors used in mechatronics systems and briefly explain.
14. State in general, the principle of operation of transducers and highlight their difference with sensors.
15. Briefly explain any two types of transducers.
16. Explain the following terminology related to transducers. (a) Accuracy (b) Repeatability (c) Stability (d) Sensitivity (e) Drift (f) Speed of response
17. What is the basic principle of a light sensor?
18. Explain the different types of sensors.
19. Explain the following: (a) Primary and secondary transducer (b) Active and passive transducer (c) Analog and digital transducer
20. Explain how a proximity sensor can be used in a closed loop to detect the presence of an object.
21. Distinguish between (a) Input transducers and Output transducers (b) Mechanical transducers and Electrical transducers.



**MODULE-2**

26. Explain briefly Analog to digital converter
27. Explain with sketch Registers & capacitors
28. Explain with sketch Low pass, high pass, notch filtering
29. Explain Data acquisition systems (DAQS)
30. Explain Supervisory control and data acquisition (SCADA)
31. What are Relays
32. Explain Solenoids
33. Stepper Motors
34. Explain DC brushed motors & DC brushless motors
35. Write note on 4-quadrant servodrives
36. Discuss about the Pulse Width Modulation.

**MODULE-3**

37. Explain briefly evolution of microprocessor
38. List any five application areas of microprocessor
39. Write the truth tables of OR, NOR, AND & NAND gates
40. What is meant by multi-core design? What are its features & advantages.
41. Explain the laws of Boolean algebra with illustration.
42. State & explain De Morgan's theorem. Write its truth table
43. What are logic gates? What is its function?
44. Explain memory representation of positive and negative integers.
45. What is floating point notation? Explain accuracy and range in floating point representation.
46. Write the architecture of 8085
47. What is microcontroller?
48. Write note on classification of.
49. Discuss about the memory & address related to the microcontroller.
50. Explain the following 1) Fetch cycle 2) State 3) Bus

**MODULE-4**

8. What is PLC?
9. Explain the PLC structure..
10. Explain briefly the ladder diagram..
11. Discuss PLC programming language
12. Write a note on timer counters, internal relays, master control
13. Write a note on jump control, shift registers, data handling, and manipulations
14. Explain briefly the selection of PLC for application.

**MODULE-5**


8. Explain Different types of guideways.
9. Write a note on anti-friction bearings, hydrostatic bearing and hydrodynamic bearing
10. With neat sketch explain Re-circulating ball screws
11. Discuss Adaptive controllers for machine tools
12. Explain Stages of design process
13. Explain briefly Traditional and Mechatronics design concepts
14. Explain any one Case studies of Mechatronics systems

**16.0 University Result**

| Examination | S+ | S  | A  | B  | C  | D  | E | %Passing |
|-------------|----|----|----|----|----|----|---|----------|
| 2021-22     | 00 | 04 | 21 | 48 | 27 | 06 | 2 | 100      |

| Prepared by                    | Checked by                                |     |           |
|--------------------------------|---|-----|-----------|
|                                |   |     |           |
| Prof. M A Hipparagi<br>Faculty | Prof. M A Hipparagi<br>Module coordinator | HOD | Principal |



|  |   |  |
|--|---|--|
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|--|---|--|

|                                    |   |                   |    |
|------------------------------------|---|-------------------|----|
| <b>Subject Title</b>               | <b>PYTHON APPLICATION PROGRAMMING (OPEN ELECTIVE)</b> |                   |    |
| <b>Subject Code</b>                | 18CS752   | <b>IA Marks</b>   | 40 |
| <b>Number of Lecture Hrs/ Week</b> | 03 L  | <b>Exam Marks</b> | 60 |
| <b>Total Number of Lecture Hrs</b> | 40  | <b>Exam Hours</b> | 03 |
| <b>CREDITS – 03</b>                |   |                   |    |

#### FACULTY DETAILS:

|                                       |   |                             |
|---------------------------------------|---|-----------------------------|
| <b>Name:</b> Prof. Prasanna Patil     | <b>Designation:</b> Asst. Professor                     | <b>Experience:</b> 09 Years |
| <b>No. of times course taught:</b> 01 | <b>Specialization:</b> Computer Science and Engineering |                             |

### 1.0 Prerequisite Subjects:

| Sl. No | Branch                           | Semester | Subject                              |
|--------|----------------------------------|----------|--------------------------------------|
| 01     | Computer Science and Engineering | I/II     | Programming in C and Data Structures |

### 2.0 Course Objectives

Students should learn to:

1. Learn Syntax and Semantics and create Functions in Python.
2. Handle Strings and Files in Python.
3. Understand Lists, Dictionaries and Regular expressions in Python.
4. Implement Object Oriented Programming concepts in Python
5. Build Web Services and introduction to Network and Database Programming in Python.

### 3.0 Course Outcomes

After studying this course, students will be able to

|                                   | Course Outcome  | Cognitive Level | POs            |
|-----------------------------------|---|-----------------|----------------|
| <b>C414.1</b>                     | Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.                          | L3              | 1, 2, 3, 8, 12 |
| <b>C414.2</b>                     | Demonstrate proficiency in handling Strings and File Systems.   | L2              | 1, 2, 3, 8, 12 |
| <b>C414.3</b>                     | Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions. | L3              | 1, 2, 3, 8, 12 |
| <b>C414.4</b>                     | Interpret the concepts of Object-Oriented Programming as used in Python.  | L2              | 1, 2, 3, 8, 12 |
| <b>C414.5</b>                     | Develop exemplary applications related to Network Programming, Web Services and Databases in Python.                        | L3              | 1, 2, 3, 8, 12 |
| <b>Total Hours of instruction</b> |   |                 | <b>40</b>      |

### 4.0 Course Content

#### Module – 1

Why should you learn to write programs, Variables, expressions and statements, Conditional execution, Functions

**8 Hours**

#### Module – 2

Iteration, Strings, Files.

