

RAMAIAH Institute of Technology

# CURRICULUM

# **Outcome Based Education**

(Effective from the Academic Year 2023 – 2024)

# INDUSTRIAL ENGINEERING AND MANAGEMENT

III & IV SEMESTER B.E.

**RAMAIAH INSTITUTE OF TECHNOLOGY** 

(Autonomous Institute, Affiliated to VTU) Bangalore – 560054.

# About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with  $A^{+}$  grade by NAAC in March 2021 for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute is also been conferred autonomous status for Ph.D program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 65% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 107 & world ranking 600 for the year 2022.

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology is recognized by Atal Ranking of Institutions on Innovation Achievements (ARIIA), MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 78<sup>th</sup> rank among 1249 top Engineering Institutions & 23<sup>rd</sup> Rank for School of Architecture in India for the year 2023 and is 1<sup>st</sup> amongst the Engineering Colleges affiliated to VTU, Karnataka.

#### About the Department:

The department was established in the year 1979 as Industrial & Production Engineering and renamed as Industrial Engineering & Management in the year 1992, with an intake of 60 students and M.Tech program was commenced in the year 2012. The department has been recognized as R&D center by VTU with 14 scholars pursuing their Ph.D. The department has well modernized laboratories namely Industrial & Quality Engineering lab, Computer Lab and Mechanical Measurement & Metrology lab. The department is having highly qualified, motivated and result oriented faculty members. All the faculty are involved in research and technical paper publications in reputed technical journals, conferences across the world. The department was accredited by the NBA in 2001, 2004, 2010, 2015 & 2022 as per the new NBA format laid down by Washington Accord. It has consistently bagged university ranks in Bangalore University & VTU. It has set a unique record of achieving 1st rank eleven times. The department has successfully conducted around 38 faculty development programs, seminars & workshops for academicians as well as industry personnel, students and technical staff. The society of Industrial Engineering and Management, "INDEMAN SOCIETY"- a student body was established in the year 1996. The activities of this society includes: Regular Industrial visits and Guest lectures are conducted twice every semester for all students. Many research projects are executed which are sponsored by UGC, AICTE, DST, VTU and VGST.

# VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socioeconomic needs

# **MISSION OF THE INSTITUTE**

#### MSRIT shall meet the global socio-economic needs through

- 1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
- 2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
- 3. Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

# **QUALITY POLICY**

We at M. S. Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

# THE VISION OF THE DEPARTMENT

To produce globally competent Industrial Engineers, Researchers and Entrepreneurs capable of developing solutions to continually improve socio-technical systems and add value to the society.

# THE MISSION OF THE DEPARTMENT

The Industrial Engineering and Management department shall transform the entrants of the Industrial Engineering and Management program into professionally competent engineers through -

- Innovative educational curricula
- Balanced research program
- Effective collaboration with industry and academia

# **PROGRAM EDUCATIONAL OBJECTIVES (PEOs):**

**PEO1:** Use the knowledge and skills of industrial engineering to model and analyze the real life problems and interpret the results.

**PEO2:** Effectively design, implement, improve and manage the integrated socio-technical systems.

**PEO3:** Build and lead cross-functional teams, upholding the professional responsibilities and ethical values.

**PEO4:** Engage in continuing education and life-long learning to be competitive and enterprising.

# **PROGRAM OUTCOMES (POs):**

The graduate of Industrial Engineering and Management will have the ability to **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.

# THE PROGRAMME SPECIFIC OUTCOMES (PSOs):

#### The graduates of Industrial Engineering and Management program will

**PSO1**: Develop Knowledge, Skills and abilities in the fields such as System design and development, Manufacturing and Research.

**PSO2**: Apply the core competence in the field of industrial and systems engineering to solve real world problem and continuously improve its performance.

**PSO3:** Exhibit innovative abilities and develop towards entrepreneurial careers with a focus on leadership and responsibility.

# Semester wise Credit Breakdown for B.E Degree Curriculum

# Batch 2022-26

| Semester<br>Course Category                          | First | Second | Third | Fourth | Fifth | Sixth | Seventh | Eighth | Total<br>Credits |
|--|-------|--------|-------|--------|-------|-------|---------|--------|------------------|
| Basic Sciences (BSC)                                 | 08    | 08     | 03    | 03     |       |       |         |        | 22               |
| Engineering Sciences (ESC)                           | 08    | 09     |       |        |       |       |         |        | 17               |
| Humanities, Social Sciences and<br>Management (HSMC) | 02    | 02     |       |        | 03    | 03    |         |        | 10               |
| Ability Enhancement Course<br>(AEC)                  | 02    | 01     | 01    | 01     | 01    |       | 03      |        | 09               |
| Universal Human Values (UHV)                         |       |        | 02    |        |       |       |         |        | 02               |
| Professional Core Courses (PCC)                      |       |        | 11    | 12     | 12    | 06    | 04      |        | 45               |
| Integrated Professional Core<br>Course (IPCC)        |       |        | 04    | 04     | 03    |       | 04      |        | 15               |
| Professional Elective Courses<br>(PEC)               |       |        | -     | -      | 03    | 06    | 03      |        | 12               |
| Institutional Open Elective<br>Courses (IOE)         |       |        | -     | -      | -     | 03    | 03      |        | 06               |
| Internship (INT)                                     |       |        |       | Yes    | -     |       |         | 05     | 05               |
| Mini Project / Project Work (PW)                     |       |        |       |        |       | 04    | 03      | 10     | 17               |
| Non Credit Mandatory Courses<br>(NCMC)               |       |        | Yes   |        | Yes   |       |         | Yes    |                  |
| Total Credits  | 20    | 20     | 21    | 20     | 22    | 22    | 20      | 15     | 160              |

# SCHEME OF TEACHING III SEMESTER

|     | III SEMESTER |                     |            |          |    |   |   |         |         |
|-----|--------------|---------------------|------------|----------|----|---|---|---------|---------|
| Sl. | Subject Code | Subject             | Teaching   | Category |    |   |   | Credits | Total   |
| No. | -            | -                   | Department |          | L  | Т | Р | Total   | contact |
|     |              |                     |            |          |    |   |   |         | hours   |
|     |              | Lanlace             |            |          |    |   |   |         | /week   |
| 1   | IM31         | Transforms &        | Maths      | BSC      | 2  | 1 | 0 | 3       | 4       |
| 1   | 11/10/1      | Linear Algebra      | Wittins    | Due      | -  | 1 | Ŭ | 5       | •       |
|     |              | Mechanical          |            |          |    |   |   |         |         |
| 2   | IM32         | Behavior of         | IEM        | IPCC     | 3  | 0 | 1 | 4       | 5       |
|     |              | Materials           |            |          |    |   |   |         |         |
| 3   | IM33         | Manufacturing       | IEM        | PCC      | 3  | 0 | 0 | 3       | 3       |
|     | 111100       | processes           | 12.01      | 100      | 5  | Ŭ | Ŭ |         | 5       |
| 4   | IM34         | Work Study and      | IEM        | PCC      | 3  | 0 | 0 | 3       | 3       |
|     |              | Materials           |            |          |    |   |   |         |         |
| 5   | IM35         | Management          | IEM        | PCC      | 3  | 0 | 0 | 3       | 3       |
|     |              | Manufacturing       |            | Daa      | 0  | 0 |   |         |         |
| 6   | IML 36       | Processes lab       | IEM        | PCC      | 0  | 0 | 1 | 1       | 2       |
| 7   | IMI 37       | Work Study and      | IEM        | PCC      | Δ  | Δ | 1 | 1       | 2       |
| /   | IIVIL 37     | Ergonomics Lab      | ILIVI      | ree      | 0  | 0 | 1 | 1       | 2       |
| 8   | UHV38        | Universal Human     | IEM        | UHV      | 2  | 0 | 0 | 2       | 2       |
|     | 011100       | Values              |            | 0111     | _  | Ŭ | Ŭ | _       | _       |
|     |              | Ability             |            |          |    |   |   |         |         |
| 9   | IMAEC39      | Course III          | IEM        | AEC      | 1  | 0 | 0 | 1       | 1       |
|     |              | (Industrial Safety) |            |          |    |   |   |         |         |
|     |              | Total               | I          | 1        | 17 | 1 | 2 | 21      | 25      |
|     |              | 10(a)               |            |          | 1/ | 1 | 3 | 41      | 43      |

|    | PE83 | Physical<br>Education           |       |      | Al        | ll stu<br>cour  | dent<br>ses | ts have to register compulsorily for any one of t<br>with the concerned coordinator (Yoga Teacher/ | the |  |
|----|------|---------------------------------|-------|------|-----------|---|-------------|--|-----|--|
| 10 | Y083 | Yoga                            |       | NCMC |           | Phy   | /sica       | al Education Director/ NSS Coordinator) in the   |     |  |
| 10 | NS83 | NSS                             |       | Newe | beg<br>fr | beginning of the III semester. Attending the register<br>from III to VIII semesters. Qualifying is mandator<br>award of the degree. |             |  |     |  |
| 11 | AM31 | Additional<br>Mathematics - I * | Maths | NCMC | 0         | 0   | 0           | 0  | 3   |  |

Nomenclature: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, HSMC: Humanity and Social Science & Management Courses, AEC–Ability Enhancement Courses, UHV: Universal Human Value Course, NCMC: Non-credit Mandatory Course

L –Lecture, T – Tutorial, P- Practical/ Drawing

**Integrated Professional Core Course (IPCC):** Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE (no SEE). However, questions from the practical part of IPCC can be included in the SEE question paper.

The Non Credit Mandatory Course, Physical Education (Sport and Athletics)/Yoga/National Service Scheme (NSS):

- 1. Student shall select any one of the NCMC's namely, Physical Education (Sport and Athletics)/Yoga/ NSS prescribed for VIII semesters and shall attend the course from the III semesters and upto end of VIII semesters to complete all the formalities of the course and appear for the SEE. Marks scored in SEE shall be included in the VIII semester grade card.
- 2. The above mentioned NCMC's shall not be considered for vertical progression as well as for the calculation of SGPA/CGPA but completion of the courses shall be mandatory for the award of degree.
- 3. SEE marks will be allotted by the concerned course teacher based on attendance and performance in the practice sessions/field in the ratio of 50:50. Maximum CIE marks are 50. SEE should be awarded by the course teacher every semester (III to VIII) for 50 marks and marks scored by the student are scaled down to 50 in the VIII semester.
- 4. The students who take a course on Physical Education and Yoga, he/she has to take up the semester end practical

examination prescribed for 100 marks. The students who opt for NSS course have to submit report and attend viva-voce examination. The marks of the report shall be 50 marks and for the presentation/viva-voce 50 marks. SEE scale down to 50 marks.

5. In case, any student fails to secure the minimum 40% of the prescribed marks, he/she shall be deemed to have secured 'F' grade.

#### **\*Lateral Entry Students:**

**The Non-Credit Mandatory Course, Inter/Intra Institutional Internship:** All the students admitted under the lateral entry category shall have to undergo a mandatory summer Internship of 02 weeks which is an NCMC course, during the intervening vacation of the III and IV semesters. Summer Internship shall include Inter / Intra Institutional activities. A Viva-voce examination shall be conducted during the IV semester. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of the degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements during subsequent semesters.

#### \* Lateral Entry Students:

The Non-Credit Mandatory Course, Additional Mathematics I is prescribed for III Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other III semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured 'F' grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics I shall have CIE component only and no SEE component. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

# AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total

credits earned for the program. Students entering 4 years degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

# SCHEME OF TEACHING IV SEMESTER

|            | IV SEMESTER     |  |                        |          |    |   |       |       |                           |
|------------|-----------------|--|------------------------|----------|----|---|-------|-------|---------------------------|
|            |                 |  |                        | Category |    | C | Total |       |                           |
| Sl.<br>No. | Subject<br>Code | Subject  | Teaching<br>Department |          | L  | Т | Р     | Total | contact<br>hours<br>/week |
| 1          | IM41            | Computational Techniques & Graph<br>Theory             | Maths                  | BSC      | 2  | 1 | 0     | 3     | 4                         |
| 2          | IM42            | Operations Research                                    | IEM                    | IPCC     | 3  | 0 | 1     | 4     | 5                         |
| 3          | IM43            | Mechanical Measurements and Metrology                  | IEM                    | PCC      | 3  | 0 | 0     | 3     | 3                         |
| 4          | IM44            | Facilities Planning and Design                         | IEM                    | PCC      | 3  | 0 | 0     | 3     | 3                         |
| 5          | IM45            | Applied Probability and Statistics                     | IEM                    | PCC      | 2  | 1 | 0     | 3     | 4                         |
| 6          | IML46           | Mechanical Measurements and<br>Metrology Lab           | IEM                    | PCC      | 0  | 0 | 1     | 1     | 2                         |
| 7          | IML47           | Applied Probability and Statistics<br>Lab              | IEM                    | PCC      | 0  | 0 | 1     | 1     | 2                         |
| 8          | IML48           | Computer Aided Machine Drawing                         | IEM                    | PCC      | 0  | 0 | 1     | 1     | 2                         |
| 9          | IMAEC49         | Ability Enhancement Course – IV<br>(Value Engineering) | IEM                    | AEC      | 1  | 0 | 0     | 1     | 1                         |
| 10         | INT410          | Inter/ Intra Institutional Internship                  |                        | NCMC     | 0  | 0 | 0     | 0     | -                         |
|            |                 | Total  |                        |          | 14 | 2 | 4     | 20    | 26                        |
| 11         | AM41            | Additional Mathematics II *                            | Maths                  | NCMC     | 0  | 0 | 0     | 0     | 3                         |

\* NCMC- Non- Credit Mandatory Course

 Nomenclature: BSC: Basic Science Course, IPCC: Integrated Professional Core Course, PCC: Professional Core Course, INT –Internship, HSMC: Humanity and Social Science & Management Courses, AEC–Ability Enhancement Courses, NCMC: Non-credit Mandatory Course

#### L –Lecture, T – Tutorial, P- Practical/ Drawing

**Integrated Professional Core Course (IPCC):** Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE (no SEE). However, questions from the practical part of IPCC can be included in the SEE question paper.

