# RV COLLEGE OF ENGINEERING®

**(Autonomous Institution Affiliated to VTU, Belagavi)**
**RV Vidyaniketan Post, Mysuru Road**
**Bengaluru – 560059**


# Scheme and Syllabus of III & IV Semester

**(Autonomous System of 2018 Scheme)**

# Master of Technology (M.Tech)
# in
# COMPUTER INTEGRATED MANUFACTURING

**DEPARTMENT OF**
## MECHANICAL ENGINEERING

## VISION

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology

## MISSION

1. To deliver outcome based Quality education, emphasizing on experiential learning with the state of the art infrastructure.
2. To create a conducive environment for interdisciplinary research and innovation.
3. To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
4. To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
5. To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

## QUALITY POLICY

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

## CORE VALUES

Professionalism, Commitment, Integrity, Team Work and Innovation

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# Master of Technology (M.Tech)
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# COMPUTER INTEGRATED MANUFACTURING

**DEPARTMENT OF**

## MECHANICAL ENGINEERING

# DEPARTMENT OF
# MECHANICAL ENGINEERING

## VISION

Quality education in Design, Materials, Thermal and Manufacturing with emphasis on research, sustainable technologies and entrepreneurship for societal symbiosis.

## MISSION

- Imparting knowledge in basic and applied areas of Mechanical Engineering.
- Providing state-of-the-art laboratories and infrastructure for academics and research in the areas of design, materials, thermal engineering and manufacturing.
- Facilitating faculty development through continuous improvement programs.
- Promoting research, education and training in materials, design, manufacturing, Thermal Engineering and other multidisciplinary areas.
- Strengthening collaboration with industries, research organizations and institutes for internship, joint research and consultancy.
- Imbibing social and ethical values in students, staff and faculty through personality development programs

## Program Outcomes (PO)

M. Tech. in Computer Integrated Manufacturing graduates will be able to:

PO1: An ability to independently carry out a research / investigation and development work to solve practical problems related to Computer Integrated Manufacturing

PO2: An ability to write and present a substantial technical report / document

PO3: An ability to demonstrate a degree of mastery over the areas of Computer Integrated Manufacturing. The mastery should be at a level higher than the requirements in the BE Mechanical Engineering and allied programs

PO4: An ability to use latest technology for the design and analysis of CNC based manufacturing and automation systems

PO5: An ability to adapt technical, safety, ethical and environmental factors in the design of Intelligence systems

PO6: An ability to perform interdisciplinary teams with social and management skills with a commitment to lifelong learning

# ABBREVIATIONS

| Sl. No. | Abbreviation | Acronym |
|---|---|---|
| 1. | VTU | Visvesvaraya Technological University |
| 2. | BS | Basic Sciences |
| 3. | CIE | Continuous Internal Evaluation |
| 4. | SEE | Semester End Examination |
| 5. | CE | Professional Elective |
| 6. | GE | Global Elective |
| 7. | HSS | Humanities and Social Sciences |
| 8. | CV | Civil Engineering |
| 9. | ME | Mechanical Engineering |
| 10. | EE | Electrical & Electronics Engineering |
| 11. | EC | Electronics & Communication Engineering |
| 12. | IM | Industrial Engineering & Management |
| 13. | EI | Electronics & Instrumentation Engineering |
| 14. | CH | Chemical Engineering |
| 15. | CS | Computer Science & Engineering |
| 16. | TE | Telecommunication Engineering |
| 17. | IS | Information Science & Engineering |
| 18. | BT | Biotechnology |
| 19. | AS | Aerospace Engineering |
| 20. | PY | Physics |
| 21. | CY | Chemistry |
| 22. | MA | Mathematics |
| 23. | MCA | Master of Computer Applications |
| 24. | MST | Structural Engineering |
| 25. | MHT | Highway Technology |
| 26. | MPD | Product Design & Manufacturing |
| 27. | MCM | Computer Integrated & Manufacturing |
| 28. | MMD | Machine Design |
| 29. | MPE | Power Electronics |
| 30. | MVE | VLSI Design & Embedded Systems |
| 31. | MCS | Communication Systems |
| 32. | MBS | Bio Medical Processing Signal & Instrumentation |
| 33. | MCH | Chemical Engineering |
| 34. | MCE | Computer Science & Engineering |
| 35. | MCN | Computer Network Engineering |
| 36. | MDC | Digital Communication |
| 37. | MRM | Radio Frequency and Microwave Engineering |
| 38. | MSE | Software Engineering |
| 39. | MIT | Information Technology |
| 40. | MBT | Biotechnology |
| 41. | MBI | Bioinformatics |