**8 Hours**

#### Module – 3

Lists, Dictionaries, Tuples, Regular Expressions

**8 Hours**

#### Module – 4

Classes and objects, Classes and functions, Classes and methods

**8 Hours**



**Module – 5**

**8 Hours**

Networked programs, Using Web Services, Using databases and SQL

**5.0 Relevance to future subjects**

| Sl. No | Semester | Subject           | Topics       |
|--------|----------|-------------------|--------------|
| 01     | VIII     | Academic Projects | Project Work |

**6.0 Relevance to Real World**

| Sl.No | Real World Mapping                            |
|-------|---|
| 01    | Implementation of machine learning algorithms |
| 02    | Final year projects on analytics              |

**7.0 Gap Analysis and Mitigation**

| Sl. No | Delivery Type    | Details          |
|--------|------------------|------------------|
| 01     | YouTube Videos   | Python Tutorials |
| 02     | Coursera Courses | Crash Courses    |

**8.0 Books Used and Recommended to Students**

| Text Books                          |  |
|-------------------------------------|--|
| 1.                                  | Charles R. Severance, “Python for Everybody: Exploring Data Using Python 3”, 1 <sup>st</sup> Edition, CreateSpace Independent Publishing Platform, 2016. ( <a href="http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf">http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf</a> ) (Chapters 1 – 13, 15) |
| 2.                                  | Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2 <sup>nd</sup> Edition, Green Tea Press, 2015. ( <a href="http://greenteapress.com/thinkpython2/thinkpython2.pdf">http://greenteapress.com/thinkpython2/thinkpython2.pdf</a> ) (Chapters 15, 16, 17)                                     |
| Reference Books                     |  |
| 1.                                  | Charles Dierbach, "Introduction to Computer Science Using Python", 1 <sup>st</sup> Edition, Wiley India Pvt Ltd. ISBN-13: 978-8126556014   |
| 2.                                  | Gowrishankar S, Veena A, “Introduction to Python Programming”, 1 <sup>st</sup> Edition, CRC Press/Taylor & Francis 2018, ISBN-13:978-08115394372   |
| 3.                                  | Mark Lutz, “Programming Python”, 4 <sup>th</sup> Edition, O’Reilly Media, 2011. ISBN-13: 978-9350232873  |
| 4.                                  | Roberto Tamassia, Michael H Goldwasser, Michael T Goodrich, “Data Structures and Algorithms in Python”, 1 <sup>st</sup> Edition, Wiley India Pvt Ltd, 2016. ISBN-13: 978-8126562176  |
| 5.                                  | ReemaThareja, “Python Programming using problem solving approach”, Oxford university press, 2017, ISBN-13:978-0199480173   |
| 6.                                  | Wesley J Chun, “Core Python Applications Programming”, 3 <sup>rd</sup> Edition, Pearson Education India, 2015.   |
| Additional Study material & e-Books |  |
| 1.                                  | Python Notes for Professionals, GoalKicker.com Free Programming books  |

**9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended**

| Website and Internet Contents References |   |
|--|---|
| 1.                                       | <a href="https://www.tutorialspoint.com/python/">https://www.tutorialspoint.com/python/</a>             |
| 2.                                       | <a href="https://www.guru99.com/python-tutorials.html">https://www.guru99.com/python-tutorials.html</a> |

**10.0 Magazines/Journals Used and Recommended to Students**

| Sl.No | Magazines/Journals              | website   |
|-------|---------------------------------|---|
| 1     | Python for Scientific Computing | <a href="http://ieeexplore.ieee.org/document/4160250/">http://ieeexplore.ieee.org/document/4160250/</a> |



## 11.0 Examination Note

### Internal Assessment: 30+10=40 Marks

- 30 Marks - from Three Internal Assessment Test
- 10 Marks - from the Assignments

### Scheme of Evaluation for Internal Assessment (30 Marks)

- a) Internal Assessment test in the same pattern as that of the main examination (Average of the three Tests): 30marks.
- b) Assignment marks for each module is 25. Average of 5 assignment marks will be taken and finally scale down to 10 marks.

### Internal Assessment Question Paper Pattern (IA):


1. Two main questions to be set from syllabus covered up to IA tests.
2. Student has to answer two full main questions and each question carries 25 marks, Total test marks are 50
  - a. Q.No I or Q.No II = 25 Marks
  - b. Q.No III or Q.No IV = 25 Marks
  - c. **Total = 50 Marks**

### Question Paper Pattern and instructions for Main Exam

1. The question paper will have ten questions
2. Each full Question consisting of 20 marks
3. There will be 2 full questions (with a maximum of four sub questions) from each module
4. Each full question will have sub questions covering all the topics under a module
5. The students will have to answer 5 full questions, selecting one full question from each module