#### \* Lateral Entry Students:

**The Non-Credit Mandatory Course, Additional Mathematics II** is prescribed for IV Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other IV semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics II shall have CIE component only and no SEE component. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

# AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years' degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

#### III SEMESTER

| LAPLACE TRANSFORMS & LINEAR ALGEBRA                      |                        |  |  |  |
|--|------------------------|--|--|--|
| Course Code: IM31  | Credits: 2:1:0         |  |  |  |
| Pre – requisites: Calculus and Basics of Linear          | Contact Hours: 28L+14T |  |  |  |
| Algebra  |                        |  |  |  |
| Course Coordinator: Dr Vijay Kumar & Dr. B. Azghar Pasha |                        |  |  |  |

#### **Course Content**

#### Unit I

**Laplace Transforms:** Definition, transforms of elementary functions, properties of Laplace transforms, existence conditions, transform of derivatives, integrals, multiplication by  $t^n$ , division by t, evaluation of integrals by Laplace transforms. Transform of Periodic function.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105134/ https://nptel.ac.in/courses/111/105/111105035/
- Impartus recording: https://a.impartus.com/ilc/#/course/119640/593 https://a.impartus.com/ilc/#/course/59742/295

#### Unit II

**Application of Laplace Transforms:** Unit–step function, Unit–impulse function. Inverse transforms, Convolution Theorem, Solution of linear differential equations and Simultaneous linear differential equations using Laplace transforms. Engineering applications.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105134/ https://nptel.ac.in/courses/111/105/111105035/
- Impartus recording: 22-https://a.impartus.com/ilc/#/course/119640/593 https://a.impartus.com/ilc/#/course/59742/295

#### Unit III

**Vector space and Linear Transformation:** Vector spaces, subspaces, Linear combination and span, Linearly independent and dependent vectors, Basis and Dimension. Linear transformation, matrix transformation, Rotation about the origin, Dilation, Contraction and Reflection. Kernel and Range. Four fundamental subspaces of a matrix.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105035/ https://nptel.ac.in/courses/111/102/111102152/
- Impartus recording: https://a.impartus.com/ilc/#/course/621524/1030 https://a.impartus.com/ilc/#/course/619570/1030

#### Unit IV

**Solution of System of linear equations:** LU decomposition of a matrix, Solving Ax=0, Ax = b, Ux=c and Rx=d.

**Orthogonality & Least squares:** Inner product, length and orthogonality. Orthogonal sets, Orthogonal projections, orthogonal and orthonormal bases, The Gram-Schmidt Process, QR factorization, Least-Squares Approximations.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105035/ https://nptel.ac.in/courses/111/102/111102152/
- Impartus recording: https://a.impartus.com/ilc/#/course/621524/1030 https://a.impartus.com/ilc/#/course/619570/1030

#### Unit V

SVD & PCA: Introduction to Eigenvalues and Eigenvectors, Similarity and Diagonalization. Symmetric Matrices, Orthogonal Diagonalization, Complex Matrices, Hermitian and Unitary Matrices, Positive Definite Matrices, The singular value decomposition (SVD), Principal Component Analysis (PCA). Application Problems.

- Pedagogy/Course delivery tools:-Chalk and talk, Power Point Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105035/ https://nptel.ac.in/courses/111/102/111102152/
- Impartus recording: -https://a.impartus.com/ilc/#/course/621524/1030
- https://a.impartus.com/ilc/#/course/619570/1030

#### **Text Books:**

- 1. B.S.Grewal Higher Engineering Mathematics Khanna Publishers 44th edition-2017.
- 2. David C. Lay, Steven R. Lay and Judi J. Mc. Donald Linear Algebra and its Applications Pearson 5th edition 2015.

#### **Reference Books:**

- Peter V. O'Neil Advanced Engineering Mathematics Cengage learning 7th edition – 2011.
- 2. Gilbert Strang, Linear Algebra and its Applications, 5th Edition (2016).
- 3. Gareth Williams Linear Algebra with Applications, Jones and Bartlett Press 9th edition 2017.
- 4. Erwin Kreyszig-Advanced Engineering Mathematics-Wiley-India publishers-10th edition-2015.

#### **Course Outcomes (COs):**

At the end of the course, students will be able to

- 1. Evaluate Laplace Transforms of given function and understand their properties (PO-1,2 & PSO-2,3)
- 2. Obtain inverse Laplace transforms and use it to solve system of ODE's (PO-1,2 & PSO-2,3)
- 3. Obtain matrix of linear transformation. (PO-1,2 & PSO-2,3)
- 4. Solve the system of equations by Least-Squares method. (PO-1,2 & PSO-2,3)
- 5. Obtain eigenvalue decomposition of a matrix and use it to study the concepts of SVD and PCA. (PO-1,2 & PSO-2,3)

#### **Course Assessment and Evaluation:**

| Continuous Internal Evaluation (CIE): 50 Marks                |       |                           |  |  |  |  |
|---|-------|---------------------------|--|--|--|--|
| Assessment Tool   | Marks | Course outcomes addressed |  |  |  |  |
| Internal test-I   | 30    | C01,C02,C03               |  |  |  |  |
| Internal test-II  | 30    | CO3,CO4,CO5               |  |  |  |  |
| Average of the two internal tests shall be taken for 30marks. |       |                           |  |  |  |  |
| Other components  | Marks | Course outcomes addressed |  |  |  |  |
| Quiz  | 10    | CO1,CO2,CO3               |  |  |  |  |
| Assignment  | 10    | CO3,CO4,CO5               |  |  |  |  |
|   |       |                           |  |  |  |  |
| Semester End Examination (SEE):                               | 100   | C01,C02,C03,C04,C05       |  |  |  |  |

# MECHANICAL BEHAVIOUR OF MATERIALS

| Course Code: IM32                                     | Credits:3:0:1          |  |  |  |
|---|------------------------|--|--|--|
| Pre – requisites: Nil                                 | Contact Hours: 42T+14P |  |  |  |
| Course Coordinator: Mr. Sridhar B.S / Mrs. Hamritha S |                        |  |  |  |

#### **Course Content**

#### Unit I

**Introduction to materials and imperfections:** Metals and Non Metals, Composites, Nano composites. Imperfections: Point defects and Line defects and surface defects **Fracture:** Ductile and brittle fracture, Ductile to brittle fracture transition.

**Fatigue:** Types of loading, Fatigue parameters, S-N curves, Factors affecting fatigue, design consideration to prevent fatigue

Creep: Fundamental mechanism of creep, properties affecting creep.

- Pedagogy / Course delivery tools: Black board teaching, Power Point Presentation
- Links: https://www.youtube.com/watch?v=FxQiS8buoDo https://www.youtube.com/watch?v=LRKzOui\_kS8&list=PLfIFNJ1DPG4ksAj eCgpbm8nLGM1Pgxer&index=3 https://www.youtube.com/watch?v=OlexdbPETPw https://www.youtube.com/watch?v=zH05sDLKMoU

#### Unit II

**Phase Diagrams**: Solid solutions, Hume Rothary rules, Gibbs phase rule, Lever rule. Iron carbon equilibrium diagram: Construction and description of phases (Binary and Eutectic phases diagrams only)

Heat treatment: Heat treatment of ferrous alloys: Classification of heat treatment processes, Jominy end quench test

Full heat treatment: Annealing and normalizing, Surface heat treatment: Carburizing, Flame hardening and Induction hardening,

- Pedagogy / Course delivery tools: Black board teaching, Power Point Presentation
- Links:https://www.youtube.com/watch?v=BJrTZ07bHm4&list=PLfIFNJ1DPG 4lENg4VUTWyKxxB911aHuJz

https://www.youtube.com/watch?v=bgpBJcIlrY4&list=PLfIFNJ1DPG4lENg4VUT WyKxxB911aHuJz&index=4

https://www.youtube.com/watch?v=erOKm7wbkJE&list=PLfIFNJ1DPG4lENg4VU TWyKxxB911aHuJz&index=11

#### Unit III

**Simple stress and strain:** Introduction, Properties of Materials, Stress, Strain, Hook's law, Poisson's Ratio, Stress- Strain Diagram for structural steel and non- ferrous materials, Principles of superposition, Total elongation of tapering bars of circular cross section (Simple problems on Principles of superposition and stress strain diagram)

**Compound bars:** Introduction, Principal planes and stresses, Mohr's circle of stresses (Analytical only).

**Torsion of circular shafts**: Introduction, Pure torsion, torsion equation of circular shafts, strength and stiffness, torsional rigidity, torsional flexibility, Power transmitted by shaft solid and hollow circular sections. (Simple problems)

- Pedagogy / Course delivery tools: Black board teaching, Power Point Presentation
- Links:https://www.youtube.com/watch?v=-XGxMASBebw&list=PLcwp2fRcIXJVJbLOtIX9OeGCKRp4R1lhX&index=2

https://www.youtube.com/watch?v=xDxeNUogj1Q&list=PLcwp2fRcIXJVJbLOtI

X9OeGCKRp4R1lhX&index=4

https://www.youtube.com/watch?v=3CuAE9hwFM0&list=PLcwp2fRcIXJVJbLOtI X9OeGCKRp4R1lhX&index=10

#### Unit IV

**Bending moment and shear force in beams:** Introduction, Types of beams loadings and supports, Shearing force in beam, Bending moment, Sign convention, Relationship between loading shear force and bending moment, SFD and BMD with salient values for cantilever beams, simply supported beams considering point loads, UDL and UVL

- Pedagogy / Course delivery tools: Black board teaching, Power Point Presentation
- Links:https://www.youtube.com/watch?v=09c0JtVXapI&list=PLcwp2fRcIXJ VJbLOtIX9OeGCKRp4R1lhX&index=12

https://www.youtube.com/watch?v=NHLzMpIp4kE&list=PLcwp2fRcIXJVJbLOtI X9OeGCKRp4R11hX&index=13

#### Unit V

**Elastic stability of columns:** Introduction, Euler's theory on columns, Effective length slenderness ratio, Short and long columns, radius of gyration, buckling load, Assumptions, derivations of Euler's Buckling load for different end conditions, Limitations of Euler's theory, Rankine's formula

Thin and thick cylinders: Thin and thick cylinders-Thin cylinders subjected to

change in length, diameter and volume, Lames equations for thick cylinders (compound cylinders not included)

- Pedagogy / Course delivery tools: Black board teaching, Power Point Presentation
- Links:https://www.youtube.com/watch?v=SCl14pvgw2E&list=PLcwp2fRcIXJ VJbLOtIX9OeGCKRp4R1lhX&index=29 https://www.youtube.com/watch?v=akOHC4gebR0&list=PLcwp2fRcIXJVJbL OtIX9OeGCKRp4R1lhX&index=30 https://www.youtube.com/watch?v=dB5QG4c7Whw&list=PLcwp2fRcIXJVJb LOtIX9OeGCKRp4R1lhX&index=31 https://www.youtube.com/watch?v=GJ7DhqqK9Vo

#### Lab Component:

| Sl No | Name of the Experiment |
|-------|------------------------|
| 1     | Rockwell Hardness Test |
| 2     | Brinell Hardness test  |
| 3     | Vicker's Hardness test |
| 4     | Izod Test              |
| 5     | Charpy Test            |
| 6     | Tensile Test           |
| 7     | Compression Test       |
| 8     | Single Shear           |
| 9     | Double Shear           |
| 10    | Bending Test           |

#### **Text Books:**

- 1. Marc Andr'e Meyers, Krishan Kumar Chawla "Mechanical behaviour of Materials", Second Edition, Cambridge University Press, 2009.
- 2. William & Smith –Materials Science and Engineering, in SI units, TMH, Special Indian edition 2008.
- 3. Basavarajaiah and Mahadevappa, Strength of Materials, University Press, 2010

#### **References:**

- 1. V Raghavan -Physical Metallurgy, Principles and Practices, PHI, 2<sup>nd</sup> Edition 2006, New Delhi.
- James F Shackelford -Introduction to Material Science for Engineering, 6<sup>th</sup> edition Pearson Prentice hall, New Jersey, 2006.

- 3. L.S.Srinath, Prakash Desai and AnanthRamu Strength of Materials, TMH Publishers, Chennai, 2008.
- S.S Bhavikatti -Strength of Materials, Vikas Publications House pvt. Ltd, 3<sup>rd</sup> edition 2009.
- 5. Timoshenko and Young -Elements of Strength of Materials, Affiliated East-Wes Press, 2<sup>nd</sup> edition 2007.
- 6. Ramamrutham, Strength of Materials, Dhanapath Rai Publishers, 2008.

#### **Course Outcomes (COs):**

Students will be able:

- 1. To identify the types of materials, structures and defects in them. They will also understand how materials fail and how the failures can be reduced. (PO-7, PSO-2)
- 2. To construct the phase diagrams and identify the different phases. Also, understand how heat treatment will increase the strength of the material with the help of different heat treatment process. (PO-7, PSO-2)
- 3. Judge the effect of stress & strain on various mechanical/machine members of various engineering materials and analyze the effect of compound stresses on members. Also study the effect of torsional moment on rigidity and strength of circular members. (PO-3, PO-12, PSO-2)
- 4. Determine the strength and rigidity of various cross sections using SFD and BMD. (PO-3, PO-12, PSO-2)
- 5. Determine the cross sectional dimensions of cylindrical pressure vessels for various stress conditions and to design suitable dimensions for columns and struts based on suitability of Euler's and Rankine's formula for crushing stresses. (PO-3, PO-12, PSO-2)

**Course Assessment and Evaluation:** 

| Continuous Internal Evaluation (CIE): 50 Marks                |       |                           |  |  |  |
|---|-------|---------------------------|--|--|--|
| Assessment Tool   | Marks | Course outcomes addressed |  |  |  |
| Internal Test – I   | 30    | CO1, CO2                  |  |  |  |
| Internal Test – II 30 CO3, CO4, CO5                           |       |                           |  |  |  |
| Average of the two internal tests shall be taken for 30 marks |       |                           |  |  |  |
| Other Components  |       |                           |  |  |  |
| Assignments   | 10    | CO1, CO2, CO3, CO4, CO5   |  |  |  |
| Quiz  | 10    | CO1, CO2, CO3, CO4, CO5   |  |  |  |
| Semester End Examination (SEE)                                | 100   | CO1, CO2, CO3, CO4, CO5   |  |  |  |

# MANUFACTURING PROCESSESCourse Code: IM33Credits: 3:0:0Pre – requisites: NilContact Hours: 42LCourse Coordinator: Sri Sudheer D. Kulkarni, Dr. Siddhartha Kar

#### **Course Content**

#### Unit I

**Metal Casting Process**: Introduction, Steps involved in casting, Pattern types, pattern allowances. Sand Casting, Types of molding sand, Ingredients of molding sand, properties;

**Special Metal Casting Processes**: Shell-mold casting, Investment casting (lost-wax process), Die casting, Centrifugal Casting, Continuous Casting.

**Melting Furnaces**: Constructional features and working of Electric furnaces- Arc, resistance and induction furnaces; Cupola

**Testing and Inspection of Castings**: Defects in Castings-Causes and remedies, Nondestructive testing: X-ray radiography, dye penetrate test, ultrasonic test, magnetic particle inspection.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentations, Animated videos
- Links:
- Casting: Introduction and Suitability: https://www.youtube.com/watch?v=ozFdTBG93uU&t=1s
   Steps of casting: https://www.youtube.com/watch?v=rL3dLQYEYKw
   Casting terminology: https://www.youtube.com/watch?v=yPpyyABaqcw
   Pattern allowances: https://www.youtube.com/watch?v=8EO25lnMj-I
   Shell-mold casting: https://www.youtube.com/watch?v=ZmAkMgl3V3w
   Investment and Permanent Mold Casting: https://www.youtube.com/watch?v=gs2cWctKLBQ
   Melting Furnaces and Practice: https://www.youtube.com/watch?v=GUctNyh1FR0
   Casting defects and their preventions: https://www.youtube.com/watch?v=ICB41-cihGk

#### Unit II

Advanced Welding Processes: Introduction, Friction welding, Ultrasonic welding, Electron beam welding, Laser welding. Welding principle, advantages, disadvantages and applications.

**Bulk Deformation Processes**: Definition, Types, Hot Working, Warm Working and Cold working of metals. Forging; Rolling; Extrusion; Rod, Wire, and Tube drawing.