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**RV COLLEGE OF ENGINEERING®, BENGALURU - 560059**
**(Autonomous Institution Affiliated to VTU, Belagavi)**

**DEPARTMENT OF MECHANICAL ENGINEERING**

# M.Tech in COMPUTER INTEGRATED MANUFACTURING

| THIRD SEMESTER CREDIT SCHEME | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** | **BoS** | **Credit Allocation** | | | |
| | | | | **L** | **T** | **P** | **Credits** |
| 1 | 18MCM31 | Digital Manufacturing | ME | 4 | 1 | 0 | **5** |
| 2 | 18MCM32 | Internship | ME | 0 | 0 | 5 | **5** |
| 3 | 18MCM33 | Major Project : Phase I | ME | 0 | 0 | 5 | **5** |
| 4 | 18XXX3EX | Elective E | ME | 4 | 0 | 0 | **4** |
| **Total number of Credits** | | | | **8** | **01** | **10** | **19** |
| **Total Number of Hours/Week** | | | | **8** | **2** | **20** | |

| SEMESTER : III | | |
|---|---|---|
| **GROUP E: PROFESSIONAL ELECTIVES** | | |
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | 18MCM3E1 | Additive Manufacturing |
| 2 | 18MPD3E2 | Surface Engineering |
| 3 | 18MCM3E3 | Advanced Manufacturing Practices |

| FOURTH SEMESTER CREDIT SCHEME | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** | **BoS** | **Credit Allocation** | | | |
| | | | | **L** | **T** | **P** | **Credits** |
| 1 | 18MCM41 | Major Project : Phase II | ME | 0 | 0 | 20 | 20 |
| 2 | 18MCM42 | Technical Seminar | ME | 0 | 0 | 2 | 2 |
| **Total number of Credits** | | | | **0** | **0** | **22** | **22** |
| **Total Number of Hours / Week** | | | | **0** | **0** | **44** | |

| SEMESTER III | | | | | | |
|---|---|---|---|---|---|---|
| **DIGITAL MANUFACTURING** | | | | | | |
| **Course Code** | **:** | **18MCM31** | | **CIE Marks** | **:** | **100** |
| **Credits: L:T:P** | **:** | **4:1:0** | | **SEE Marks** | **:** | **100** |
| **Total Hours** | **:** | **52L** | | **SEE Duration** | **:** | **3 Hrs.** |

| **Unit-I** | **10 Hrs** |
|---|---|

**Introduction:** Development of Manufacturing Engineering, Status of Digital Manufacturing, Research Methods, Architecture, Organization Model and Function Model of Digital Manufacturing System, Industrial Internet, Case studies

**Design for Additive Manufacturing:** Design for Manufacturing and Assembly, Core DFAM Concepts and Objectives, CAD Tools for AM, Synthesis Methods

| **Unit-II** | **10 Hrs** |
|---|---|

**Computing Manufacturing:** Virtual Prototyping, Reverse Engineering, Application of Reverse Engineering, Discrete Model of Manufacturing Computing, Information Model of Manufacturing computing, Geometric Modeling in Manufacturing Computing, Computational Geometry

**Manufacturing Informatics:** Information Characteristics, Activities and Manufacturing Informatics, Integration, Sharing and Security of Manufacturing Information. Integration Model, Principle and Mechanism of Sharing Manufacturing Resources.

| **Unit -III** | **12 Hrs** |
|---|---|

**Intelligent Manufacturing System:** The Application of Sensor in the Processing Data Mining, Data Mining Applied to Digital Manufacturing, Knowledge Reasoning in Engineering Design, Intelligent Knowledge-Based Manufacturing System, Self-Learning of Manufacturing System, Adaptation of Manufacturing System, The Concepts and Features of Intelligent Manufacturing, Multi-Agent Manufacturing System.