## 12.0 Course Delivery Plan

| Module   | Lecture No. | Content of Lecturer                    | % of Portion |
|----------|-------------|--|--------------|
| <b>1</b> | 1           | Why should you learn to write programs | 20           |
|          | 2           | Variables                              |              |
|          | 3           | Expressions and statements             |              |
|          | 4           | Continued...                           |              |
|          | 5           | Conditional execution                  |              |
|          | 6           | Continued...                           |              |
|          | 7           | Functions                              |              |
|          | 8           | Continued...                           |              |
| <b>2</b> | 9           | Iteration                              | 20           |
|          | 10          | Continued...                           |              |
|          | 11          | Strings                                |              |
|          | 12          | Continued...                           |              |
|          | 13          | Continued...                           |              |
|          | 14          | Files                                  |              |
|          | 15          | Continued...                           |              |
|          | 16          | Continued...                           |              |
| <b>3</b> | 17          | Lists                                  | 20           |
|          | 18          | Continued...                           |              |
|          | 19          | Dictionaries                           |              |
|          | 20          | Continued...                           |              |
|          | 21          | Tuples                                 |              |
|          | 22          | Continued...                           |              |
|          | 23          | Regular Expressions.                   |              |
|          | 24          | Continued...                           |              |
| <b>4</b> | 25          | Classes and objects                    | 20           |
|          | 26          | Continued...                           |              |
|          | 27          | Continued...                           |              |

|  |   |  |
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|--|---|--|

|          |    |                         |    |
|----------|----|-------------------------|----|
| <b>5</b> | 28 | Classes and functions   | 20 |
|          | 29 | Continued...            |    |
|          | 30 | Continued...            |    |
|          | 31 | Classes and methods     |    |
|          | 32 | Continued...            |    |
|          | 33 | Networked programs      |    |
|          | 34 | Continued...            |    |
|          | 35 | Continued...            |    |
| <b>5</b> | 36 | Using Web Services      | 20 |
|          | 37 | Continued...            |    |
|          | 38 | Continued...            |    |
|          | 39 | Using databases and SQL |    |
|          | 40 | Continued...            |    |

### 13.0 Assignments, Pop Quiz, Mini Project, Seminars

| Sl.No. | Title  | Outcome expected   | Allied study             | Week No. | Individual / Group activity                     | Reference: book/website /Paper |
|--------|--|--|--------------------------|----------|---|--------------------------------|
| 1      | Assignment 1: University Questions on Module 1 | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 1 of the syllabus | 2        | Individual Activity. Printed solution expected. | Book 1                         |
| 2      | Assignment 2: University Questions on Module 2 | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 2 of the syllabus | 4        | Individual Activity. Printed solution expected. | Book 1                         |
| 3      | Assignment 3: University Questions on Module 3 | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 3 of the syllabus | 6        | Individual Activity. Printed solution expected. | Book 1                         |
| 4      | Assignment 4: University Questions on Module 4 | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 4 of the syllabus | 8        | Individual Activity. Printed solution expected. | Book 2                         |
| 5      | Assignment 5: University Questions on Module 5 | Students study the Topics and write the Answers. Get practice to solve university questions. | Module 5 of the syllabus | 10       | Individual Activity. Printed solution expected. | Book 1                         |

### 14.0 QUESTION BANK

#### MODULE- 1

- What is wrong with the following code:
 

```
>>>print 'Hello world!'
File "<stdin>", line 1
print 'Hello world!'
^
SyntaxError: invalid syntax
>>>
```
- Write a program that uses input to prompt a user for their name and then welcomes them.
- Write a program to prompt the user for hours and rate per hour to compute gross pay.
- Write a program which prompts the user for a Celsius temperature, convert the temperature to Fahrenheit, and print out the converted temperature.
- Rewrite your pay computation to give the employee 1.5 times the hourly rate for hours worked above 40 hours.



6. Rewrite your pay program using try and except so that your program handles non-numeric input gracefully by printing a message and exiting the program. The following shows two executions of the program:

Enter Hours: 20

Enter Rate: nine

Error, please enter numeric input

Enter Hours: forty

Error, please enter numeric input

7. What is the purpose of the “def” keyword in Python?  
8. Rewrite your pay computation with time-and-a-half for overtime and create a function called computepay which takes two parameters (hours and rate).  
9. Rewrite the grade program from the previous chapter using a function called computegrade that takes a score as its parameter and returns a grade as a string.

Score Grade

> 0.9 A

> 0.8 B

> 0.7 C

> 0.6 D

<= 0.6 F

### MODULE- 2

- Write a program which repeatedly reads numbers until the user enters “done”. Once “done” is entered, print out the total, count, and average of the numbers. If the user enters anything other than a number, detect their mistake using try and except and print an error message and skip to the next number.
- Write another program that prompts for a list of numbers as above and at the end prints out both the maximum and minimum of the numbers instead of the average.
- Write a while loop that starts at the last character in the string and works its way backwards to the first character in the string, printing each letter on a separate line, except backwards.
- Given that fruit is a string, what does fruit[:] mean?
- Take the following Python code that stores a string: str = 'X-DSPAM-Confidence:0.8475'  
Use find and string slicing to extract the portion of the string after the colon character and then use the float function to convert the extracted string into a floating point number.
- Write a program to read through a file and print the contents of the file (line by line) all in upper case.
- Write a program to prompt for a file name, and then read through the file and look for lines of the form: X-DSPAM-Confidence:0.8475.  
When you encounter a line that starts with “X-DSPAM-Confidence:” pull apart the line to extract the floating-point number on the line. Count these lines and then compute the total of the spam confidence values from these lines. When you reach the end of the file, print out the average spam confidence.
- Sometimes when programmers get bored or want to have a bit of fun, they add a harmless Easter Egg to their program. Modify the program that prompts the user for the file name so that it prints a funny message when the user types in the exact file name “nana boo boo”. The program should behave normally for all other files which exist and don't exist.