**Processing of Metal Powders**: Powder Metallurgy, Compaction of Metal Powders, Sintering, Secondary and Finishing Operations

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentations, Animated videos
- Links: Metal Working Processes: Hot & Cold Working: https://www.youtube.com/watch?v=dNbVsmVgOnM Powder Metallurgy: https://www.youtube.com/watch?v=MgukjCT9o80

#### Unit III

**Theory of Metal Cutting**: Single point tool nomenclature, geometry, Cutting tool materials, orthogonal & oblique cutting, Merchants analysis, Ernst-Merchant's solution, shear angle relationship, problems on Merchants analysis

**Cutting Fluids**- properties, types & selection, machinability, factors affecting machinability.

**Tool Wear & Tool Failure**: Effects of cutting parameters, Tool life criteria, Taylor's tool life equation, problems on tool life evaluation

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentations, Animated videos
- Links: Single point cutting tool: <u>https://www.youtube.com/watch?v=81Fdif5e85c&t=7s</u> Mechanism of chip formation: https://www.youtube.com/watch?v=WiY60zAa4c4&t=20s Machining forces and MCD: https://www.youtube.com/watch?v=Dcx1Vf\_1Z3o&t=117s Tool life: https://www.youtube.com/watch?v=-R-fySRLa9Q

#### Unit IV

**Machine Tools:** Drilling Machines: Classification, constructional features, drilling & related operations, types of drill & drill bit nomenclature. Shaper- Classifications, constructional features, Specification of shaper, Shaper Mechanisms. Numerical Problems on calculation of machining time.

Milling Machines: Classification, constructional features, milling cutters & nomenclatures, milling operations, up milling & down milling concepts.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentations, Animated videos
- Links: Lathe:https://www.youtube.com/watch?v=T6vR81ysTG8&t=270s https://www.youtube.com/watch?v=XLriJNaygQc&t=2015s
   Drilling: https://www.youtube.com/watch?v=OBO7Keg2Lv8&t=2750s
   Shaping: https://www.youtube.com/watch?v=60CFKE6Gqa0
   Milling: https://www.youtube.com/watch?v=DWtcjWltRFw&t=4s
   Grinding: https://www.youtube.com/watch?v=RtGl5hpiT\_w

#### Unit V

**Modern Machining Methods:** Hybrid Machining Processes: Overview, Classification, Basic Principles of Vibration assisted EDM, Electro-Chemical Discharge Machining.

**Micromanufacturing**: Introduction, Crystal Growing and Wafer Preparation, Films and Film Deposition, Oxidation, Lithography, Etching, Diffusion and Ion Implantation, Metallization and Testing, Wire Bonding and Packaging.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentations, Animated videos
- Links:EDM: https://www.youtube.com/watch?v=rA09KaPL7\_8&t=88s ECM: https://www.youtube.com/watch?v=fOc65syJvDM ECDM: https://www.youtube.com/watch?v=-tcaR7oSx\_w

#### **Text Books:**

- 1. Serope Kalpakjian and Steven R. Schniid Manufacturing Processes for Engineering MaterialsTechnology, Pearson Education Asia, 5 th Edition. 2015.
- Amitabha Ghosh & Mallik -Manufacturing science, Affiliated East West press, 1995 4. HMT -Production Technology, Tata McGraw Hill, 2020
- 3. E. Paul Degarmo -Materials and Processes in Manufacturing, 9th edition, PHI, 2011.

#### **References:**

- 1. John A. Schey–Introduction to Manufacturing Processes, 3rd Edition, McGraw Hill International Editions,2012
- Roy A Lindberg -Material and Processes of Manufacture, PHI Publishers, 4<sup>th</sup> edition, Pearson Education, 2006
- 3. Pandey & Shah -Modem machining process, TMH, 2000.
- 4. El-Hofy, H., Youssef, H. (2020). Non-traditional and Advanced Machining Technologies. United Kingdom: CRC Press.

#### **Course Outcomes (COs):**

At the end of the course, students will be able to:

- 1. Understand and compare various moulding methods, select a suitable furnace for a given metal and identify the defects in castings by suitable inspection / testing methods. (PO-1, PO-6, PO-7, PSO-1)
- Select a suitable welding technique for the given application and enhance their knowledge in the area of metal forming / processing techniques. (PO-1, PO-6, PO-7, PSO-1)
- 3. Apply the concept of metal cutting operations, analyze the forces acting during metal cutting and estimate the tool life (PO-1, PO-6, PO-7, PSO-1)
- 4. Apply the knowledge of operations of various machine tools (PO-1, PO-2, PSO-1)
- 5. Appreciate the application of modern machining methods and understand various micromachining methods (PO-1, PO-6, PO-7, PSO-1)

| Continuous Internal Evaluation CIE): 50 Marks                 |       |                              |  |  |  |
|---|-------|------------------------------|--|--|--|
| Assessment Tool   | Marks | Course outcomes<br>addressed |  |  |  |
| Internal Test – I   | 30    | CO1, CO2                     |  |  |  |
| Internal Test – II  | 30    | CO3, CO4, CO5                |  |  |  |
| Average of the two internal tests shall be taken for 30 marks |       |                              |  |  |  |
| Other Components  |       |                              |  |  |  |
| Assignments   | 10    | CO1, CO2, CO3, CO4, CO5      |  |  |  |
| Quiz  | 10    | CO1, CO2, CO3, CO4, CO5      |  |  |  |
| Semester End Examination (SEE)                                | 100   | CO1, CO2, CO3, CO4, CO5      |  |  |  |

#### **Course Assessment and Evaluation:**

# WORK STUDY AND ERGONOMICSCourse Code: IM34Credits: 3:0:0Pre – requisites: NilContact Hours: 42LCourse Coordinator: Dr. M Rajesh / Dr. Hemawthy. S

#### **Course Content**

#### Unit I

**Productivity:** Definition of productivity, Productivity and Standards of living, Individual enterprises, Work content, Productivity of materials, and, building, machine and power. Measurement of productivity (labor, material, multifactor), factors affecting the productivity.

**Work Study:** Definition, objective and scope of work study. Work-study procedure, Human factor in work study Work study and management, work study and supervision, work study and worker.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Productivity <u>https://www.youtube.com/watch?v=gJDYV2SmFeY</u>

#### Unit II

**Introduction to Method Study:** Definition, objective and scope of method study, Charts to record moments in shop operation – process charts, flow diagram, string diagram, travel chart and multiple activity charts, questioning technique.

**Micro and Memo Motion Study:** Principles of motion economy, classification of movements, two handed process chart, and micro motion study.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Introduction to Method Study https://www.youtube.com/watch?v=gJDYV2SmFeY Micro and Memo Motion Study https://www.youtube.com/watch?v=dgWeLrtrvcQ

#### Unit III

**Introduction to Work Measurement:** Definition, objective and benefit of work measurement. Work measurement techniques. Work sampling with simple problems. **Time Study:** Time Study, Definition, time study equipment, selection of job, steps in time study, breaking jobs into elements.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Introduction to Work Measurement https://www.youtube.com/watch?v=NaNWD6JLLeM Time Study https://www.youtube.com/watch?v=zWQovrjB7Uc&list=PLLy\_2iUCG87BbIF 6sF5sy\_ZZLFoUcnncb

#### Unit IV

**Time Study (Contd...):** Rating, Systems of rating. Scales of rating, factors affecting rate of working, Allowances and Standard time calculation: (Problems with no machine allowance, with machine allowance).

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Time Study https://www.youtube.com/watch?v=p0RX0wvVtQF6sF5sy\_ZZLFoUcnncb

#### Unit V

**Ergonomics:** Introduction, areas of study under ergonomics, history of ergonomics, man-machine system-components and their functions, simple design of workplace using ergonomics.

**Design of man-machine system**: Quantitative, qualitative and representational display. Influence of climate, illumination, noise on human efficiency.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Ergonomics https://www.youtube.com/watch?v=ZU9pYim15fI
  Design of man-machine system https://www.youtube.com/watch?v=cTBA5SC6HsQ

#### **Text Books:**

- Geroge Kanawaty ILO -Introduction to work study, ISBN 13:9788120406025 Publisher: India Book House Pvt. Ltd, 4<sup>th</sup> Revised Edition, 2008.
- M.P.Groover-Work Systems: The Methods, Measurement & Management of Work, ISBN: 978-93-325-8124-1, Pearson, 1<sup>st</sup> Edition, 2013.
- 3. Ralph M Barnes -Motion and Time study, ISBN: 13:978981426182 Publisher:John Wiley, 7<sup>th</sup> edition 2009.

#### **References:**

- 1. Andris Freivalds and Benjamin Niebel Niebel's Methods, Standards, & Work Design, ISBN-13: 978-0073376318, Mc Graw Hill, 13th Edition, 2014
- M S Sanders and E J McCormic -Human Factors in Engineering Design, ISBN: 13:9780070549012, Mc Graw Hill, 7<sup>th</sup> Edition.
- William Stevenson, Operations Management, ISBN: 13: 978-9353163419,McGraw Hill Education; 12<sup>th</sup> edition.

#### Web links and video lectures (e-Resources):

- 1. https://www.youtube.com/watch?v=yhywrCChJBQ&list=PLLy\_2iUCG87D5n 9zraFS2QYajk0OAOIVK
- 2. https://www.youtube.com/watch?v=yhywrCChJBQ

#### **Course Outcomes (COs):**

At the end of the course, students will be able to

- 1. Identify areas where there would be a need for improvement of productivity, reduction of ineffective time in an organization. (PO-1, PO-2, PO-3, PO-5, PSO-1)
- Analyze and Develop method study techniques and use the correct set of method study techniques, tools for a given scenario (PO-2, PO-3, PO-5, PSO-2)
- 3. Determining sample size based on work sampling study and understanding time study concepts. (PO-1, PO-2, PO-5, PSO-2)
- Apply the tools and techniques of work study in order to measure the rate of working and establish standard time for simple and complex process (PO-1, PO-2, PO-5, PSO-2)
- 5. Design and develop the man machine system and its function in industry, society and areas where the effect of such a system can be created(PO-1, PO-2, PO-5, PSO-3)

| Continuous Internal Evaluation (CIE): 50 Marks                |       |                           |  |  |  |
|---|-------|---------------------------|--|--|--|
| Assessment Tool   | Marks | Course outcomes addressed |  |  |  |
| Internal Test – I   | 30    | CO1, CO2                  |  |  |  |
| Internal Test – II  | 30    | CO3, CO4, CO5             |  |  |  |
| Average of the two internal tests shall be taken for 30 marks |       |                           |  |  |  |
| Other Components  |       |                           |  |  |  |
| Assignments   | 10    | CO1, CO2, CO3, CO4, CO5   |  |  |  |
| Quiz  | 10    | CO1, CO2, CO3, CO4, CO5   |  |  |  |
| Semester End Examination (SEE)                                | 100   | CO1, CO2, CO3, CO4, CO5   |  |  |  |

#### **Course Assessment and Evaluation:**

# MATERIALS MANAGEMENTCourse Code: IM35Credits: 3:0:0Pre – requisites: NilContact Hours: 42LCourse Coordinator: Dr Hemavathy S / Dr. Shobha. R

#### **Course Content**

#### Unit I

**Inventory Fundamentals:** Operating Environment, Material and Information Flow, Aggregate Inventory Management, Supply and Demand Patterns, Functions and Objectives of Inventory Management, Inventory Costs.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Inventory and Flow of Material https://www.youtube.com/watch?v=9J91Lo1D8MI

Supply and Demand Patterns - https://www.youtube.com/watch?v=KJOvsvA0FME

#### Unit II

**Purchasing:** Establishing Specifications of purchasing, Functional Specification Description, Selecting Suppliers, Price Determination, Impact of MRP on Purchasing, Supply Chain Concept, Supply Chain Metrics, Organizational Implications of SCM.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Supply Chain Concept https://www.youtube.com/watch?v=lZPO5RclZEo Impact of MRP on Purchasing https://www.youtube.com/watch?v=TXlD6w2UV6s Organizational implications of SCM https://www.youtube.com/watch?v=LZYEREK0qz4

#### Unit III

**Order Quantities:** Financial Statements and Inventory, Making the Production Plan, ABC Inventory Control, Economic Order Quantity (EOQ), Variations of EOQ Model, Quantity Discounts, Use of EOQ when Costs are not known, Period Order Quantity (POQ).

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation.
- Links: ABC Inventory Control
  - https://www.youtube.com/watch?v=BWbnKgFNcKg

Economic Order Quantity - https://www.youtube.com/watch?v=iMBXwAgl6n4

#### Unit IV

**Independent Demand Ordering Systems:** Order Point System, Determining Safety Stock, Determining Service Levels, Different Forecast and Lead Time Intervals, Determining when Order Point is reached, Periodic Review System, Distribution Inventory.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Determining Safety Stock https://www.youtube.com/watch?v=8KMU1H\_3qZE
   Forecast and Lead time interval https://www.youtube.com/watch?v=kARq9TIxsOM

#### Unit V

**Physical Inventory and Warehouse Management:** Warehousing Management, Physical Control and Security, Inventory Record and Accuracy, Vendor Rating Problems.

**Physical Distribution:** Physical Distribution System, Transportation, Warehousing, Packaging, Materials Handling, Multi-Warehouse Systems.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Warehousing Management https://www.youtube.com/watch?v=OZWY87oeSOU
   Physical Distribution System https://www.youtube.com/watch?v=UYZdIHUYh6M

#### **Text Books:**

1. Steve Chapman & Tony Arnold – Introduction to Materials Management, Pearson, 2016.

#### **References:**

- 1. **P Gopalakrishna & M Sundaresan** Materials Management: An Integrated Approach, PHI, 2012.
- 2. A K Dutta Materials Management: Procedures, Text and Cases, PHI, 2009.
- 3. S D Sharma Operations Research, 4th edition, 2009.
- 4. Kanti Swaroop Operations Research, S Chand, 2001.