**Future Development of Digital Manufacturing Science:** The Precision of Digital Manufacturing, The Extremalization of Digital Manufacturing, The Environmental Protection of Digital Manufacturing.

| **Unit -IV** | **10 Hrs** |
|---|---|

**The Concept of the IIoT:** Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols, TCP/IP, API: A Technical Perspective, Middleware Architecture.

**Cloud and Fog:** M2M Learning and Artificial Intelligence, AR, Industrial Internet Architecture Framework (IIAF), Data Management.

| **Unit -V** | **10 Hrs** |
|---|---|

**Augmented Reality:** The Role of Augmented Reality in the Age of Industry 4.0, Introduction, AR Hardware and Software Technology, Industrial Applications of AR, Maintenance, Assembly, Collaborative Operations , Training.

**Smart Factories**: Introduction, Smart factories in action, Importance, Real world smart factories, The way forward. A Roadmap: Digital Transformation, Transforming Operational Processes, Business Models, Increase Operational Efficiency, Develop New Business Models.

**Course outcomes:**

**After completing the course, the students will be able to**

**CO1:** Explain the working process and technology development in Digital Manufacturing

**CO2:** Apply the principles of DM in the manufacturing industry

**CO3:** Apply the Industrial 4.0 concepts in a manufacturing plant to improve productivity and profits

**CO4:** Evaluate the effectiveness of Cloud Computing in a networked economy.

| **Reference Books:** | |
|---|---|
| **1** | Fundamentals of Digital Manufacturing Science, Zude Zhou, Shane (Shengquan) Xie, Dejun Chen, 2012.Springer ISBN 978-0-85729-564-4, |
| 2 | Collabarative design and planning for digital manufacturing, Lihni Wang, Andrew Y.C. Nee, Springer Series, 2009, ISBN 998-1-84882-286-3 |
| 3 | Industry 4.0 The Industrial Internet of Things, Alasdair Gilchrist, A press Publisher, ISBN-13 (pbk): 978-1-4842-2046-7. |
| 4 | Industry 4.0: Managing The Digital Transformation, Alp Ustundag, Emre Cevikcan, Springer, 2018 ISBN 978-3-319-57869-9 |

**Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)**

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

**Scheme of Semester End Examination (SEE) for 100 marks:**

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

| SEMESTER: III | | | | | | |
|---|---|---|---|---|---|---|
| **INTERNSHIP** | | | | | | |
| **Course Code** | **:** | **18MCM32** | | **CIE Marks** | **:** | **100** |
| **Credits L:T:P** | **:** | **0:0:5** | | **SEE Marks** | **:** | **100** |
| **Hours/week** | **:** | **10** | | **SEE Duration** | **:** | **3 Hrs** |

**GUIDELINES**

1) The duration of the internship shall be for a period of 8 weeks on full time basis after II semester final exams and before the commencement of III semester.
2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3) Internship must be related to the field of specialization of the respective PG programme in which the student has enrolled.
4) Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5) Students have to present the internship activities carried out to the departmental committee and only upon approval by the committee, the student can proceed to prepare and submit the hard copy of the final internship report. However, interim or periodic reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6) The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.
7) The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry / Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents
    - Chapter 1 - Profile of the Organization: Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
    - Chapter 2 - Activities of the Department
    - Chapter 3 - Tasks Performed: summaries the tasks performed during 8-week period
    - Chapter 4 – Reflections: Highlight specific technical and soft skills that you acquired during internship
    - References & Annexure

**Course outcomes: After completing the course, the students will be able to**

**CO1:** Apply engineering and management principles
**CO2:** Analyse real-time problems and suggest alternate solutions
**CO3:** Communicate effectively and work in teams
**CO4:** Imbibe the practice of professional ethics and need for lifelong learning.