### MODULE- 3

- Write a function called chop that takes a list and modifies it, removing the first and last elements, and returns None. Then write a function called middle that takes a list and returns a new list that contains all but the first and last elements.
- Figure out which line of the above program is still not properly guarded. See if you can construct a text file which causes the program to fail and then modify the program so that the line is properly guarded and test it to make sure it handles your new text file.
- Rewrite the guardian code in the above example without two if statements. Instead, use a compound logical expression using the and logical operator with a single if statement.
- Download a copy of the file from [www.py4e.com/code3/romeo.txt](http://www.py4e.com/code3/romeo.txt) Write a program to open the file romeo.txt and read it line by line. For each line, split the line into a list of words using the split function. For each word, check to see if the word is already in a list. If the word is not in the list, add it to the list. When the program completes, sort and print the resulting words in alphabetical order.
- Rewrite the program that prompts the user for a list of numbers and prints out the maximum and minimum of the numbers at the end when the user enters “done”. Write the program to store the numbers the user enters in a list and use the max() and min() functions to compute the maximum and minimum numbers after the loop completes
- Write a program that categorizes each mail message by which day of the week the commit was done. To do this look for lines that start with “From”, then look for the third word and keep a running count of each of the days of the week.



At the end of the program print out the contents of your dictionary (order does not matter). Sample Line: From stephen.marquard@uct.ac.za Sat Jan 5 09:14:16 2008.

- Write a program that reads a file and prints the letters in decreasing order of frequency. Your program should convert all the input to lower case and only count the letters a-z. Your program should not count spaces, digits, punctuation, or anything other than the letters a-z. Find text samples from several different languages and see how letter frequency varies between languages. Compare your results with the tables at [wikipedia.org/wiki/Letter\\_frequencies](http://wikipedia.org/wiki/Letter_frequencies).
- Change the socket program socket1.py to prompt the user for the URL so it can read any web page. You can use `split('/')` to break the URL into its component parts so you can extract the host name for the socket connect call. Add error checking using try and except to handle the condition where the user enters an improperly formatted or non-existent URL.
- Change your socket program so that it counts the number of characters it has received and stops displaying any text after it has shown 3000 characters. The program should retrieve the entire document and count the total number of characters and display the count of the number of characters at the end of the document.

#### MODULE- 4

- Write a definition for a class named Circle with attributes center and radius, where center is a Point object and radius is a number. Instantiate a Circle object that represents a circle with its center at (150, 100) and radius 75. Write a function named `point_in_circle` that takes a Circle and a Point and returns True if the Point lies in or on the boundary of the circle.
- Write a function named `rect_in_circle` that takes a Circle and a Rectangle and returns True if the Rectangle lies entirely in or on the boundary of the circle. Write a function named `rect_circle_overlap` that takes a Circle and a Rectangle and returns True if any of the corners of the Rectangle fall inside the circle. Or as a more challenging version, return True if any part of the Rectangle falls inside the circle.
- Write a function called `draw_rect` that takes a Turtle object and a Rectangle and uses the Turtle to draw the Rectangle. Write a function called `draw_circle` that takes a Turtle and a Circle and draws the Circle.
- Write a function called `mul_time` that takes a Time object and a number and returns a new Time object that contains the product of the original Time and the number. Then use `mul_time` to write a function that takes a Time object that represents the finishing time in a race, and a number that represents the distance, and returns a Time object that represents the average pace (time per mile). The datetime module provides time objects that are similar to the Time objects in this chapter, but they provide a rich set of methods and operators.
- Use the datetime module to write a program that gets the current date and prints the day of the week. Write a program that takes a birthday as input and prints the user's age and the number of days, hours, minutes and seconds until their next birthday. For two people born on different days, there is a day when one is twice as old as the other. That's their Double Day.
- Write a program that takes two birthdays and computes their Double Day. For a little more challenge, write the more general version that computes the day when one person is n times older than the other.
- This exercise is a cautionary tale about one of the most common, and difficult to find, errors in Python. Write a definition for a class named Kangaroo with the following methods: An `__init__` method that initializes an attribute named `pouch_contents` to an empty list. A method named `put_in_pouch` that takes an object of any type and adds it to `pouch_contents`. A `__str__` method that returns a string representation of the Kangaroo object and the contents of the pouch. Test your code by creating two Kangaroo objects, assigning them to variables named `kanga` and `roo`, and then adding `roo` to the contents of `kanga's` pouch.