#### Web links and video lectures (e-Resources):

- 1. https://nptel.ac.in/courses/110105095
- 2. https://nptel.ac.in/courses/110106045
- 3. https://nptel.ac.in/courses/110107073
- 4. https://www.digimat.in/nptel/courses/video/110105095/L01.html
- 5. https://egyankosh.ac.in/bitstream/123456789/14842/1/Unit-13.pdf

#### **Course Outcomes (COs):**

At the end of the course, students will be able to:

- 1. Analysis of the fundamental concepts of materials management and its implications. (PO-1,2,3& PSO1,2)
- 2. Develop suitable purchasing system which could be efficient and effective in a particular system. (PO-1,2,3& PSO1,2)
- 3. Implement various inventory control systems to make the system cost effective. (PO-1,2,3& PSO1,2)
- 4. Assess the advanced inventory control systems for better control of the process. (PO-1,2,3& PSO1,2)
- 5. Analysis of a basic warehousing system and its effectiveness. (PO-1,2,3& PSO1,2)

#### **Course Assessment and Evaluation:**

| <b>Continuous Internal Evaluation (CIE): 50 Marks</b> |   |                           |  |  |  |
|---|---|---------------------------|--|--|--|
| Assessment tool                                       | Marks   | Course outcomes addressed |  |  |  |
| Internal test-I                                       | 30  | CO1, CO2                  |  |  |  |
| Internal test-II                                      | 30  | CO3, CO4, CO5             |  |  |  |
| Average of the two internal tests will                | Average of the two internal tests will be considered for evaluation of 30 Marks |                           |  |  |  |
| Other components- 20 Marks                            |   |                           |  |  |  |
| Assignment  | 10  | CO1, CO2, CO3, CO4, CO5   |  |  |  |
| Quiz  | 10  | CO1, CO2, CO3, CO4, CO5   |  |  |  |
| Semester End Examination (SEE)                        | 100   | CO1, CO2, CO3, CO4, CO5   |  |  |  |

# MANUFACTURING PROCESSES LAB

Course Code: IML36 Pre – requisites: Nil

Contact Hours: 14P

Credits: 0:0:1

Course Coordinator: Sudheer D. Kulkarni, Dr. Siddhartha Kar

# **Course Content**

### Unit I

# Part A- Foundry & Forging

#### I. Testing of Moulding Sand

- 1. Moisture Content test
- 2. Clay Content Test
- 3. Grain Fineness test
- 4. Compression strength test
- 5. Shear Strength test
- Pedagogy: Demonstration and hands-on training
- Links: Permeability test: https://www.youtube.com/watch?v=aeIrFFFhNRY Compression Test: https://www.youtube.com/watch?v=RGitRZQkaiQ

# II. Foundry practice

- 1. Preparation of moulds using split patterns
- 2. Preparation of moulds without patterns (i.e. with hand cutting)
- Pedagogy: Demonstration and hands-on training
- Links: https://www.youtube.com/watch?v=PkjpmPLNKZs

#### **III.** Forging operations

- 1. Preparation of L-model
- 2. Preparation of Hexagonal rod
- Pedagogy: Demonstration and hands-on training
- Links: Metal Forming Virtual Simulation Lab: http://msvs-dei.vlabs.ac.in/

# Part B - Machine Tool Operations

# IV. Lathe with four jaw chuck

- 1. Thread cutting operation
- 2. Eccentric operation
- Pedagogy: Demonstration and hands-on training
- Links: Lathe Operations: https://www.youtube.com/watch?v=XXpOwsD0fWM

#### V. Milling Machine

- 1. Spur gear cutting
- Pedagogy: Demonstration and hands-on training
- Links: Gear cutting: https://www.youtube.com/watch?v=39ZiVUA-JNY

#### VI. Shaping Machine

- 1. Rectangular groove cutting
- 2. Dovetail cutting
- Pedagogy: Demonstration and hands-on training
- Links: https://www.youtube.com/watch?v=\_Xn-rSl0ZqE

#### **Text Books:**

- 1. Amitabha Ghosh & Mallik -Manufacturing science, Affiliated East West press, 1995
- 2. HMT -Production Technology, Tata McGraw Hill, 2001
- 3. P.Radhakrishnan **-Manufacturing Technology**, Scitech Publications, Chennai, Vol- I, 2002
- 4. P.N.Rao -Manufacturing Technology and M/C tool & metal cutting, Tata Mc Graw Hill, 1998

#### **References:**

- John A. Schey -Introduction to Manufacturing Processes, McGraw Hill, 3<sup>rd</sup> Edition, 2001.
- 2. Pandey & Shah -Modem machining process, TMH, 2000.
- 3. B J Ranganath -Metal Cutting and tool design, Vikas Publications.

#### **Course Outcomes (COs):**

At the end of the course, students will be able to:

- 1. Analyze the properties of moulding sand and derive conclusions (PO-1, PO-2, PO-3, PSO-1, PSO-2)
- 2. Apply casting and forging technologies to create various shapes (PO-1, PO-2, PO-3, PSO-1, PSO-2)
- 3. Apply the concepts of metal cutting to create components by using various machine tools (PO-1, PO-2, PO-3, PSO-1, PSO-2)

# **Course Assessment and Evaluation:**

| Continuous Internal Evaluation (CIE): 50 Marks   |       |                           |  |
|--|-------|---------------------------|--|
| Assessment Tool  | Marks | Course outcomes addressed |  |
| Weekly evaluation of laboratory<br>manuals / records after the<br>conduction of every experiment | 30    | CO1, CO2, CO3             |  |
| Practical Tests  | 20    | CO1, CO2, CO3             |  |
| Semester End Examination<br>(SEE)  | 50    | CO1, CO2, CO3             |  |

# WORKSTUDY AND ERGONOMICS LAB

Course Code: IML37

Credits: 0:0:1

Pre – requisites: Nil

Contact Hours: 14P

# Course Coordinator: Dr. M Rajesh / Dr. Hemavathy. S

### **Course Content**

## List of Experiments:

- 1. Construction of Outline Process Chart for simple assembly
- 2. Recording the given activity using Flow Process Chart (Men/Material/Equipment)
- 3. Constructing the String Diagram for a shop-floor activity
- 4. Construction of Two Handed Process Chart for pin board assembly
- 5. Rating practice using walking simulator
- 6. Rating practice for dealing a deck of cards
- 7. Rating Practice for pin board assembly
- 8. Rating Practice for marble experiment
- 9. Determination of standard time for simple operations using stop watch method
- 10. Determination of standard time for simple operations using Predetermined time standards
- 11. Measurement of parameters (heart beat rate, calorie consumption) using walking simulator
- 12. Measurement of parameters (heart beat rate, calorie consumption, revolutions per minute) using ergometer
- 13. Strength and Endurance test on a person.
- 14. Effect of noise, light and heat on human efficiency in work environment.

# **Text Books:**

- GerogenKanawaty ILO -Introduction to work study, ISBN 13:9788120406025 Publisher: India Book House Pvt. Ltd, 4<sup>th</sup> Revised Edition, 2008.
- M.P.Groover-Work Systems: The Methods, Measurement & Management of Work, ISBN: 978-93-325-8124-1, Pearson, 1<sup>st</sup> Edition, 2013.
- Ralph M Barnes -Motion and Time study, ISBN: 13:978981426182 Publisher: John Wiley, 7<sup>th</sup> edition 2009.

#### **References:**

- Andris Freivalds and Benjamin Niebel Niebel's Methods, Standards, & Work Design, ISBN-13: 978-0073376318, Mc Graw Hill, 13<sup>th</sup> Edition, 2014
- 2. M S Sanders and E J McCormic Human Factors in Engineering Design, ISBN: 13:9780070549012, Mc Graw Hill, 7<sup>th</sup> Edition

#### **Course Outcomes (COs):**

At the end of the course, students will be able to

- 1. Identify areas where work study tools and techniques can be applied (PO1,3& PSO 1,2)
- 2. Apply the tools and techniques to various simulated scenarios and real life problems in industry and society (PO-1,3& PSO1,2)
- 3. Create novel designs of work place and other areas where improvement can be applied with perspective of various constraints faced in real life situation at society and industry level (PO-1,3& PSO1,2,3)

#### Web links and video lectures (e-Resources):

- 1. https://www.youtube.com/watch?v=zWQovrjB7Uc&list=PLLy\_2iUCG87BbIF 6sF5sy\_ZZLFoUcnncb
- https://www.youtube.com/watch?v=GxT0LD1kZFk&list=PLLy\_2iUCG87BbI F6sF5sy\_ZZLFoUcnncb&index=2

#### **Course Assessment and Evaluation:**

| Continuous Internal Evaluation (CIE): 50 Marks |       |                              |  |
|--|-------|------------------------------|--|
| Assessment tool                                | Marks | Course outcomes<br>addressed |  |
| Weekly Evaluation-Lab Record                   | 30    | CO1, CO2, CO3                |  |
| Lab Test                                       | 20    | CO1, CO2, CO3                |  |
| Semester End Examination (SEE)                 | 50    | CO1, CO2, CO3                |  |

# UNIVERSAL HUMAN VALUES

**Course Code: UHV38** 

Credits: 2:0:0

Pre – requisites: Nil

Contact Hours: 28L

# Course Coordinator: Dr. M R Shivakumar

## Course content Unit I

#### Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- 1. Understanding the need, basic guidelines, content and process for Value Education
- 2. Self-Exploration–what is it? its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration
- 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
- 4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
- 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
- 6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels
- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Holistic Development and Role of Education https://youtu.be/sGZtTPelhQ

# Unit II

# Understanding Harmony in the Human Being - Harmony in Myself!

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' Sukh and Suvidha
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Swasthya
Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Harmony in Human Being- Self and Body https://youtu.be/0ERSMkRPQBM

Links: Harmony in Human Being- Self https://youtu.be/83oGJ4oDeIg

Links: Harmony between Self and Body Prosperity https://youtu.be/aJ\_BU2OgpKs

#### Unit III

#### Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

- 1. Understanding Harmony in the family the basic unit of human interaction
- 2. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti;
- 3. Trust (Vishwas) and Respect (Samman) as the foundational values of relationship
- 4. Understanding the meaning of Vishwas; Difference between intention and competence.
- 5. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship
- 6. Understanding the harmony in the society (society being an extension of family):
- 7. Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals
- 8. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family!

Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Harmony in Family- Trust https://youtu.be/F2KVW4WNnS8

Links: Harmony in family- Respecthttps://youtu.be/iLqNRPuv0\_8

Links: Harmony in family- Other Feeling Justice https://youtu.be/TcYJB7reKnM

Links: Harmony in the Society https://youtu.be/BkWgFinrnPw

#### Unit IV

# Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

- 1. Understanding the harmony in the Nature
- 2. Interconnectedness and mutual fulfillment among the four orders of naturerecyclability and self-regulation in nature
- 3. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space
- 4. Holistic perception of harmony at all levels of existence

Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Harmony in Nature https://youtu.be/K1Jpd\_ojydw
- Links: Harmony in Existence https://youtu.be/mormUeZ\_RUE

#### Unit V

#### Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics:
- A. Ability to utilize the professional competence for augmenting universal human order
- B. Ability to identify the scope and characteristics of people-friendly and ecofriendly production systems,
- C. Ability to identify and develop appropriate technologies and management patterns for above production systems.
  - Case studies of typical holistic technologies, management models and production systems
  - Strategy for transition from the present state to Universal Human Order:
- A. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
- B. At the level of society: as mutually enriching institutions and organizations

#### Suggested Learning Resources:

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration

#### **Text Books:**

 R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

#### **Reference Books:**

- 1. **B L Bajpai**, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
- 2. **PL Dhar, RR Gaur**, 1990, Science and Humanism, Commonwealth Publishers.
- 3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
- 4. **Ivan Illich**, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
- 5. **Donella H. Meadows, Dennis L. Meadows, Jorgen Randers**, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
- 6. **Subhas Palekar**, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
- 7. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
- 8. **E.F. Schumacher**, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
- 9. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

#### Web links and Video Lectures (e-Resources):

- 1. https://www.youtube.com/channel/UCQxWr5QB\_eZUnwxSwxXEkQw
- 2. https://www.youtube.com/watch?v=P4vjfE-YnVk&list=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZlGC4
- Course handouts: https://drive.google.com/drive/folders/1zioX\_4L2fCNX4Agw282PN86pcZZT 3Osr?usp=sharing
- 4. **Presentation slides:** https://drive.google.com/drive/folders/1rMUKh1s0HPRBlpp\_b1mpSduNRcwS6YH?usp=sharing

#### **Course Outcomes (COs):**

At the end of the course, Students will be able to:

- 1. Apprehend the need of Value Education over Human aspirations (PO-6)
- 2. Assimilate Harmony over the physical needs and to overcome the self- needs for a prosperous life. (PO-6)
- 3. Recognize the need of Harmony in the Family and Society for a better World. (PO-6)
- 4. Explain the need of mutual understanding for Holistic Harmony in all the Levels of Human Existence. (PO-6)
- 5. Explain the Holistic understanding of Harmony and Professional Ethics at Individual Level and Society. (PO-6, PO-8)

| Continuous Internal Evaluation (CIE): 50 Marks  |                 |                           |  |  |
|---|-----------------|---------------------------|--|--|
| Assessment Tool   | Marks           | Course outcomes addressed |  |  |
| Internal test-I   | 30              | CO1, CO2, CO3             |  |  |
| Internal test-II  | 30              | CO3, CO4, CO5             |  |  |
| Average of the two internal tests will be   | taken for 30    | marks.                    |  |  |
| Other components  |                 |                           |  |  |
| <ul> <li>Assignment</li> <li>Quiz</li> <li>Presentation</li> <li>Model / mini project</li> <li>Any other</li> </ul> | 20 (10 +<br>10) | CO1, CO2, CO3, CO4, CO5   |  |  |
| Semester End Examination (SEE)  | 100             | CO1, CO2, CO3, CO4, CO5   |  |  |

# ABILITY ENHANCEMENT COURSE – III<br/>(INDUSTRIAL SAFETY)Course Code: IMAEC39Credits: 1:0:0Pre – requisites: NilContact Hours: 14LCourse Coordinator: Sri Sudheer D. Kulkarni / Dr. Siddhartha Kar

#### **Course Contents**

#### Unit I

**Introduction to Industrial Safety:** Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Need for safety. Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Authority and responsibilities of Safety Officer.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation.
- Links for videos: https://www.youtube.com/watch?v=v-eltsixu4I

# Unit II

**Safety Management:** Introduction, Organization and Personnel, planning, Safety Management System, emergency preparedness, Safety Committees, Corrective Preventive action, Personal protective equipment- Types of PPEs, Personal protective equipment, respiratory and non-respiratory equipment.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation.
- Links for videos: https://www.youtube.com/watch?v=j3SKq9TTnW8&t=1195s

# Unit III

**Safety programs:** Safety procedures. Safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation.
- Links for videos: https://www.youtube.com/watch?v=NI89F0ISMog

https://www.youtube.com/watch?v=pwkjK0Zqa3w

# Unit IV

**Occupational Accidents:** Concept of an accident, reportable and non-reportable accidents, reporting to statutory authorities. Safe professional & occupational health and industrial hygiene.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation.
- Links for videos: https://www.youtube.com/watch?v=VhuZ6M7a8N8 https://www.youtube.com/watch?v=SPDKEZBsydg https://www.youtube.com/watch?v=Rr-xFmErOTk

#### Unit V

**Identification and Prevention of Hazards:** Hazard and risk, Types of hazards – Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation.
  - Links for videos: https://www.voutube.com/watch?v=O7TIXagh3gk

https://www.youtube.com/watch?v=Q711Xaqn5qk

#### **Text Books:**

- 1. Rao, S. S. (2008). Industrial Safety Health and Environment Management Systems. India: Khanna.
- 2. L M Deshmukh. Industrial Safety Management. (2005). (n.p.): Tata McGraw Hill Education Pvt. Limited.

#### **Reference Books:**

- 1. Friend, M., Kohn, J. (2007). Fundamentals of Occupational Safety and Health. United States: Government Institutes.
- 2. Industrial Safety Management: 21st Century Perspectives of Asia. (2017). Singapore: Springer Nature Singapore.
- 3. Blake, R. P. (1964). Industrial Safety. Taiwan: Prentice-Hall.