**Scheme of Continuous Internal Evaluation (CIE):**
The evaluation committee shall consist of Guide, Professor and Associate Professor/Assistant Professor. The committee shall assess the presentation and the progress reports in two reviews.

The evaluation criteria shall be as per the rubrics given below:

| Reviews | Activity | Weightage |
|---|---|---|
| Review-I | Explanation of the application of engineering knowledge in industries, ability to comprehend the functioning of the organization/ departments, | 45% |
| Review-II | Importance of resource management, environment and sustainability presentation skills and report writing | 55% |

**Scheme for Semester End Evaluation (SEE):**
The SEE examination shall be conducted by an external examiner (domain expert) and an internal examiner. Evaluation will be done in batches, not exceeding 6 students per batch.

| SEMESTER: III | | | | | | |
|---|---|---|---|---|---|---|
| **MAJOR PROJECT : PHASE I** | | | | | | |
| **Course Code** | **:** | **18XMCM33** | | **CIE Marks** | **:** | **100** |
| **Credits L:T:P** | **:** | **0:0:5** | | **SEE Marks** | **:** | **100** |
| **Hours/week** | **:** | **10** | | **SEE Duration** | **:** | **3 Hours** |

**GUIDELINES**

1. The Major Project work comprises of Phase-I and Phase-II. Phase-I is to be carried out in third semester and Phase-II in fourth semester.
2. The total duration of the Major project shall be 24 weeks.
3. Major project shall be carried out on individual student basis in his/her respective PG programme specialization. Interdisciplinary projects are also considered.
4. The allocation of the guides shall be preferably in accordance with the expertise of the faculty.
5. The project may be carried out on-campus/industry/organization with prior approval from the Head of the Department.
6. The duration of the Phase-I shall be of 12 weeks.
7. If a student fails to satisfy the Phase-I, shall be allowed to complete in the fourth semester before commencement of Phase-II of 4$^{th}$ Semester.
8. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

**Course outcomes: After completing the course, the students will be able to**

**CO1:** Conceptualize, design and implement solutions for specific problems.
**CO2:** Communicate the solutions through presentations and technical reports.
**CO3:** Apply project and resource managements skills, professional ethics, societal concerns
**CO4:** Synthesize self-learning, sustainable solutions and demonstrate life-long learning

**Scheme of Continuous Internal Examination (CIE)**
Evaluation shall be carried out in two reviews. The evaluation committee shall consist of Guide, Professor and Associate Professor/Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

| Reviews | Activity | Weightage |
|---|---|---|
| Review-I | Selection of the topic, Literature Survey, Problem Formulation and Objectives | 45% |
| Review-II | Methodology and Report writing | 55% |

**Scheme for Semester End Evaluation (SEE):**
Phase-I evaluation shall be done by an external examiner (domain expert) and respective guide as per the schedule. Maximum of three candidates per batch shall be allowed to take examination. The batches are to be formed based on specific domain of work.

| SEMESTER: III | | | | | | |
|---|---|---|---|---|---|---|
| **ADDITIVE MANUFACTURING (Elective–E1)** | | | | | | |
| **Course Code** | **:** | **18MCM3E1** | | **CIE Marks** | **:** | **100** |
| **Credits L: T: P** | **:** | **4:0:0** | | **SEE Marks** | **:** | **100** |
| **Hours** | **:** | **52L** | | **SEE Duration** | **:** | **3 hrs** |

| **Unit – I** | **10 Hrs** |
|---|---|

**Development of Additive Manufacturing Technology:** Computer-Aided Design Technology, Associated Technologies, Classification of AM Processes, Metal Systems, Metal Systems, Hybrid Systems, Steps in Additive Manufacture, Maintenance of Equipment, Materials Handling Issues