#### MODULE - 5

- Change the socket program socket1.py to prompt the user for the URL so it can read any web page. You can use `split('/')` to break the URL into its component parts so you can extract the host name for the socket connect call. Add error checking using try and except to handle the condition where the user enters an improperly formatted or non-existent URL.
- Change your socket program so that it counts the number of characters it has received and stops displaying any text after it has shown 3000 characters. The program should retrieve the entire document and count the total number of characters and display the count of the number of characters at the end of the document.
- Use `urllib` to replicate the previous exercise of (1) retrieving the document from a URL, (2) displaying up to 3000 characters, and (3) counting the overall number of characters in the document. Don't worry about the headers for this exercise, simply show the first 3000 characters of the document contents.
- Change the `urllinks.py` program to extract and count paragraph (p) tags from the retrieved HTML document and display the count of the paragraphs as the output of your program. Do not display the paragraph text, only count them. Test your program on several small web pages as well as some larger web pages.
- Change either the `www.py4e.com/code3/geojson.py` or `www.py4e.com/code3/geoxml.py` to print out the two-character country code from the retrieved data. Add error checking so your program does not traceback if the country

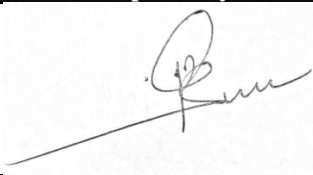







code is not there. Once you have it working, search for "Atlantic Ocean" and make sure it can handle locations that are not in any country.

## 15.0 University Result

| Examination     | APPEARED | PASS | FAIL | %Passing |
|-----------------|----------|------|------|----------|
| FEB/ MARCH 2022 | 95       | 84   | 11   | 88.4     |

| Prepared by   | Checked by  |  |                  |
|---|---|--|------------------|
|  |  |  |                  |
| <b>Prof. Prasanna Patil</b>   | <b>Prof. M. G. Huddar</b>   | <b>HOD</b>   | <b>Principal</b> |

|  |   |  |
|--|---|--|
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|--|---|--|

|                                  |                |                   |    |
|----------------------------------|----------------|-------------------|----|
| <b>Subject Title</b>             | <b>CIM Lab</b> |                   |    |
| <b>Subject Code</b>              | 18MEL76        | <b>IA Marks</b>   | 40 |
| <b>No of Practical Hrs/ Week</b> | 01+02          | <b>Exam Marks</b> | 60 |
| <b>Total No of Practical Hrs</b> | 42             | <b>Exam Hours</b> | 03 |
| <b>CREDITS – 02</b>              |                |                   |    |

#### FACULTY DETAILS:

|   |                                    |                             |
|---|------------------------------------|-----------------------------|
| <b>Name:</b> Prof. M S Futane               | <b>Designation:</b> Asst.Professor | <b>Experience:</b> 17 Years |
| <b>No. of times course taught:</b> 08 Times | <b>Specialization:</b> CIM         |                             |

### 1.0 Prerequisite Subjects:

| Sl. No | Branch                 | Semester | Subject |
|--------|------------------------|----------|---------|
| 01     | Mechanical Engineering | I/II     | CAED    |
| 02     | Mechanical Engineering | III/IV   | CAMD    |
| 03     | Mechanical Engineering | V/VI     | CAMA    |

### 2.0 Course Objectives

- To explain the functions and operations of CNC Machines.
- Construct numerical control (NC) part program.
- Construct computer numerical control (CNC) part program.
- Describe the preparatory commands such as G Codes, M Codes, T Codes etc.
- To write manual part program for turning drilling, milling machines and simulate the same.
- Explain robot programming language for simple operations such as pick and place, stacking objects using teach pendant and off line programming.
- Use the knowledge of pneumatics and hydraulics to demonstrate the related experiments.

### 3.0 Course Outcomes

The student, after successful completion of the course, will be able to

| CO                                | Course Outcome   | Cognitive Level | POs                   |
|-----------------------------------|--|-----------------|-----------------------|
| CO408. 1                          | Appreciate NC & CNC machines & its practical use in industry.  | A               | 1,2,3,4,5,6,8,9,10,12 |
| CO408. 2                          | Distinguish between absolute & incremental coordinate system.  | A               | 1,2,3,4,5,6,8,9,10,12 |
| CO408. 3                          | Make use of computer assisted part programming software to perform milling, drilling and turning operations in design, simulation and manufacturing. | A               | 1,2,3,4,5,6,8,9,10,12 |
| CO408. 4                          | Write manual part programs for milling, turning operations.  | A               | 1,2,3,4,5,6,8,9,10,12 |
| CO408. 5                          | Explain what is FMS & ASRS   | A               | 1,2,3,4,5,6,8,9,10,12 |
| CO408. 6                          | Develop the robot program by using basic commands.   | A               | 1,2,3,4,5,6,8,9,10,12 |
| CO408. 7                          | Read and explain Electro Hydraulics & Pneumatic circuits.  | U               | 1,2,3,4,5,6,8,9,10,12 |
| <b>Total Hours of instruction</b> |  |                 | <b>42</b>             |



## 4.0 Course Content

### PART – A

#### Manual CNC part programming

using ISO Format G/M codes for 2 turning and 2 milling parts. Selection and assignment of tools, correction of syntax and logical errors, and verification of tool path using CNC program verification software.

### PART – B

#### CNC part programming using CAM packages.

Simulation of Turning, Drilling, Milling operations. 3 typical simulations to be carried out using simulation packages like: Cadem CAM Lab-Pro, MasterCAM. Program generation using software. Optimize spindle power, torque utilization, and cycle time. Generation and printing of shop documents like process and cycle time sheets, tool list, and tool layouts. Cut the part in single block and auto mode and measure the virtual part on screen. Post processing of CNC programs for standard CNC control systems like FANUC, SINUMERIC and MISTUBISHI.

### PART – C

#### (Only for Demo/Viva voce)

FMS (Flexible Manufacturing System): Programming of Automatic storage and Retrieval system (ASRS) and linear shuttle conveyor Interfacing CNC lathe, milling with loading unloading arm and ASRS to be carried out on simple components. Robot programming: Using Teach Pendent & Offline programming to perform pick and place, stacking of objects (2 programs). Pneumatics and Hydraulics, Electro-Pneumatics: 3 typical experiments on Basics of these topics to be conducted.