#### **Course Outcomes (COs):**

At the end of the course the student will be able to:

- 1. Identify safety related issues in work place (PO: 6, 7 & PSO-2).
- Prevent an unsafe event and manage emergency situations in work place (PO: 6, 7 & PSO-2).
- 3. Implement and practice safety procedures in his/her profession (PO: 6, 7 & PSO-2).
- 5. Apply safety procedures and ensure safe professional health and hygiene (PO: 6, 7 & PSO-2).
- 6. Identify hazards and take preventive measures (PO: 6, 7 & PSO-2).

| Continuous Internal Evaluation (CIE): 50 Marks |                                |                     |  |  |
|--|--------------------------------|---------------------|--|--|
| Assessment Tool                                | Marks                          | Course outcomes     |  |  |
|  |                                | addressed           |  |  |
| Internal Test – I                              | 30                             | CO1, CO2            |  |  |
| Internal Test – II                             | 30                             | CO3, CO4, CO5       |  |  |
| Average of the two internal t                  | tests shall be taken for 30 ma | arks                |  |  |
|  |                                |                     |  |  |
| Other Components                               | Marks                          | Course outcomes     |  |  |
|  |                                | addressed           |  |  |
| ⊠Assignments                                   | 20 (10+10)                     | CO1, CO2, CO3, CO4, |  |  |
| ⊠Quiz  |                                | CO5                 |  |  |
| □Presentations                                 |                                |                     |  |  |
| □Model/Mini Project                            |                                |                     |  |  |
| □Any other                                     |                                |                     |  |  |
|  |                                |                     |  |  |
| Semester End                                   | 50                             | CO1, CO2, CO3, CO4, |  |  |
| Examination (SEE)                              |                                | CO5                 |  |  |

# **PHYSICAL EDUCATION**

**Course Code: PE83** 

**Credits: NCMC** 

Pre – requisites: Nil

#### Course Coordinator: Dr. Kiran Kumar H K

#### **Course Contents**

#### Unit I

#### **Course Learning Objectives:**

- 1. To introduce students to the importance of physical fitness for success in any career.
- 2. To instill in them concepts of team spirit and team building
- 3. To develop positive thinking, goal setting and decision-making abilities under duress.
- 4. To harness values and skills like leadership, communication and sacrifice.
- 5. To inculcate in students, the ability to handle success and failures with equanimity.

**Selection Process:** A Student shall select any one of the following Sports based on his/her interest and the facility available. The details **of Sports Facilities available** (both indoor and outdoor) at institute campus are as below:

| Outdoo                        | r Games  | Indoor Games                |                    | Athletics  |                    |
|-------------------------------|--|-----------------------------|--------------------|--|--------------------|
| Games                         | No. of<br>Students   | Games                       | No. of<br>Students | Events   | No. of<br>Students |
| Volleyball                    | 12 x 4 = 48  | Badminton                   | 30                 | <b>Sprint</b> - 100mt, 200mt, 400mt                          |                    |
| Basketball                    | 12 x 4 = 48  | Table<br>Tennis             | 30                 | Middle distance<br>running –<br>800mt, 1,500mt               | 60                 |
| Kabaddi                       | 12 x 4 = 48  | Chess                       | 30                 | Long distance<br>running –<br>5,000mt,<br>10,000mt           |                    |
| Kho Kho                       | 12 x 4 = 48  | Weight<br>Training<br>[Gym] | 35                 | Jumping Events<br>–<br>Long Jump<br>Triple Jump<br>High Jump | 30                 |
| Throw<br>ball                 | 12 x 4 = 48  |                             |                    | Throwing<br>Events<br>Shot Put<br>Discuss<br>Javelin         | 30                 |
| Football<br>Hockey<br>Cricket | $16 \times 4 = 64$<br>$16 \times 4 = 64$<br>$16 \times 4 = 64$ | Note: Studer                | nts should b       | ring their own spor  | ts attires         |
| CIICKEL                       | $10 \times 4 = 04$   |                             |                    |  |                    |

**Contact Sessions:** A student shall abide by the following during the sessions scheduled in the semester.

#### Session 1

Fundamentals of Physical Education, value addition to personality through fitness education, discipline and team building activities, Orientation towards particular sports and skill training

#### Session 2

Formation of teams based on student's orientation and preference. Team practice and skill enhancement.

#### Session 3

Conduction of matches in all sporting events registered by Students. Evaluation of each student shall be based on their performance either in team or individual. The student representing the Institute at University/State/National/International Level will be awarded additional marks during evaluation.

#### **Course Outcomes (COs):**

- 1. Develop interest and skill in playing particular sports.
- 2. Understand the process of organizing sporting events.
- 3. Appreciate the role of fitness for a better lifestyle.
- 4. Derive lessons from sports activities for effective planning and discipline in Life.
- 5. Analyze situations and optimize end results.

- 1. A committee consisting of Sports Director and Coaches of respective Sports will be formed to observe and evaluate the students for CIE in each semester.
- 2. Students shall follow the schedules, rules and regulations as prescribed by the Committee.
- 3. Students shall mandatorily have 85% attendance to be eligible for evaluation.
- 4. All the Sessions and evaluation process will be common for all semesters of the academic year.
- 5. The final result will be reflected on the grade card of  $8^{\text{th}}$  Semester.
- 6. The final marks shall be calculated after scaling down CIE to 50 marks & combining with 50 marks for SEE.

| YOGA  |               |  |
|---|---------------|--|
| Course Code: YO83   | Credits: NCMC |  |
| Pre – requisites: Nil                                     |               |  |
| Course Coordinator: Dr. Hari Chandra B P & Dr. Parimala P |               |  |

#### **Course Contents**

#### Unit I

#### **Course Learning Objectives:**

- 1. To introduce to the students, the fundamental theoretical aspects of yoga.
- 2. To inculcate in students a habit of practicing yoga.
- 3. To be able to demonstrate basic yoga asanas.
- 4. To be able to practice fundamental breathing practices and mudras.
- 5. To understand the relevance of yoga and research in modern times.

**Introduction:** Definition of yoga, benefits, astangas of yoga, Relevance of yoga and yoga-research in modern times.

Asanas: Kriyathmakachalanas, Suryanamaskar, Superbrain yoga, Vrikshasana, Trikonasana, Veerabhadrasana, Paschimotasana, Purvothanasana, Bharadwajasana, Amruthasana, Parivruttha Trikonasana, Parsvakonasana, Ustrasana, Padmasana, Jaaanushirshasana, Navasana, Ardhachakrasana, Ardhakatichakrasana, Jataraparivarthanasana, Sethubandasana, Sarvangasana, Mathyasana, Dhanurasana, Shirshasana.

**Pranayamas:** Anuloma-Viloma, Suryanuloma, Chandranuloma, Brahmari, Suryanbedhana, Chandrabedhana, Sheetali, Seethkari, Sadantha, bastrika.

**Mudras:** Chinmudra-Jnanamudra, Praana mudra, panchaprana mudras, panchabhoota mudras, Pruthvi mudra, Shoonya mudra, Surya mudra, Jalodharanashaka mudra, Kundalini mudra, shoonyavaayu mudra, shakti mudra, sandhi mudra, vajra mudra and garuda mudra.

#### **Course Outcomes (COs):**

At the end of the course, a student will

- 1. Understand the fundamental and theoretical aspects of yoga.
- 2. Develop a habit of practicing yoga.
- 3. Demonstrate basic yoga asanas.
- 4. Demonstrate fundamental breathing practices.
- 5. Understand the relevance of yoga and its research in modern times.

#### **Reference books:**

- 1. Light on yoga, B K S Iyengar, Publisher -Thorsons, UK, 2006
- 2. Light on pranayama, B K S Iyengar, Publisher Element; First Edition
- 3. The Essential Yoga Mudras for Healing, Dr. Aasoori K. Rangaraja Iyengar, Saranga Publishing; First Edition 2021

#### Pedagogy:

• Chalk and talk, demonstration, videos, ppt.

#### **Contact Sessions:**

There would be one introduction class, and five contact classes in each semester. The candidates shall practice yoga on a daily basis, or in the worst case on alternate days at their place of residence and maintain a short diary in the format provided by yoga teacher. The same shall be brought to the classes.

#### **Online reference sources:**

- Yoga for beginners part 1: https://www.youtube.com/watch?v=VwPeThpwfWI
- Yoga for beginners part 2: https://www.youtube.com/watch?v=s\_pnJTcOp8A
- Suryanamaskar: https://www.youtube.com/watch?v=nUdlucNd6go&t=133s
- Yoga for anxiety and stress: https://www.youtube.com/watch?v=hJbRpHZr d0
- Common yoga protocol: https://www.youtube.com/watch?v=Av5ib XRKT4
- Relevance of yoga in modern times: www.youtube.com/watch?v=HUzBCts7BTo

#### **Course Assessment & Evaluation:**

- 1. A committee consisting of Yoga Instructors will be formed to observe and evaluate the students for CIE in each semester.
- 2. Students shall follow the schedules, rules, and regulations as prescribed by the Committee.
- 3. Students shall mandatorily have 85% attendance to be eligible for evaluation.
- 4. All the Sessions and evaluation processes will be common for all semesters of the academic year.
- 5. The final result will be reflected on the grade card of 8<sup>th</sup> Semester.
- 6. The final marks shall be calculated after scaling down CIE to 50 marks & combining it with 50 marks for SEE.

#### Scheme of SEE:

| Practical Demonstration | 30 marks |
|-------------------------|----------|
| Write-up                | 10 marks |
| Viva                    | 10 marks |
| Total                   | 50 marks |

# NATIONAL SERVICE SCHEME

Course Code: NS83

**Credits: NCMC** 

Pre – requisites: Nil

creans: NCI

Course Coordinator: Dr. Puttabore Gowda & Dr. Siddaraju C

# **Course Contents**

# Unit I

# **Course Learning Objectives:**

- 1. To introduce students to the importance of national service
- 2. To harness values and skills like leadership, teamwork and sacrifice.
- 3. To serve society through educational services and health
- 4. To work towards rural and local development through technological services
- 5. To inculcate in students, the ability to handle socially relevant projects.

# Students shall involve in activities related to national and regional technical and non-technical services, as listed below.

- Serving society by bringing awareness on education and cleanliness.
- Blood donation camps
- Developing technologies for rural masses.
- Conduction and participation in camps for a social cause.
- Educating towards health and well-being of individuals/society.
- Cultural and educational programs for society.
- Contributing towards the improvement of civil services and bringing certain shortcomings to the notice of higher authorities for suitable remedial actions.
- Contribution towards traffic management and other public services.
- Clean up and development of water sources around public places.
- Services during a disaster or other needy situations.
- Camps for the rejuvenation of lakes and water bodies.
- Serving nature and agriculture.
- Awareness programs on health and food adulteration.
- Presenting papers/talks in various fora on the above topics.
- Developing technologies for rural masses beyond academic requirements.
- Plantation programs.
- Conducting programs for self-sustainability, and human and national development.

- Contribution towards orphans and challenged individuals through well-recognized organizations.
- Carrying out designated activities in villages.
- Development and implementation of strategies for solid waste, E-waste etc.
- Education towards pollution control and traffic management.
- Production of documentaries and short films/videos for motivating people on any of the above causes.

#### **Course Outcomes (COs):**

At the end of the course, a student will be able to

- 1. Understand the importance of national service.
- 2. Gain skills like leadership and teamwork.
- 3. Volunteer towards educational services and health.
- 4. Contribute to rural and local development through technical services.
- 5. Comprehend socially relevant projects

#### **Contact Sessions:**

The students shall attend the review and contact sessions as scheduled by the course coordinator.

- 1. The candidates shall maintain a record of activities in a Diary, and get them endorsed during the contact sessions at least 3 times in a semester.
- 2. A detailed project report should be submitted during the last fortnight of the semester
- 3. Evaluation will be done during each semester based on the nature of the contribution.
- 4. The final marks shall be calculated after scaling down CIE to 50 marks & combining with 50 marks for SEE

# **ADDITIONAL MATHEMATICS – I**

Course Code: AM31 Pre – requisites: Nil Credits: 0:0:0 Contact Hours: 42L

Course Coordinator: Dr. Shashi Prabha Gogate S

#### **Course Content**

#### Unit I

**Differential Calculus:** Successive differentiation, nth derivatives of some standard functions, Leibnitz theorem, Polar curves. Angle between the radius vector and the tangent, angle between curves, length of the perpendicular from pole to the tangent, pedal equations. Taylor's and Maclaurin's expansions.

- Pedagogy / Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105121/ https://nptel.ac.in/courses/111/104/111104144/
- Impartus recording: -https://a.impartus.com/ilc/#/course/107625/1030

#### Unit II

| Integral | Calculus: | Introduction, | Reduction | formula, | Reduction    | formula   |
|----------|-----------|---------------|-----------|----------|--------------|-----------|
| for 🗙    | , 🗙       | and           | ]         | . Eval   | uation of do | ouble and |
|          |           |               |           |          |              |           |

triple integrals.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/111/105/111105121/ https://a.impartus.com/ilc/#/course/107625/1030

#### Unit III

**Vector Algebra:** Scalar and vectors. Vector addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple product-simple problems. Vector functions of a single variable. Derivative of a vector function, geometrical interpretation. Velocity and acceleration.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/111/105/111105134
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

#### Unit IV

**Vector Differentiation:** Scalar and vector fields, gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of avector field, irrotational vector. Laplace's operator. Vector identities connected with gradient, divergence and curl.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: https://nptel.ac.in/courses/111/105/111105134
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

#### Unit V

**First Order Differential Equations**: Solution of first order and first degree differential equations, variable separable methods, homogeneous equations, linear and Bernoulli's equations, exact differential equations.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/59742/295

#### **Text Books:**

- 1. **B.S. Grewal** Higher Engineering Mathematics, Khanna Publishers, 44<sup>th</sup> edition, 2017.
- 2. **Erwin Kreyszig** Advanced Engineering Mathematics Wiley Publication, 10<sup>th</sup> Edition, 2015.

#### **Reference Books:**

- 1. H. K. Dass Higher Engineering Mathematics S Chand Publications, 1998.
- B. V. Ramana Engineering Mathematics Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008.

#### **Course Outcomes (COs):**

At the end of the course the student will be able to

- 1. Solve problems related to nth derivative to some standard functions, polar curves and power series expansions. (PO-1,2)
- 2. Apply the concept of reduction formula to determine the length, area, volume of revolution of an arc of the curve. (PO-1,2)
- 3. Solve the problems related to velocity and acceleration. (PO-1,2)
- 4. Apply vector differentiation to identify solenoidal and irrotational vectors. (PO-1,2)
- 5. Apply the concept of various methods to solve first order first degree differential equations. (PO-1,2)

| Continuous Internal Evaluation (CIE): 50 Marks                 |       |                           |  |  |
|--|-------|---------------------------|--|--|
| Assessment Tool  | Marks | Course outcomes addressed |  |  |
| Internal test-I  | 30    | CO1, CO2, CO3             |  |  |
| Internal test-II   | 30    | CO3, CO4, CO5             |  |  |
| Average of the two internal tests shall be taken for 30 marks. |       |                           |  |  |
| Other components   | Marks | Course outcomes addressed |  |  |
| Quiz   | 10    | CO1, CO2, CO3             |  |  |
| Assignment   | 10    | CO3, CO4, CO5             |  |  |

# **IV SEMESTER**

| COMPUTATIONAL | <b>TECHNIQUES AN</b> | <b>ND GRAPH THEORY</b> |
|---------------|----------------------|------------------------|
|---------------|----------------------|------------------------|

| Course Code: IM41                                     | Credits: 2:1:0         |  |
|---|------------------------|--|
| Pre – requisites: Nil                                 | Contact Hours: 28L+14T |  |
| Course Coordinator: Mr. B. Azghar Pasha& Dr. Sowmya G |                        |  |

#### **Course Content**

#### Unit I

**Interpolation:** Piecewise linear, quadratic and cubic interpolation, Cubic spline interpolation. Hermite interpolation.