**Design for AM:** Application Areas, Vat Photopolymerization Processes, Materials, Reaction Rates, Process Modeling, Vector Scan VP Machines, Two-Photon Vat Photopolymerization, Process Benefits and Drawbacks

| **Unit – II** | **10 Hrs** |
|---|---|

**Powder Bed Fusion Processes**: Introduction, Materials, Powder Fusion Mechanisms, Process Parameters and Modeling, Powder Handling, Laser, UV and IR; Process Benefits and Drawbacks.
**Extrusion-Based Systems**: Introduction, Basic Principles, Plotting and Path Control, Fused Deposition Modeling, Stereo lithography: Materials, Processes parameters, advantages and limitations.

| **Unit – III** | **10 Hrs** |
|---|---|

**Material and Binder Jetting:** Evolution, Materials, Material Processing Fundamentals, Material Jetting Machines, Process Benefits and drawbacks, binding materials and systems.
**Sheet Lamination Processes:** Introduction, Materials, Processes, Ultrasonic AM**,** Directed Energy Deposition Processes, Material Delivery, DED Systems, Process Parameters

| **Unit – IV** | **10 Hrs** |
|---|---|

**Design for Additive Manufacturing:** Design for Manufacturing and Assembly, AM Unique Capabilities, Core DFAM Concepts and Objectives, CAD Tools for AM.
**Applications for Additive Manufacture:** Introduction, The Use of AM to Support Medical Applications, Aerospace and Automotive Applications.

| **Unit –V** | **12 Hrs** |
|---|---|

**Rapid Tooling:** Introduction, Direct and Indirect AM tooling process; Production of Injection Molding Inserts, EDM Electrodes, Investment Casting and Other Systems, RTV Silicone Tooling, Calcium silicate based castable tooling.
**Direct Digital Manufacturing:** Align Technology, Siemens and Phonak, Custom Footwear and Other DDM Examples, DDM Drivers, Manufacturing Versus Prototyping, Cost Estimation, Cost Model, Build Time Model, Laser Scanning Vat Photopolymerization, , Life-Cycle Costing, Future of DDM

**Course Outcomes:**
**After going through this course the student will be able to:**
**CO1:** Explain the working process and technology development of Additive Manufacturing.
**CO2:** Apply the principles of AM in manufacturing industry
**CO3:** Analyze the concepts of AM in Production Process
**CO4:** Evaluating the techniques involved in AM

**Reference Books:**


| | |
|---|---|
| **1** | Additive Manufacturing Technologies, Ian Gibson, David Rosen, Brent Stucker, Springer, 2ndEdition. ISBN 978-1-4939-2112-6 |
| 2 | 3D Printing and Additive Manufacturing, Principles and Applications, Chee Kai Chua, Kah Fai Leong, 4th Ed, ISBN 978-9-8145-7140-1 |
| 3 | Additive Manufacturing, Amit Bandyopadhyay, Susmita Bose, CRC Press 2015 ISBN 9781482223590 |
| 4 | Collabarative design and planning for digital manufacturing, Lihni Wang, Andrew Y.C. Nee, Springer Series, 2009, ISBN 998-1-84882-286-3 |

**Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)**
CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

**Scheme of Semester End Examination (SEE) for 100 marks:**
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

| SEMESTER: III | | | | | | |
|---|---|---|---|---|---|---|
| **SURFACE ENGINEERING (Elective–E2)** | | | | | | |
| **Course Code** | **:** | **18MPD3E2** | | **CIE Marks** | **:** | **100** |
| **Credits L: T: P** | **:** | **4:0:0** | | **SEE Marks** | **:** | **100** |
| **Hours** | **:** | **52L** | | **SEE Duration** | **:** | **3 hrs** |