## 5.0 Relevance to future subjects

| SL. No | Semester | Subject                           | Topics / Relevance                             |
|--------|----------|-----------------------------------|--|
| 01     | VI       | Computer Integrated Manufacturing | Provides basics of machine tools & Programming |
| 02     | VIII     | Project work                      | Generation of components for project           |

## 6.0 Relevance to Real World

| SL.No | Real World Mapping             |
|-------|--------------------------------|
| 01    | Automobile Industries          |
| 02    | Designing & simulation purpose |

## 7.0 Books Used and Recommended to Students

| Text Books  |
|---|
| 1. Computer Integrated Manufacturing, J A Rehj and Henry W Krauber    |
| Reference Books   |
| 2. Fundamental Concepts and Analysis, Ghosal A. Robotics Oxford 2006. |
| 3. Computer Integrated Manufacturing, J A Rehj and Henry W Krauber    |
| 4. CAD/CAM by Zeid TMH.   |
| Additional Study material & e-Books                                   |
| A Textbook of CIM & automation eBook By M P Grover PDF.               |

## 8.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

| Website and Internet Contents References   |
|--|
| 1. <a href="https://en.wikipedia.org/wiki/Machine_shop">https://en.wikipedia.org/wiki/Machine_shop</a> |
| 2. <a href="http://www.nptel.ac.in">http://www.nptel.ac.in</a>   |



## 9.0 Magazines/Journals Used and Recommended to Students

| Sl.No | Magazines/Journals   | website   |
|-------|--|---|
| 1     | International Journal of Computer Integrated Manufacturing         | <a href="http://www.tandfonline.com/toc/tcim20/current">www.tandfonline.com/toc/tcim20/current</a>  |
| 2     | Robotics and Computer-Integrated Manufacturing - Journal           | <a href="https://www.journals.elsevier.com/robotics-and-computer-integrated-manufacturing">https://www.journals.elsevier.com/robotics-and-computer-integrated-manufacturing</a> |
| 3     | Robotics and Computer-Integrated Manufacturing - ScienceDirect.com | <a href="http://www.sciencedirect.com/science/journal/07365845">www.sciencedirect.com/science/journal/07365845</a>  |

## 10.0 Examination Note

**Internal Assessment:**

Theoretical aspects as well as relevant sketches should be drawn neatly for questions asked in Internal Assessments

**Scheme of Evaluation for Internal Assessment (20 Marks)**

(a) Internal Assessment test in the same pattern as that of the main examination 20marks.

**SCHEME OF EXAMINATION: (80 Marks)**

One question is to be set from Part-A 40Marks, One question is to be set from either Part-B 20Marks

Viva-Voce 20Marks

## 11.0 Course Delivery Plan

| Unit No.      | Experiment No. | Content of Lecturer   | % of Portion |
|---------------|----------------|---|--------------|
| <b>PART A</b> | 1              | Introduction to CIM using Edge Cam Software   | <b>7.14</b>  |
|               | 2              | Introduction to different preparatory commands ie. G Codes, M Codes etc.  | <b>7.14</b>  |
|               | 3              | Preparation of the turning job on computer and its simulation.  | <b>7.14</b>  |
|               | 4              | Preparation of drilling job on computer and its simulation.   | <b>7.14</b>  |
|               | 5              | Preparation of Milling Job on a Computer and its simulation.  | <b>7.14</b>  |
|               | 6              | Selection and assignment of tools   | <b>7.14</b>  |
|               | 7              | correction of syntax and logical errors   | <b>7.14</b>  |
| <b>PART B</b> | 8              | Introduction to write a NC part program for turning.  | <b>7.14</b>  |
|               | 9              | Introduction to write a NC part program for drilling.   | <b>7.14</b>  |
|               | 10             | Introduction to write a NC part program for milling.  | <b>7.14</b>  |
| <b>PART C</b> | 11             | Demonstration of Flexible Manufacturing System(FMS) of Automatic Storage and Retrieval System(ASRS) and Linear Shuttle Conveyor Interfacing CNC Lathe, Milling, Loading, Unloading Arm and ASRS to be carried out on simple components. | <b>7.14</b>  |
|               | 12             | Demonstration-Introduction to Robot Programming Language Using Teach Pendant and Offline Programming to perform pick and place, stacking of objects.  | <b>7.14</b>  |
|               | 13             | Demonstration on pneumatics and hydraulics, electro pneumatics at least 3 circuit diagrams.   | <b>7.14</b>  |

## 12.0 QUESTION BANK

1. Define computer integrated manufacturing and what are its applications.
2. Define automation and types of automation.
3. What is flexible manufacturing system (FMS)?
4. What is ASRS in FMS?
5. Define numerical control and what are the basic components of numerical control.
6. What is the NC coordinate system for drilling and milling?
7. What is the NC coordinate system for turning.
8. What are three basic types of motion control systems in numerical control?