**Curve Fitting:** Curve fitting by the method of least squares, fitting linear, quadratic and geometric curves,

#### Problem solving/demonstration of methods using any open source software.

- Pedagogy/Course delivery tools: Chalk and talk
- Online tools: Use of open source software to demonstrate methods and solve problems on interpolation
- Links: https://nptel.ac.in/courses/111/106/111106101/
- Impartus recording: https://a.impartus.com/ilc/#/course/96127/452 https://a.impartus.com/ilc/#/course/132243/636

#### Unit II

**Bivariate Interpolation:** Lagrange's bivariate interpolation. Newton's bivariate interpolation.

Numerical Differentiation: Derivatives using finite differences of higher order.

**Numerical Integration:** Gauss Legendre one point, two point and three point techniques. Romberg integration.

#### Problem solving/demonstration of methods using any open source software.

- Pedagogy/Course delivery tools: Chalk and talk
- Online tools: Use of open source software to demonstrate methods and solve problems on numerical differentiation and integration.
- Links: https://nptel.ac.in/courses/111/106/111106101/
- Impartus recording: https://a.impartus.com/ilc/#/course/96127/452

https://a.impartus.com/ilc/#/course/132243/636

#### Unit III

**Fundamentals of Graph Theory:** Types of graphs, connected & disconnected graphs, Isomorphic graphs, Operations on Graphs, Euler graphs, Hamiltonian Paths and Circuits. Trees, properties of trees, Rooted & Binary Trees, Spanning trees and fundamental circuit.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111106050 https://nptel.ac.in/courses/106104170 https://nptel.ac.in/courses/111106102

#### Unit IV

**Cut-sets & Planarity:** Cut-sets, Properties of cut-sets, fundamental cut-sets, connectivity and separability, Planar graphs, homeomorphic graphs, Kurutowski's theorem (no proof), Elementary reduction of graphs in the detection of planarity. **Directed graphs:** Types of digraphs, binary relations on digraph, Euler digraph, Arborescence, strongly and weakly connected digraphs, condensation of a digraph.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111106050 https://nptel.ac.in/courses/106104170 https://nptel.ac.in/courses/111106102

#### Unit V

**Applications of Graph Theory**: Konigsberg Bridge problem, Travelling salesman problem, Seating arrangement problem. Prim's and Kruskal's algorithm for minimal spanning tree. Dijkstra's algorithm. Matrix representation of graphs - Incidence Matrix, circuit Matrix, cut-set matrix, reduced incidence matrix, fundamental circuit matrix and fundamental cut-set Matrix. Path and adjacency matrix. Application to Transport network – Max flow & Min-cut theorem. Application of Graph theory in Markov processes.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111106050 https://nptel.ac.in/courses/106104170 https://nptel.ac.in/courses/111106102

#### **Text Books:**

- 1. **B.S. Grewal** Higher Engineering Mathematics, Khanna Publishers, 44<sup>th</sup> edition, 2017.
- 2. **Narsingh Deo** Graph theory with Application to Engineering and Computer science, PHI Learning Private Limited, 2010.

#### **Reference Books:**

- Richard. L. Burden, J. Douglas Faires, Annette M. Burden Numerical Analysis, Brooks Cole - 10<sup>th</sup> edition, 2015.
- M.K. Jain, S.R.K. Iyengar and R.K. Jain Numerical methods for scientific and Engineering computation – New Age International Publisher, 6<sup>th</sup> edition, 2012.
- 3. J. A. Bondy and U.S.R. Murty Graph theory, Springer, 2008.
- 4. **R. Diestel**, Graph theory, 5<sup>th</sup> edition, Springer, 2017.

#### **Course Outcomes (COs):**

At the end of the course the student will be able to

- 1. Fit a curve to a given data using interpolation and least squares technique. (PO-1, 2 & PSO-1)
- 2. Find derivative and integral of a given data numerically. (PO-1, 2 & PSO-1, 2)
- 3. Analyse different types of graphs and perform operations on graphs. (**PO-1.2 & PSO-1.2**)
- 4. .Find cut-sets, planar graphs and determine spanning arborescence of a digraph. (**PO-1, 2 & PSO-1, 2**)
- 5. Analyse the characteristics of graphs through their matrix representations and solve application problems. (PO-1, 2 & PSO-1, 2)

| Continuous Internal Evaluation (CIE): 50 Marks                |          |                                   |  |  |
|---|----------|-----------------------------------|--|--|
| Assessment Tool   | Marks    | Course outcomes addressed         |  |  |
| Internal test-I   | 30       | C01,C02,C03                       |  |  |
| Internal test-II  | 30       | CO3,CO4,CO5                       |  |  |
| Average of the two internal tests shall be taken for 30marks. |          |                                   |  |  |
| Other components  | Marks    | Course outcomes addressed         |  |  |
| other components  |          | Course outcomes addressed         |  |  |
| Quiz  | 10       | CO1,CO2,CO3                       |  |  |
| Quiz<br>Assignment  | 10<br>10 | CO1,CO2,CO3           CO3,CO4,CO5 |  |  |
| Quiz<br>Assignment  | 10<br>10 | CO1,CO2,CO3           CO3,CO4,CO5 |  |  |

# **OPERATIONS RESEARCH**

| Course Code: IM42                                     | Credits: 2:0:1         |  |  |
|---|------------------------|--|--|
| Pre – requisites: Nil                                 | Contact Hours: 42L+14T |  |  |
| Course Coordinator: Dr. G S Prakash / Dr. Sridhar B S |                        |  |  |

#### **Course Content**

#### Unit I

**Introduction:** OR methodology, Definition of OR, Application of OR to engineering and Managerial problems, Features of OR models, Limitation of OR, Models of OR. **Linear Programming: Definition**, Mathematical formulation, standard form, Solution space, solution – feasible, basic feasible, optimal, infeasible, multiple, optimal, Redundancy, Degeneracy. Graphical method. Product mix problems.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://elearning.vtu.ac.in/econtent/courses/video/IPIM74.html

#### Unit II

**Linear Programming: Simplex** method, variants of simplex algorithm – Artificial variable techniques, Duality concept.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://elearning.vtu.ac.in/econtent/courses/video/IPIM74.html

#### Unit III

**Transportation Problem: Formulation** of transportation model, Basic feasible solution using different methods (North-West corner, Least Cost, Vogel's Approximation Method) Optimality Methods. Unbalanced transportation problem, Degeneracy in transportation problems.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://elearning.vtu.ac.in/econtent/courses/video/IPIM74.html

#### Unit IV

**Assignment Problem: Formulation** of the Assignment problem, unbalanced assignment problem, Typical Assignment problems, Traveling salesman problem.

**Project Management**: Network construction, determination of critical path, project duration and floats. PERT - estimation of project duration and variance.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://elearning.vtu.ac.in/econtent/courses/video/IPIM74.html

#### Unit V

**Queuing Theory: Queuing** system and their characteristics, The M/M/I Queuing system, Steady state performance analyzing of M/M/1 queuing model.

**Game Theory: Formulations** of games, two person zero sum game, games with and without saddle point, graphical solutions (2x n, mx2 game), and dominance property.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://elearning.vtu.ac.in/econtent/courses/video/IPIM74.html

#### Lab component: Using TORA Software/ Excel:

- 1. Introduction to optimization problems and software.
- 2. Formulation of LPP and solving LPP using software (Minimization problem)
- 3. Formulation of LPP and solving LPP using software (Maximization problem)
- 4. Formulation of Transportation problems and solving.
- 5. To solve an assignment problem.
- 6. To solve traveling salesman problems

#### **Text Books:**

- 1. Taha-Operation Research an Introduction,ISBN-81-203-3043-9, 8<sup>th</sup> Edition, 2006.
- 2. Ravindran, Philips and Soleberg-Operations Research Principles and practice, John Wiley & Sons, ISBN-13 978-81-265-1256-0, 2nd Edition-2007.
- 3. Operation Search, Kanti Swarup, Publisher: Sultan Chand & Sons ,ISBN: 9788180549090, 8180549097, Edition: 2014.

#### **References:**

- Hiller and Libermann-Introduction to Operation Research, Mc Graw NHill 5<sup>th</sup>edn. -2000
- 2. J K Sharma -Operations Research Theory and Application, Pearson Education Pvt Ltd,2<sup>nd</sup>Edn, ISBN-0333-92394-4-2006

#### Web links and video lectures (e-Resources)

- 1. https://onlinecourses.nptel.ac.in/noc20\_ma45/preview
- 2. https://nptel.ac.in/courses/110106062
- 3. https://nptel.ac.in/courses/112106131

#### **Course Outcomes (COs):**

At the end of the course, student will be able to

- 1. Appreciate the wide applicability of operations research technology from agriculture to defense, covering almost all domains of science, arts, commerce and technology. (PO-1, PSO-1)
- 2. Build the optimum solution for numerous problems of operations research by systematic defining, formulating, analyzing, developing an optimum solution and further refining the solution using simplex method. (PO-1, PO-2, PO-3, PSO-2)
- 3. Obtain optimum cost /profit by the application of transportation algorithm. (PO-1, PO-2, PO-3, PSO-2)
- 4. Develop minimum cost and maximum profit solutions to Assignment and travelling salesman problems. Optimize the project duration and cost using PERT/CPM techniques. (PO-1, PO-2, PO-3, PSO-2)
- 5. Provide probabilistic and heuristic solutions for real life problems using the Queuing and Game theory models. (PO-1, PO-2, PO-3, PSO-2)

| Continuous Internal Evaluation (CIE): 50 Marks                                  |       |                           |  |  |
|---|-------|---------------------------|--|--|
| Assessment tool   | Marks | Course outcomes addressed |  |  |
| Internal test-I   | 30    | CO1, CO2                  |  |  |
| Internal test-II 30 CO3, CO4, CO5   |       |                           |  |  |
| Average of the two internal tests will be considered for evaluation of 30 Marks |       |                           |  |  |
| Other components- 20 Marks  |       |                           |  |  |
| Assignment  | 10    | CO1, CO2, CO3, CO4, CO5   |  |  |
| Quiz  | 10    | C01,C02, C03, C04, C05    |  |  |
| Semester End Examination (SEE)  | 100   | CO1, CO2, CO3, CO4,CO5    |  |  |

# MECHANICAL MEASUREMENTS AND METROLOGY

| Course Code: IM43                                       | Credits: 3:0:0     |
|---|--------------------|
| Pre – requisites: Nil                                   | Contact Hours: 42L |
| Course Coordinator: Dr. R. Shobha / Dr. M.R. Shivakumar |                    |

#### **Course Content**

#### Unit I

**Standards of Measurement:** Definition and objectives of metrology, Standards, standards of length, International prototype meter, Wavelength standard. Slip gauges, Wringing phenomena, Numerical problems on building of slip gauges.

**Measurements and Measurement System:** Definition, methods of measurements, generalized measurement system. Definition and concept of accuracy, precision, sensitivity, Calibration, threshold. Concepts of hysterics, repeatability, Linearity and Loading effect. Errors in measurement, classification of errors.

- Pedagogy/Course delivery tools: Chalk and talk. Power point presentation, Videos
- Lab components/Practical topics: Slip gauges, measuring system
- Links: Standards https://www.youtube.com/watch?v=oCkaxMI19X8
- Mechanical measurements https://www.youtube.com/watch?v=U8y48L\_qn6E,impartus RIT

#### Unit II

**Systems of Limits, Fits, Tolerances and Gauging:** Introduction, Definition of Tolerance, Principle of Inter changeability and selective assembly, concepts of limits of size and tolerance, definition of fit, Different types of fit, Hole basis system and shaft basis system. Introduction to gauges, classification of gauges, design of gauges using Taylor's Principle. Introduction to surface roughness.

- Pedagogy/Course delivery tools: Chalk and talk. Power point presentation, Videos
- Lab components/Practical topics: Gauges/Surface roughness tester
- Links: Systems of Limits, Fits https://www.youtube.com/watch?v=6jWLImflG1Y Surface roughness - https://www.youtube.com/watch?v=U8y48L\_qn6E

#### Unit III

**Comparators:** Need of comparator, Characteristics, classification and advantages, Dial gauge, Johansson Mikrokator, Zeiss Ultra – Optimeter.

**Angle measurements and interferometry:** Introduction, sine bar- principle of sine bar, Errors in sine bar. Principle of interferometry, optical flat, principle of autocollimator. **Screw thread and gear measurement**: Terminology of screw threads, measurement of major diameter, Measurement of Minor diameter and pitch. Measurement of angle and effective diameter of screw threads by 2– wire method, Profile projector-working principle, Tool maker's microscope – construction and working principle. Gear terminology, Parkinson gear tester- construction. Use of gear tooth vernier calliper and gear tooth micrometer.

- Pedagogy/Course delivery tools: Chalk and talk. Power point presentation, Videos
- Lab components/Practical topics: Dial gauge, Sine bar, optical flat, autocollimator, floating carriage diameter measuring instrument, profile projector, took maker's microscope, Parkinson gear tester
- Links: Comparator https://www.youtube.com/watch?v=5YLvHXMr7f4 Interferometry - https://www.youtube.com/watch?v=Qv5YzrqL6sU Screw thread measurements - https://www.youtube.com/watch?v=xPGi2e-gOo8

#### Unit IV

**Coordinate measuring machine-** Features of CMM, performance of CMM, application and advantages of CMM.

**Transducer:** Classification of transducers, mechanical transducers-mechanical springs, pressure sensitive elements, Electrical transducers- resistive transducers, strain gauge, LVDT.

**Measurement of Force, torque and pressure:** Analytical balance, Platform balance. Proving ring – sketch and working principle. Torque measurement-Prony brake dynamometer, Basic bourdon tube, Elastic diaphragms. McLeod Vacuum gauge – working principle.

- Pedagogy/Course delivery tools: Chalk and talk. Power point presentation, Videos
- Lab components/Practical topics: CNC-CMM, LVDT
- Links: CMM https://www.creaform3d.com/blog/what-is-cmm-and-theirtypes/ Transducers - https://gmw.com/transducers/ Measurement of Force, and pressure https://www.fierceelectronics.com/components/pressure-measurementprinciples-and-practice

#### Unit V

**Temperature Measurement:** Resistance thermometers – sketch and working principles, Thermocouple, Laws of thermocouple, Optical Pyrometer.

**Strain gauges** – Mechanical strain gauge, optical strain gauge, Electrical resistance strain gauges-bonded type.

**ISO: Concepts and Practices:** Introduction, What is system?, Summary of elements of ISO 9001, Advantages of Adopting ISO 9000, Registration of ISO 9000, Validity of registration, preparation, organizing documentation and metrological requirements of ISO 9000 standards.