| **Unit – I** | **10 Hrs** |
|---|---|
| **Surface cleaning** – classification, and selection of cleaning processes-alkaline cleaning, solvent cold cleaning and vapour degreasing, eemulsion cleaning, pickling and descaling<br>**Tribology -** surface degradation, wear and corrosion, types of wear, roles of friction and lubrication-overview of different forms of corrosion. | |
| **Unit – II** | **12 Hrs** |
| **Surface Engineering of ferrous and nonferrous materials**: cast iron, carbon and alloy steels, aluminium and alloys, copper and alloys, magnesium and alloys. Nickel and alooys,<br>**Conversion coatings** : Chemical and electrochemical polishing, significance, specific examples, phosphate, chromating, chemical coloring, anodizing of aluminum alloys, thermo chemical processes - industrial practices | |
| **Unit – III** | **10 Hrs** |
| **Surface pre-treatment**, deposition of copper, zinc, nickel and chromium - principles and practices, alloy plating, electro composite plating, electroless plating of copper, nickel phosphorous, nickel-boron;<br>**Environmental protection issues**; Environmental regulation of surface engineering, cadmium elimination vapour degreasing alternatives, competent organic coating. | |
| **Unit – IV** | **10 Hrs** |
| **Sputter technique** – Methods, applications, plasma treatments, nitriding, carbonizing, boriding, titanising methods, applications<br>**Laser coatings** : Laser alloying, sources, variables, methods, applications, specific industrial applications | |
| **Unit –V** | **10 Hrs** |
| **Thermal spraying-** techniques, advanced spraying techniques - plasma surfacing, D-Gun and high velocity oxy-fuel processes,<br>**Laser surface alloying and Cladding -** specific industrial applications, tests for assessment of wear and corrosion behaviour. | |

**Course Outcomes:**

**After going through this course the student will be able to:**

**CO1:** Explain various forms of corrosion and basic concepts of surface engineering

**CO2:** Evaluate the different surface engineering processes with respect to industrial practices

**CO3:** Apply the knowledge of different spraying techniques in surface engineering

**CO4:** Analyse tests for assessment of wear and corrosion behavior.

**Reference Books**


| | |
|---|---|
| 1. | Surface modification technologies - An Engineer's guide, Sudarshan T S,, Marcel Dekker, Newyork, ISBN 10: 0824780094, 1989 |
| 2. | Electroplating and Other Surface Treatments - A Practical Guide, Varghese C.D, TMH, 0074604643 9780074604649, 1993 |
| 3. | Surface Engineering Practice, Processes, Fundamentals and Applications in Corrosion and Wear, Strafford, K.N., Datta, P.K., and Gray, J.S., Ellis Harwood, ISBN *13*: 9780138780593 (1990). |
| 4. | Advanced Surface Coatings: A Hand book of Surface Engineering, Mathews, A., Spinger, ISBN 095328–7203 (1991). |

**Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)**

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

**Scheme of Semester End Examination (SEE) for 100 marks:**

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

| SEMESTER: III | | | | | | |
|---|---|---|---|---|---|---|
| **ADVANCED MANUFACTURING PRACTICES (Elective–E3)** | | | | | | |
| **Course Code** | **:** | **18MCM3E3** | | **CIE Marks** | **:** | **100** |
| **Credits L: T: P** | **:** | **4:0:0** | | **SEE Marks** | **:** | **100** |
| **Hours** | **:** | **52L** | | **SEE Duration** | **:** | **3 hrs** |

| **Unit –I** | **10 Hrs** |
|---|---|

**Just in Time Production** – Primary purpose, profit through cost reduction, elimination of over production, quality control, quality assurance, respect for humanity, flexible work force, JIT production adapting to changing production quantities, process layout for shortened lead Times, standardization of operation, automation.