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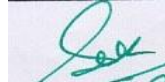
**Mech. Engg. Dept.**


**Course Plan**

**VII SEM**

**2022-23 Odd Sem**

9. Define CNC and need for CNC.
10. What are the advantages and disadvantages of CNC System?
11. What are the different CNC machining centers?
12. What is machine control unit and list the sub systems of MCU.
13. What is CNC part programming? And explain manual part programming and computer assisted part programming briefly.
14. What are the important involved in the development of a part program.
15. List the different NC words to prepare a block in NC programming.
16. What are the different NC data formats?
17. List different preparatory codes and their meaning.
18. What are the standard formats to write a manual part program.
19. What are the different steps in computer assisted part programming?
20. List the different NC part programming languages.
21. What is an industrial robot and what are basic components of it.
22. What are the basic robots motions?
23. List the technical features of robots.
24. What is meant by grippers and effectors in robot?
25. List the robot sensors.
26. What are the steps involved in robot programming.
27. What are the different robot applications?
28. What is hydraulics and pneumatics and electro pneumatics draw at least one circuit diagram to explain it.

| Prepared by           | Checked by               |  |   |
|-----------------------|--------------------------|--|---|
|                       |                          |  |  |
| <b>Mr. M S Futane</b> | <b>Mr. S. A. Goudadi</b> | <b>HOD</b>   | <b>Principal</b>  |

|  |   |  |                          |
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|  |   |  | <b>Course Plan</b>       |
|  |   |  | <b>VII SEM</b>           |
|  |   |  | <b>2022-23 Odd Sem</b>   |

|                            |                   |                   |             |
|----------------------------|-------------------|-------------------|-------------|
| <b>Course Title</b>        | <b>DESIGN LAB</b> |                   |             |
| <b>Course Code</b>         | 18MEL77           | <b>CIE Marks</b>  | 40          |
| <b>Practical Hrs/ Week</b> | 0:2:2             | <b>SEE Marks</b>  | 60          |
| <b>Practical Hrs</b>       | 02                | <b>Exam Hours</b> | 03          |
|                            |                   |                   | Credits: 02 |

|   |                                     |                                    |
|---|-------------------------------------|------------------------------------|
| <b>FACULTY DETAILS:</b>                   |                                     |                                    |
| <b>Name:</b> Prof. S.A. Goudadi           | <b>Designation:</b> Asst. Professor | <b>Experience:</b> 15 Years        |
| <b>No. of times course taught:</b> 2 Time |                                     | <b>Specialization:</b> Design Engg |

### 1.0 Prerequisite Subjects:

| Sl. No | Branch                 | Semester | Subject                |
|--------|------------------------|----------|------------------------|
| 01     | Mechanical Engineering | III      | Mechanics of Materials |
| 02     | Mechanical Engineering | V        | Dynamics of Machines   |
| 03     | Mechanical Engineering | VII      | Mechanical vibrations  |

### 2.0 Course Learning Objectives:

- To understand the concepts of natural frequency, logarithmic decrement, damping and damping ratio.
- To understand the techniques of balancing of rotating masses.
- To verify the concept of the critical speed of a rotating shaft.
- To illustrate the concept of stress concentration using Photo elasticity.
- To appreciate the equilibrium speed, sensitiveness, power and effort of a Governor.
- To illustrate the principles of pressure development in an oil film of a hydrodynamic journal bearing.

### 3.0 Course Outcomes


After successful completion of the course, the student will be able to;

| CO                         | Course Outcome  | Cognitive Level | POs        |
|----------------------------|---|-----------------|------------|
| C418.1                     | Compute the natural frequency of the free and forced vibration of single degree freedom systems, critical speed of shafts.  | L3              | 1,2,6,8,12 |
| C418.2                     | Carry out balancing of rotating masses.   | L3              | 1,2,6,8,12 |
| C418.3                     | Analyse the governor characteristics.   | L3              | 1,2,6,8,12 |
| C418.4                     | Determine stresses in disk, beams, plates and hook using photo elastic bench  | L3              | 1,2,6,8,12 |
| C418.5                     | Determination of Pressure distribution in Journal bearing   | L3              | 1,2,6,8,12 |
| C418.6                     | Analyze the stress and strains using strain gauges in compression and bending test and stress distribution in curved beams. | L3              | 1,2,6,8,12 |
| Total Hours of instruction |   |                 | 42         |

### 4.0 Course Content

| Sl.No.          | Experiments  |
|-----------------|--|
| <b>PART - A</b> |  |
| 1               | Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional). |
| 2               | Balancing of rotating masses   |



|  |   |  |
|--|---|--|
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|--|---|--|

|                 |   |
|-----------------|---|
| 3               | Determination of critical speed of a rotating shaft   |
| 4               | Determination of equilibrium speed, sensitiveness, power and effort of Porter/Proell /Hartnell Governor.  |
| <b>PART - B</b> |   |
| 5               | Determination of Fringe constant of Photo-elastic material using.<br>a) Circular disc subjected to diametral compression.<br>b) Pure bending specimen (four-point bending)                            |
| 6               | Determination of stress concentration using Photo-elasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook |
| 7               | Determination of Pressure distribution in Journal bearing   |
| 8               | Determination of Principal Stresses and strains in a member subjected to combined loading using Strain  |
| 9               | Determination of stresses in Curved beam using strain gauge.  |

### 5.0 Relevance to future subjects

| SL. No | Semester | Subject      | Topics / Relevance  |
|--------|----------|--------------|---|
| 1      | VIII     | Project work | Analysis of vibration of machine parts, Performance of Journal bearings |

### 6.0 Relevance to Real World


| SL.No | Real World Mapping  |
|-------|---|
| 01    | As a field of study it is very important for analyzing systems consisting of single bodies or multiple bodies interacting with each other.                  |
| 02    | A dynamics analysis is what allows one to predict the motion of an object or objects, under the influence of different forces, such as gravity or a spring. |