- Pedagogy/Course delivery tools: Chalk and talk. Power point presentation, Videos
- Lab components/Practical topics: Thermocouple
- Links:

https://www.cedengineering.com/userfiles/Principles%20and%20Methods%20 of%20Temperature%20Measurement-R1.pdf

Strain gauge - https://www.sciencedirect.com/topics/engineering/mechanical-strain https://www.iso.org/obp/ui/#iso:std:iso:9000:ed-4:v1:en

#### **Text Books:**

- 1. R K Jain, Engineering metrology, Khanna Publications, 21st Edition.
- Beckwith -Margangoni and Lienhard Mechanical Measurements, 6<sup>th</sup> Edition, Pearson Education Asia, 2020
- 3. I.C. Gupta **-Engineering Metrology**, Dhampat Rai Publications, 7<sup>th</sup> edition, 2013.

#### **References:**

- 1. Doebelin -Mechanical Measurements, THM, 5<sup>th</sup> adetion, 2003
- 2. ALsutko Jerry D. Faulk -Industrial Instruments, Thompson Asia Pvt. Ltd. 2002.

#### Web links and Video Lectures (e-Sources):

- 1. https://nptel.ac.in/courses/112106138
- 2. https://onlinecourses.nptel.ac.in/noc19\_me70/preview
- 3. https://a.impartus.com/ilc/#/course/119876/593

#### **Course Outcomes (COs):**

At the end of 5the course, students will be able to

- 1. Apply the concepts of metrology and measurements in industries. (PO-1, PO-3, PSO-1)
- 2. Design the inspection gauges. (PO-1, PO-2, PO-3, PSO-1)
- 3. Use the metrology instruments in angle measurements, screw thread measurements, gear measurements and measurements using CMM. (PO-1, PO-2, PO-5, PSO-1, PSO-2)
- 4. Understand the use of transducers in measurements and working of torque, force and pressure measuring instruments. (PO-1, PO-2, PO-5, PSO-1, PSO-2)
- Understand the concept of temperature and strain measurement and able to develop ISO procedure in metrology and measurements. (PO-5, PO-6, PO-10, PSO-1, PSO-2, PSO-3)

| Continuous Internal Evaluation (CIE): 50 marks            |       |                           |
|---|-------|---------------------------|
| Assessment tool   | Marks | Course outcomes addressed |
| Internal Test-1   | 30    | CO1, CO2                  |
| Internal test Test-II                                     | 30    | CO3, CO4, CO5             |
| Average of two internal tests shall be taken for 30 marks |       |                           |
| Other Components  |       |                           |
| Assignment  | 10    | CO1, CO2, CO3, CO4, CO5   |
| Quiz/Surprise test/ Assignment                            | 10    | CO1, CO2, CO3, CO4, CO5   |
| Semester End Examination (SEE)                            | 100   | CO1, CO2, CO3, CO4, CO5   |

# FACILITIES PLANNING AND DESIGN

Course Code: IM44 Pre – requisites: Nil Credits: 3:0:0 Contact Hours: 42L

Course Coordinator: Dr. M Rajesh / Dr. Shilpa M

#### **Course Content**

#### Unit I

**Plant Location and layout:** Factors influencing plant location, location economics - problems. Objectives of plant layout, Principles of plant layout, Line Balancing-Problems.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Plant Location and layout https://www.youtube.com/watch?v=x8WBqsMLF8A

#### Unit II

**Material Handling:** Objectives and principles of Material handling, Unit load concept, classification and types of material handling equipment, Modern material handling concepts and equipment, RFID. Muther's Systematic Layout Planning procedure – problems

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Material Handling https://www.youtube.com/watch?v=Up1oSSJn6oM

# Unit III

**Space Determination and Area Allocation:** Factors for consideration in space planning, area allocation factors to be considered, Plot plan, Sequence demand Straight line and non-directional methods – Analytical treatment. Determination of manpower and equipment requirement, use of travel chart for layout planning, analytical treatment.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Space Determination and Area Allocation https://www.youtube.com/watch?v=IBeubZYAGLU

#### Unit IV

Layout Evaluation: Methods of constructing the layout, efficiency indices.

Layout models: Single facility and multi facility location models, warehouse design.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Layout Evaluation https://www.youtube.com/watch?v=xk7hS8zCHgA

#### Unit V

**Computer Aided Layout:** Introduction to CRAFT, COFAD, PLANET, CORELAP and ALDEP – Analytical treatment.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Computer Aided Layout https://www.youtube.com/watch?v=q8xxKVtRbws

# **Text Books:**

- 1. James M Apple -Plant Layout and Material handling, 2<sup>nd</sup> Edition, John, Wiely and Sons. 2017-Reprint
- 2. Francies, R.L. and White, J.A **-Facility layout and Location**, Mc Graw Hill, 2<sup>nd</sup> edition. 2015
- 3. Tompkins J A and White **-A Facilities planning**, Wiley; 3<sup>rd</sup> edition, November 11, 2002

# **References :**

- 1. Muther Richard -Practical layout, Mc Graw Hill-1955.
- Sunderesh Heragu -Facilities Design, PWS Publishing Company, ISBN-0-534 - 95183.
- 3. James M Moore -Plant Layout Design, Mac Millan Co.1962 LCCCN61-5204.

# Web links and video lectures (e-Resources):

- 1. https://www.youtube.com/watch?v=ZwGXOoiToTA
- 2. https://www.youtube.com/watch?v=aSd8Hbg-tuY&list=PLLy\_2iUCG87A-kHGx4YUY97ShTTqBfA6-

#### **Course outcomes**

At the end of the course, students will be able

- 1. Identify the optimal location and layout from the alternatives. (PO-2,3& PSO2)
- 2. Aware of the different types of modern material handling equipment's for their use in the industry. (PO-5& PSO1)
- 3. Enhance productivity of the organization by efficient usage of men, materials and equipment's. (PO-1,2& PSO3)
- 4. Evaluate the layout efficiency. (PO-1,4& PSO3)
- 5. Use computer algorithms to design plant layouts. (PO-5,11& PSO1)

| Continuous Internal Evaluation (CIE): 50 Marks               |       |                          |
|--|-------|--------------------------|
| Assessment tool  | Marks | Course outcomes attained |
| Internal Test-I  | 30    | CO1, CO2                 |
| Internal Test-II   | 30    | CO3, CO4, CO5            |
| Average of the two internal test shall be taken for 30 marks |       |                          |
| Other components   |       |                          |
| Assignment   | 10    | CO1, CO2, CO3, CO4, CO5  |
| Quiz/Surprise test/ Assignment                               | 10    | CO1, CO2, CO3, CO4, CO5  |
| Semester End Examination (SEE)                               | 50    | CO1, CO2, CO3, CO4, CO5  |

# APPLIED PROBABILITY AND STATISTICS

| Course Code: IM45     |
|-----------------------|
| Pre – requisites: Nil |

Credits: 2:1:0 Contact Hours: 28+14T

Course Coordinator: Dr. M Shilpa / Dr. Niranjan C A

#### **Course Content**

#### Unit I

**Introduction to statistics:** Measure of central tendency and dispersion, Tabular and Graphical display-Histogram, Ogive curve, Box plot, Stem and Leaf plot

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111106112

https://nptel.ac.in/courses/111105041 http://elearning.vtu.ac.in/econtent/courses/video/MBA/MBA23.html

# Unit II

#### **Random Variables and Probability distributions:**

**Discrete Random Variables and Probability distributions:** Introduction to Discrete Random variables (No analytical treatment), Discrete probability distributions - Binominal distribution, Poisson distribution, Uniform distribution, Applications.

**Continuous Random Variables and Probability Distributions:** Introduction to Continuous random variables (No analytical treatment), Continuous Probability distributions - Exponential Distribution, Normal distribution

Central Limit Theorem

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/117105085 https://nptel.ac.in/courses/111105041 http://elearning.vtu.ac.in/econtent/courses/video/MBA/MBA23.html

# Unit III

Sampling Distributions – Introduction (simple problems)

**Statistical Intervals for single sample** – Confidence interval Estimation on mean of a Normal distribution, variance known and variance unknown.

**Tests of hypotheses -** Introduction, Tests on the mean of a Normal distribution, Tests of hypotheses on means of two normal distributions, Goodness of fit test on Uniform, Binomial and Poisson distributions

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111105041 http://elearning.vtu.ac.in/econtent/courses/video/MBA/MBA23.html

#### Unit IV

**Regression and Correlation:** Simple Linear Regression Analysis, correlation coefficient, Karl Pearson and Spearman's coefficients, Coefficient of Determination, Multiple linear Regression (2 independent variables)

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111105042 https://nptel.ac.in/courses/111104074 http://elearning.vtu.ac.in/econtent/courses/video/MBA/MBA23.html

#### Unit V

**Design of Experiments:** Introduction, terminologies, principles of experimental design, Introduction to ANOVA (simple problems)

**Introduction to Big data**: Definition of data science, Characteristics of Big Data, Categorization of Analytical methods Data, Visualization, Multivariate Statistics Missing Data, Outliers, Normality, Linearity, and Homoscedasticity (no analytical treatment)

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111104075 https://nptel.ac.in/courses/110105087

#### **Text Books:**

- 1. William W Hines, Douglas C Montgomery -Probability and Statistics in Engineering, John Wiley and Sons, 2<sup>nd</sup> Edn.
- 2. Richard I Levin, David S Rubin -Statistics for Management, Prentice Hall India, ISBN-81- 203-0893-X, 6<sup>th</sup> Edn.

#### **References:**

- 1. George C Runger-Applied statistics and Probability for Engineers, John Wiley and Sons, ISBN-0-471-17027-5, 2ndEdn.
- Douglas C. Montgomery, George C. Runger, Norma F. Hubele, "Engineering Statistics", John Wiley and Sons, 5th Edn, ISBN-13: 978-0470631478 ISBN-10: 0470631473 year: 2010
- 3. Schaum's Outline of Statistics, 5th Edition (Schaum's Outlines) March 14,

2014, ISBN- 13: 978-0071822527 ISBN-10:0071822526

- 4. Daniel, Terrell -Business Statistics for Management and Economics, Houghton Mifflin Company, ISBN-0-395-62835-0, 6thEdn.
- 5. Walpole & Mayer -Probability and Statistics, MacMillan Publishing Company, 1989.
- 6. Probability and Statistics for Engineers. Richard A. Johnson, Irwin Miller, John Freund

#### **Course Outcomes (COs):**

At the end of the course, student will be able to

- 1. Collect, organize and analyze the data in the real life situation and represent the data in graphical form (PO-1,2 &PSO-2)
- 2. Apply the correct probability distribution for the given situation to determine the probability (PO-5 &PSO-2)
- 3. Set up, test and make decisions about hypotheses when uncertainty exists. (PO-2,5&PSO-1)
- 4. Identify the degree and direction of relationship among process variables and develop appropriate regression models for the same. (PO-1,5&PSO-1)
- 5. Perform Analysis of Variance for simple experimental designs and understand the importance for big data in real world situation

| Continuous Internal Evaluation (CIE): 50 Marks                                  |       |                           |
|---|-------|---------------------------|
| Assessment tool   | Marks | Course outcomes addressed |
| Internal test-I   | 30    | CO1, CO2                  |
| Internal test-II  | 30    | CO3, CO4, CO5             |
| Average of the two internal tests will be considered for evaluation of 30 Marks |       |                           |
| Other components- 20 Marks  |       |                           |
| Assignment  | 10    | CO1, CO2, CO3, CO4, CO5   |
| Surprise test   | 10    | CO1, CO2, CO3, CO4        |
| Semester End Examination (SEE)  | 100   | C01,C02, C03, C04, C05    |

# MECHANICAL MEASUREMENTS AND METROLOGY LAB

| Course Code: IML46                                     | Credits: 0:0:1     |
|--|--------------------|
| Pre – requisites: Nil                                  | Contact Hours: 14P |
| Course Coordinator: Dr. M R Shivakumar / Dr. R. Shobha |                    |

#### **Course Content**

#### Unit I

- 1. Demonstration of optical flats, clinometers, load cell, stroboscope, slip gauges, sine bar, drill tool and lathe tool dynamometers.
- 2. Measurements of gear elements using Toolmaker's microscope.
- 3. Measurements of angle using autocollimator.
- 4. Measurement of screw thread elements using floating carriage diameter measuring instruments.
- 5. Alignment test on drilling machine.
- 6. Testing of gear concentricity using Parkinson gear tester.
- 7. Measurement of thread parameters using profile projector.
- 8. Calibration of dial gauge using standard LVDT.
- 9. Calibration of LVDT using micrometer.
- 10. Determination of elastic modulus using strain gauges.
- 11. Determination of thermal expansion of metal specimen.
- 12. Calibration of CMM using standard sphere.
- 13. Measurement of specimen dimensions in CMM using MCS.
- 14. Measurement of specimen dimensions in CMM using PCS.

#### **References:**

- Beckwith -Margangoni and Lienhard Mechanical Measurements, Prentice Hall Publishers, 6<sup>th</sup> Edition, 2006.
- 2. I.C. Gupta **-Engineering Metrology**, Dhampat Rai Publications, 7<sup>st</sup> edition, 2013.
- 3. R K Jain, Engineering Metrology, Khanna Publications, 8th Edition, 2002.
- 4. AC DMIS EXT Version Guide AEH Industrial Metrology Company limited.
- 5. Quadra Check 200 Users Guide Metronics, Inc., Bedford, New Hampshire, USA.
- 6. J.F.W. Galyerand C.R. Shotbolt– "Metrology for Engineers", 5<sup>th</sup> edition. Published by London: Cassell, 1990.