**Sequence and Scheduling Used by Suppliers:** Monthly and daily Information. sequenced withdrawal system by sequenced schedule table, problems and counter measures in applying the Kanban system to sub-contractors.

| **Unit -II** | **10 Hrs** |
|---|---|

**Toyota Production System**-The philosophy of TPS, basic frame work of TPS, Kanbans. Determining the number of Kanbans in Toyota Production System, Kanban number under constant quantity withdrawal system, constant cycle, non-constant quantity withdrawal system.

**Kanban Systems-** Supplier Kanban and the sequence schedule for use by suppliers - Later replenishment system by Kanban, Sequenced Withdrawal System and Circulation of the Supplier Kanban within Toyota. production smoothing in TPS, production planning, production smoothing, adaptability to demand fluctuations, sequencing method for the mixed model assembly line to realize smoothed production of goal.

| **Unit -III** | **12 Hrs** |
|---|---|

**Just-in-Time Production** with Total Quality Control just in time concept, cutting lot sizes, cutting set-up times, cutting purchase order costs, the JIT cause-Effect chain,

**Quality Improvements:** scrap/quality improvements, motivational effects, responsibility effects, small group improvement activities, withdrawal of buffer inventory, the total quality control concept.

| **Unit -IV** | **10 Hrs** |
|---|---|

**Total Quality Control**-Introduction-Total Quality Control concepts, responsibility, learning from the west, TQC concepts categorized, goals, habit of improvement, perfection, basics, process control, easy to see quality control as facilitator, small lot sizes, housekeeping,

**Scheduling**: Capacity scheduling, daily machine checking, techniques and Aids, exposure of problems, fool proof devices, tools of analysis, QC circles, TQC in Japanese-owned US electronics plant, TQC in Japanese-owned automotive plants.

| **Unit -V** | **10 Hrs** |
|---|---|

**Plant Configurations:** Introduction-ultimate plant configuration, job shop fabrication, frame welding, forming frame parts from tubing, dedicated production lines, overlapped production, the daily schedule, forward linkage, physical merger of processes, adjacency,

**Material Handling Systems**: mixed models, automated production lines, pseudo robots, robots, CAD and manufacturing, conveyors and stacker cranes, automatic quality monitoring

**Course Outcomes:**

**After going through this course the student will be able to:**

**CO1:** Explain the role of JIT, TPS and TQC strategies in production system

**CO2:** Analyze the various concepts of modern manufacturing practices

**CO3:** Apply the concepts of JIT and TPS in real time applications

**CO4:** Evaluate the various process requirement to decide the plant configuration

| **Reference Books:** | |
|---|---|
| 1 | Japanese Manufacturing Techniques, Richard Schonberger, Pearson Higher Education - ISBN:0029291003, 1982 |
| 2 | An Integrated Approach To Just In Time, Yasuhiro Monden, Toyota Production system, CRC Press, 4th Edition, ISBN: 9781439820971, 2011 |
| 3 | Simon & Schuster, Adult Lean Thinking, James Womack, ISBN: 0743249275, 2003. |
| 4 | The machine that changed the World - The story of Lean production, Harper Perennial edition published James P. Womack, Daniel T Jones, and Daniel Roos,, ISBN-13: 978-0-7432-9979-4, 1991. |

**Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)**
CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

**Scheme of Semester End Examination (SEE) for 100 marks:**
The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

| SEMESTER: IV | | | | | | |
|---|---|---|---|---|---|---|
| **MAJOR PROJECT : PHASE II** | | | | | | |
| **Course Code** | **:** | **18MCM41** | | **CIE Marks** | **:** | **100** |
| **Credits L:T:P** | **:** | **0:0:20** | | **SEE Marks** | **:** | **100** |
| **Hours/Week** | **:** | **40** | | **SEE Duration** | **:** | **3 Hours** |

**GUIDELINES**

1. Major Project Phase-II is continuation of Phase-I.
2. The duration of the Phase-II shall be of 12 weeks.
3. The student needs to complete the project work in terms of methodology, algorithm development, experimentation, testing and analysis of results.
4. It is mandatory for the student to present/publish the work in National/International conferences or Journals
5. If any student does not complete the project work and submit the report within the specified schedule, extension of project shall be permitted.
6. The reports shall be printed on A4 size with 1.5 spacing and Times New Roman with font size 12, outer cover of the report (wrapper) has to be Ivory color for PG circuit Programs and Light Blue for Non-Circuit Programs.