### 7.0 Books Used and Recommended to Students

| Reference Books                       |
|---------------------------------------|
| 1. Theory of machines By S.S.Rattan   |
| 2. Mechanical Vibrations By V.P.singh |

### 8.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

| Website and Internet Contents References  |
|---|
| 3. <a href="http://nptel.ac.in">http://nptel.ac.in</a>  |
| 4. <a href="http://www.vtuesource.com">www.vtuesource.com</a>   |
| 5. <a href="http://www.sapnaonline.com">http://www.sapnaonline.com</a>  |
| 6. Anmited video on Governer: <a href="https://www.youtube.com/watch?v=HS_YGZXP2xY">https://www.youtube.com/watch?v=HS_YGZXP2xY</a>   |
| 7. Video on proell governer: <a href="https://www.youtube.com/watch?v=qD8R-NtC8bo">https://www.youtube.com/watch?v=qD8R-NtC8bo</a>  |
| 8. Video on Gyroscope: <a href="https://www.youtube.com/watch?v=NeXIV-wMVUk">https://www.youtube.com/watch?v=NeXIV-wMVUk</a>  |
| 9. Video on Journal bearing: <a href="https://www.youtube.com/watch?v=xhtq8xqBXwE">https://www.youtube.com/watch?v=xhtq8xqBXwE</a>  |
| 10. Video on Critical speed of shaft: <a href="https://www.youtube.com/watch?v=ZEawe4jCbFw">https://www.youtube.com/watch?v=ZEawe4jCbFw</a>   |
| 11. Balancing of Rotating Masses: <a href="https://www.youtube.com/watch?v=0MeAZFFqmek&amp;list=PLdLe0dTcWW-">https://www.youtube.com/watch?v=0MeAZFFqmek&amp;list=PLdLe0dTcWW-</a> |

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|--|---|--|

[u\\_dCcNGoAK8fx2PiS5gkVu](https://www.youtube.com/watch?v=p1JDMvWGdsk)

12. Static and dynamic balancing by Tecquipment :

<https://www.youtube.com/watch?v=p1JDMvWGdsk>

13. Forced vibrations by Tecquipment : [https://www.youtube.com/watch?v=r\\_ouYEHr5U](https://www.youtube.com/watch?v=r_ouYEHr5U)

14. Video on Free Vibration: <https://www.youtube.com/watch?v=RYKJo2iAz74>

## 9.0 Magazines/Journals Used and Recommended to Students

| Sl. No | Magazines/Journals  | website   |
|--------|---|---|
| 1      | Mechanism and Machine Theory  | <a href="https://www.journals.elsevier.com">https://www.journals.elsevier.com</a>   |
| 2      | International Journal of Mechanical and Materials Engineering (IJMME) | <a href="http://www.springer.com">http://www.springer.com</a>   |
| 3      | Multi body System Dynamics  | <a href="http://www.springer.com">http://www.springer.com</a>   |
| 4      | Journal of Dynamic Systems, Measurement, and Control                  | <a href="http://dynamicsystems.asmedigitalcollection.asme.org/article.aspx?articleid=1403252">http://dynamicsystems.asmedigitalcollection.asme.org/article.aspx?articleid=1403252</a> |

## 10.0 Examination Note

Scheme of Examination:

One question from Part A: 40 marks

One question from Part B: 40 Marks

Viva voce: 20 Marks

Total: 100 Marks

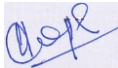
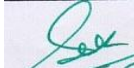
## 11.0 Course Delivery Plan

| Expt No | Lecture/ Practical No | Name of the Experiment   | % of Portion |
|---------|-----------------------|--|--------------|
| 1       | 1                     | Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)                          | 16.67        |
| 2       | 2                     | Balancing of rotating masses   | 8.33         |
| 3       | 3                     | Determination of critical speed of a rotating shaft.   | 8.33         |
| 4       | 4                     | Determination of equilibrium speed, sensitiveness, power and effort of Porter/Proel /Hartnel Governor.   | 16.67        |
| 5       | 5                     | Determination of Fringe constant of Photo elastic material using.<br>a) Circular disc subjected to diametric compression.<br>b) Pure bending specimen (four point bending )                            | 12.5         |
| 6       | 6                     | Determination of stress concentration using Photo elasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook. | 18.75        |
| 7       | 7                     | Determination of Pressure distribution in Journal bearing.   | 6.25         |
| 8       | 8                     | Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes  | 6.25         |
| 9       | 9                     | Determination of stresses in Curved beam using strain gauge.   | 6.25         |

## 12.0 QUESTION BANK



1. What are the different types of vibrations?
2. What is natural frequency?
3. What is resonance?
4. What is the critical speed?
5. Why we are balancing the rotating masses?
6. What is the meaning of stress concentration?
7. Define sensitivity, effort, power in governors.
8. What is the difference between journal and bearing?
9. Define the principal stress.
10. What is the difference between strain rosettes and strain gauges?
11. What is the difference between governor and fly wheel?

| <b>Prepared by</b>       | <b>Checked by</b>          |  |   |
|--------------------------|----------------------------|--|---|
| -Sd-                     | -Sd-                       |  |  |
| <b>Prof. S.A.Goudadi</b> | <b>Prof. D. N. Inamdar</b> | <b>HOD</b>   | <b>Principal</b>  |