#### Web links and Video Lectures (e-sources):

- 1. https://kkwmqclab.blogspot.com/2020/08/experiment-no-4-measurement-of-thread.html
- 2. https://www.ijariit.com/manuscripts/v3i6/V3I6-1241.pdf
- 3. https://www.keyence.co.in/ss/products/measure-sys/measurement-selection/type/3d.jsp

#### **Course Outcome (COs):**

- 1. Perform measurement precisely using various measuring devices. (PO-1, PO-2, PSO-1)
- 2. Develop calibration methods to the various measuring devices. (PO-1, PO-2, PO-3, PSO-1)
- 3. Compare and contrast the measuring equipment required for various applications in industry. (PO-4, PO-5, PSO-1, PSO-2)
- 4. Interpret the measured results. (PO-4, PO-5, PSO-1, PSO-2)
- 5. Solve the measurement related problems encountered in industries. (PO-4, PO-5, PSO-2)

| Continuous Internal Evaluation (CIE): 50 marks |       |                           |
|--|-------|---------------------------|
| Assessment tool                                | Marks | Course outcomes addressed |
| Weekly evaluation of laboratory                |       |                           |
| manuals/ records after the conduction          | 30    | CO1, CO2, CO3, CO4, CO5   |
| of every experiment                            |       |                           |
| Practical test                                 | 20    | CO1, CO2, CO3, CO4, CO5   |
| Semester End Examination (SEE)                 | 50    | CO1, CO2, CO3, CO4, CO5   |

# APPLIED PROBABILITY AND STATISTICS LAB

| Course Code: IML47                                  | Credits: 0:0:1     |
|---|--------------------|
| Pre – requisites: Nil                               | Contact Hours: 14P |
| Course Coordinator: Dr. M. Shilpa /Dr. Niranjan C A |                    |

#### **Course Content**

#### Unit I

#### Part - A

#### Software: MS Excel

- 1. Determining the measures of central tendency and dispersion of a given process
- 2. Graphical/ Pictorial representation of data Histogram, Ogive curve, Bar Chart, Column chart, Pie chart, Line chart
- 3. Interval estimation and hypothesis testing on single population mean
- 4. Interval estimation and hypothesis testing on Two population means
- 5. Interval estimation and hypothesis testing on single population Proportion
- 6. Construction of scatter plot and determination of Karl Pearson's correlation coefficient
- 7. Determination of Spearman's Correlation Coefficient
- 8. Conduction of simple linear regression analysis
- 9. Conduction of ANOVA to test significance of regression
- 10. Testing the goodness of fit using Normal distribution
- 11. Testing the goodness of fit using Binominal distribution
- 12. Testing the goodness of fit using Poisson distribution
- 13. Testing the goodness of fit using Uniform distribution (for experiments 10-13, calculations through MS Excel)

#### Part - B

#### Software: SYSTAT statistical software package and Python

- 1. Determination of basic statistics and construction of histogram for a given quality Characteristic
- 2. Construction of Box Plot and Density Dot Graph
- 3. Determining the probability for discrete probability distributions –Hyper Geometric, Binominal and Poisson distributions
- 4. Determining the probability for Continuous probability distributions Normal and Exponential distributions
- 5. Generation of random samples for the probability distributions Poisson, Binomial, Normal and Exponential distributions

- 6. Interval estimation and Hypothesis testing on single population mean.
- 7. Interval estimation and Hypothesis testing on two population means
- 8. Interval estimation and Hypothesis testing on single population Proportion.
- 9. Testing the goodness of fit using Chi- Square test for Normal Distribution
- 10. Construction of scatter plot and determining Karl Pearson's correlation coefficient.
- 11. Conduction of simple linear regression analysis.
- 12. Conduction of Multiple linear regression analysis.
- 13. Construction of function plots for non-linear regression problems
- 14. Case study on engineering and management related problems.
- 15. Python Descriptive Statistics Measuring Central Tendency & Variability Suggested software packages: MS Excel, SYSTAT / MINITAB 17 – Statistical Software Package/ R studio, Python

Note: At least 13 experiments have to be conducted from the above list of experiments

# **Text Books:**

- 1. George C Runger-Applied statistics and Probability for Engineers, John Wiley and Sons, ISBN-0-471-17027-5, 2ndEdn.2003.
- Richard I Levin, David S Rubin -Statistics for Management, Prentice Hall India, ISBN- 81-203-0893-X, 6th Edn. 1991
- 3. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".

# **References:**

- William W Hines, Douglas C Montgomery -Probability and Statistics in Engineering, John Wiley and Sons, 2<sup>nd</sup> Edn.
- 2. Daniel, Terrell -Business Statistics for Management and Economics, Houghton Mifflin Company, ISBN-0-395-62835-0, 6<sup>th</sup> Edn.
- 3. Walpole & Mayer -Probability and Statistics, MacMillan Publishing Company, 4th edition, 1989. ISBN: 9780024242228.
- Douglas C. Montgomery, George C. Runger, Norma F. Hubele, "Engineering Statistics", John Wiley and Sons, 5<sup>th</sup> Edn, ISBN-13: 978-0470631478 ISBN10: 0470631473 year: 2010.
- Schaum's Outline of Statistics, 5<sup>th</sup> Edition (Schaum's Outlines) March 14, 2014, ISBN- 13: 978-0071822527 ISBN-10:0071822526.
- The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2<sup>nd</sup> Edn.), Trevor Hastie Robert Tibshirani Jerome Friedman, Springer, 2014
#### **Course Outcomes (COs):**

At the end of the course, student will be able to

- 1. Collect and present the real life data numerically as well as graphically. (PO-1, PO-3, PSO- 1)
- 2. Arrive at appropriate estimates and inferences and take decisions in uncertainty (PO-1, PO-2, PSO-2)
- 3. Apply the right probability distribution for a real life problem (PO-1, PO-5, PSO-2)
- 4. Conduct correlation and regression analysis in situations involving many variables. (PO-1, PO-5, PSO-1)

| Continuous Internal Evaluation (CIE): 50 Marks |       |                          |  |
|--|-------|--------------------------|--|
| Assessment tool                                | Marks | Course outcomes attained |  |
| Weekly Evaluation-Lab Record                   | 30    | CO1, CO2,CO3,CO4         |  |
| Lab Test                                       | 20    | CO1, CO2,CO3,CO4         |  |
| Semester End Examination (SEE)                 | 50    | C01,C02,C03,C04          |  |

# COMPUTER AIDED MACHINE DRAWING

| Course Code: IML48                                       | Credits: 0:0:1      |  |
|--|---------------------|--|
| Pre – requisites: CAED Lab                               | Contact Sessions: 1 |  |
| Course Coordinator: Dr. M R Shivakumar / Dr. Sridhar B S |                     |  |

#### **Course Content**

#### Unit I

#### PART - A

**Introduction:** Graphic interface software, 3D environment, basic commands of software and drawing standards.

**Construction of simple machine parts:** Conversion of orthographic views into 3D views of simple machine parts.

- Pedagogy/Course delivery tools: Chalk and talk, Powerpoint presentation, Animated videos
- Lab Component / Practical Topics: Machine Components in Machine Shop
- Links: https://www.youtube.com/watch?v=3j2YEuTiAOc https://www.youtube.com/watch?v=AzFz8A5HgiQ https://www.youtube.com/watch?v=j20W2k4XIiY&list=RDCMUCqG32kBhp L8Vjb4WsCUc4dQ&start\_radio=1&rv=j20W2k4XIiY&t=18

#### PART - B

## Assembly Drawings (Part drawing should be given):

1.Screw jack, 2. Plummer block (pedestal bearing)im44 Knuckle joint

- Pedagogy/Course delivery tools: Chalk and talk, Powerpoint presentation, Animated videos
- Lab Component / Practical Topics: Subassemblies in Machines at Machine Shop
- Links: https://www.youtube.com/watch?v=mSWGCpZW3xg

#### **Text Books:**

- 1. A premier on computer aided engineering drawing-2007- VTU Publication Belguam.
- 2. K R Gopala Krishna -Machine drawing, Subhash Publications, 2006 Bangalore.
- 3. S Trymbakamurthy -A text book Computer aided machine drawing, CBS publisher, New Delhi 2006

#### **References:**

- 1. N Siddeswar, P Kannaih, V V S Shastri -Machine drawing, Tata Mc Graw Hill, 2006.
- 2. N D Bhatt and V M Panchal -Machine drawing, Charotar Publishing House, 43<sup>rd</sup> edition, 2008.

#### **Course Outcomes (COs):**

At the end of the course, students will be able to

- 1. Apply drawing standards and construct 3D machine components. (PO-1, PO-2, PO-3, PO-10, PSO-1, PSO-2)
- 2. Create complex machine drawings. (PO-1, PO-2, PO-3, PO-10, PSO-1, PSO-2)

#### Web links and video lectures (e-Resources):

- 1. https://www.youtube.com/watch?v=fHqolQwz93U
- 2. https://www.youtube.com/watch?v=JZ-6AfadSQI
- 3. https://www.youtube.com/watch?v=5IEKtwLOQCM
- 4. https://www.youtube.com/watch?v=jWBO9HQxJyo
- 5. https://www.youtube.com/watch?v=bb3zelbCEAY
- 6. https://www.youtube.com/watch?v=e16S\_87zU\_s
- 7. https://www.youtube.com/watch?v=SGfLx9YsCSQ
- 8. https://www.youtube.com/watch?v=lwYIw0C9RTk

| Continuous Internal Evaluation (CIE) : 50 Marks |       |                              |  |
|---|-------|------------------------------|--|
| Assessment tool                                 | Marks | Course outcomes<br>addressed |  |
| Weekly Evaluation-Lab Record                    | 30    | CO1, CO2                     |  |
| Lab Test  | 20    | CO1, CO2                     |  |
| Semester End Examination (SEE)                  | 50    | CO1,CO2                      |  |

# ABILITY ENHANCEMENT COURSE – IV (VALUE ENGINEERING) Course Code: IMAEC49 Credits: 1:0:0 Pre – requisites: Nil Contact Hours: 14L Course Coordinator: Sri Sudheer D. Kulkarni / Dr. Hemavathy S.

## **Course Content**

#### Unit I

**Introduction to Value Analysis:** Definition of Value, Types of values: Meaning of Value, types of value.

Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, Applications, advantages and limitations of Value analysis.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation.
- Links for videos: https://www.youtube.com/watch?v=mJoaZ4GewyI

https://www.youtube.com/watch?v=6CAFcTo2K6E

# Unit II

**Functional Cost and its Evaluation:** Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and Noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation.
- Links for videos: https://www.youtube.com/watch?v=4MizKV4DoRw

https://www.youtube.com/watch?v=Y5ixDMXiNj4

# Unit III

**Problem Setting & Solving System:** A problem solvable stated is half solved, steps in problem setting system, Identification, Separation and Grouping of functions. Various steps in problem solving.

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation.
- Links for videos: https://www.youtube.com/watch?v=TT6tVH6cDMM

https://www.youtube.com/watch?v=mfHy6\_-vDAc

## Unit IV

**Value Engineering Techniques:** Result Accelerators - Avoid generalities, get all available costs, Use information from only the best source, Blast, create, refine, Use real creativity, Identify and overcome roadblocks, Use industry specialists to extend specialized knowledge, Get a dollar sign on key tolerances Utilize vendors' available functional products, Utilize and pay for vendors' skills and knowledge, utilize specialty processes, Utilize applicable standards, Use the criterion, "Would I spend my money this way?"

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation.
- Links for videos: http://nraoiekc.blogspot.com/2012/03/value-engineeringexamples-cases-and.html

https://www.value-eng.org/page/AboutVM

#### Unit V

**Application of Value Analysis:** Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, and marketing

- Pedagogy/course delivery tools: Chalk and talk, Power Point Presentation.
- Links for videos: https://www.youtube.com/watch?v=66QK\_P5pxY8 https://www.youtube.com/watch?v=mqC4Wn\_OK-I

#### **Text Books:**

- Techniques of Value Analysis and Engineering- Lawrence D. Miles, McGraw

   Hill Book Company, 2ndEdn.
- Value engineering for Cost Reduction and Product Improvement M.S. Vittal, Systems Consultancy Services Edn 1993

#### **References:**

- 1. Value Management, Value Engineering and Cost Reduction Edward D Heller Addison Wesley Publishing Company 1971
- 2. Value Engineering, Concepts, Techniques and Applications: Anil Kumar Mukhopadhyaya · Sage Publications -2003.

#### **Course Outcomes (COs):**

At the end of the course, student will be able to

- 1. Understand the basics of value engineering and its significance (PO:1, 11, PSO:1)
- 2. Identify and evaluate the functional cost for a given project (PO:1, 11, PSO: 1)
- 3. Analyze a problem and apply problem solving techniques to various engineering situations (PO:1, 2, PSO: 1,2)
- 4. Apply the tools and techniques of value engineering for different cases (PO:1,6 PSO: 1)
- 5. Perform value analysis in various areas of engineering and management. (PO:1,2,11, PSO: 1,2)

| Continuous Internal Evaluation (CIE): 50 Marks |                              |                     |
|--|------------------------------|---------------------|
| Assessment Tool                                | Marks                        | Course outcomes     |
|  |                              | addressed           |
| Internal Test – I                              | 30                           | CO1, CO2            |
| Internal Test – II                             | 30                           | CO3, CO4, CO5       |
| Average of the two internal t                  | ests shall be taken for 30 m | arks                |
|  |                              |                     |
| Other Components                               | Marks                        | Course outcomes     |
|  |                              | addressed           |
| ⊠Assignments                                   | 20 (10+10)                   | CO1, CO2, CO3, CO4, |
| ⊠Quiz  |                              | CO5                 |
| □Presentations                                 |                              |                     |
| □Model/Mini Project                            |                              |                     |
| □Any other                                     |                              |                     |
|  |                              |                     |
| Semester End                                   | 50                           | CO1, CO2, CO3, CO4, |
| Examination (SEE)                              |                              | CO5                 |

# ADDITIONAL MATHEMATICS – II (FOR LATERAL ENTRY DIPLOMA STUDENTS)

Course Code: AM41

Credits: 0:0:0

**Contact Hours: 42** 

Pre – requisites: Nil Course Coordinator: Dr. Veena B N

## **Course Content**

# Unit I

**Differential Calculus- I:** Partial differentiation, Euler's theorem, total differential coefficient, differentiation of composite and implicit functions.

- Pedagogy/Course delivery tools: Chalk and talk
- Online tools: Use of open source software's to demonstrate methods and solve problems on interpolation
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030

# Unit II

**Differential Calculus- II:** Jacobian and Properties. Taylor's theorem for function of two variables, maxima and minima for functions of two variables.

- Pedagogy/Course delivery tools: Chalk and talk
- Online tools: Use of open source software's to demonstrate methods and solve problems on numerical differentiation and integration.
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/107625/1030 https://a.impartus.com/ilc/#/course/59742/295

# Unit III

**Vector Integration:** Line integrals, surface integrals and volume integrals. Green's theorem, Stokes' and Gauss divergence theorem (without proof) and problems, orthogonal curvilinear coordinates.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105134/
- Impartus recording: https://a.impartus.com/ilc/#/course/619570/1030

#### Unit IV

**Higher Order Differential Equations**: Higher order linear differential equations, method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/105/111105121/
- Impartus recording: https://a.impartus.com/ilc/#/course/96127/452

## https://a.impartus.com/ilc/#/course/59742/295

# Unit V

**Probability:** Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability- illustrative examples. Bayes theorem – examples.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: https://nptel.ac.in/courses/111/107/111107119/ https://nptel.ac.in/courses/111/107/111107119/
- Impartus recording: https://a.impartus.com/ilc/#/course/283623/703

# **Text Books:**

- 1. **B.S. Grewal** Higher Engineering Mathematics, Khanna Publishers, 44<sup>th</sup> edition, 2017.
- 2. **Erwin Kreyszig** Advanced Engineering Mathematics Wiley Publication, 10<sup>th</sup> Edition, 2015.

# **Reference Books:**

- 1. **H. K. Dass** Higher Engineering Mathematics S Chand Publications, 1998
- 2. **B. V. Ramana** Engineering Mathematics Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008.

#### **Course Outcomes (COs):**

At the end of the course the student will be able to

- 1. To carryout differentiation of function of several variables. (PO-1,2)
- 2. Solve the problems related to Jacobians, the extreme values of a function and Taylors series. (PO-1,2)
- 3. Exhibit the interdependence of line, surface and volume integrals using integral theorems. (PO-1,2)
- 4. Find the solution of second and higher order ODEs with constant and variable coefficients. (PO-1,2)
- 5. Solve the problems on conditional probability and Baye's theorem. (PO-1,2)

| Continuous Internal Evaluation (CIE): 50 Marks                 |       |                           |  |
|--|-------|---------------------------|--|
| Assessment Tool  | Marks | Course outcomes addressed |  |
| Internal test-I  | 30    | CO1, CO2, CO3             |  |
| Internal test-II   | 30    | CO3, CO4, CO5             |  |
| Average of the two internal tests shall be taken for 30 marks. |       |                           |  |
| Other components   | Marks | Course outcomes addressed |  |
| Quiz   | 10    | CO1, CO2, CO3             |  |
| Assignment   | 10    | CO3, CO4, CO5             |  |