**Course Outcomes:**

**After going through this course the student will be able to:**

**CO1:** Conceptualize, design and implement solutions for specific problems
**CO2:** Communicate the solutions through presentations and technical reports
**CO3:** Apply project and resource managements skills, professional ethics, societal concerns
**CO4:** Synthesize self-learning, sustainable solutions and demonstrate life-long learning

**Scheme of Continuous Internal Examination (CIE)**

Evaluation shall be carried out in three reviews. The evaluation committee shall consist of Guide, Professor and Associate Professor/Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

| Reviews | Activity | Weightage |
|---|---|---|
| Review-I | Review and refinement of Objectives, Methodology and Implementation | 20% |
| Review-II | Implementation, Testing, Verification and Validation of results, Conclusions and Future Scope of Work | 40% |
| Review-III | Report Writing and Paper Publication | 40% |

**Scheme for Semester End Evaluation (SEE):**

Major Project Phase-II SEE shall be conducted in two stages. This is initiated after fulfilment of submission of project report and CIE marks.

**Stage-1 Report Evaluation**

Evaluation of Project Report shall be done by guide and an external examiner.

**Stage-2 Project Viva-voce**

Major Project Viva-voce examination is conducted after receipt of evaluation reports from guide and external examiner.

Both Stage-1 and Stage-2 evaluations shall be completed as per the evaluation formats.

**SEE procedure is as follows:**

| | **Internal Guide** | **External Examiner** | **TOTAL** | |
|---|---|---|---|---|
| **SEE Report Evaluation** | 100 marks | 100 marks | | 200 marks |
| | | | (A) | (200/2) = 100 marks |
| **Viva-Voce** | Jointly evaluated by Internal Guide & External Evaluator | | (B) | 100 marks |
| | | | **Total Marks** | **[(A)+(B)]/2 = 100** |

| SEMESTER: IV | | | | | | |
|---|---|---|---|---|---|---|
| **TECHNICAL SEMINAR** | | | | | | |
| **Course Code** | **:** | **18MCM42** | | **CIE Marks** | **:** | **50** |
| **Credits L:T:P** | **:** | **0:0:2** | | **SEE Marks** | **:** | **50** |
| **Hours/Week** | **:** | **4** | | **SEE Duration** | **:** | **30 min** |

**GUIDELINES**

1) The presentation shall be done by individual students.
2) The seminar topic shall be in the thrust areas of respective PG programme.
3) The seminar topic could be complementary to the major project work
4) The student shall bring out the technological developments with sustainability and societal relevance.
5) Each student must submit both hard and soft copies of the presentation along with the report.

**Course Outcomes:**
**After going through this course the student will be able to:**
**CO1:** Identify topics that are relevant to the present context of the world
**CO2:** Perform survey and review relevant information to the field of study.
**CO3:** Enhance presentation skills and report writing skills
**CO4:** Develop alternative solutions which are sustainable

**Scheme of Continuous Internal Evaluation (CIE):** Evaluation shall be carried out in two reviews. The evaluation committee shall consist of Guide, Professor and Associate Professor/Assistant Professor.

The evaluation criteria shall be as per the rubrics given below:

| Reviews | Activity | Weightage |
|---|---|---|
| Review-I | Selection of Topic, Review of literature, Technical Relevance, Sustainability and Societal Concerns, Presentation Skills | 45% |
| Review-II | Technological Developments, Key Competitors, Report writing | 55% |

**Scheme for Semester End Evaluation (SEE):**
The SEE examination shall be conducted by an external examiner and an internal examiner. Evaluation will be done in batches, not exceeding 6 students per batch.