RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)
RV Vidyaniketan Post, Mysore Road
Bengaluru – 560 059

Scheme and Syllabus of III & IV Semesters

(Autonomous System of 2018 Scheme)

Master of Technology (M.Tech)

in

PRODUCT DESIGN AND 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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PRODUCT DESIGN AND 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 Product Design and Manufacturing graduates will be able to:

PO1: Independently carry out a research / investigation and development work to solve practical problems related to product design & manufacturing.

PO2: Write and present a substantial technical report / document in the field of product design & manufacturing.

PO3: Demonstrate a degree of mastery over the areas of product design. The mastery would be at a level higher than the requirements in the bachelor's in Mechanical Engineering

PO4: Use modern tools for the design and analysis of static and dynamic systems and mechanisms.

PO5: Adopt safety, ethical and environmental factors in product design and processes

PO6: Perform in multidisciplinary teams with sound interpersonal 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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(Autonomous Institution Affiliated to VTU, Belagavi)

DEPARTMENT OF MECHANICAL ENGINEERING

M.Tech in PRODUCT DESIGN AND MANUFACTURING

THIRD SEMESTER CREDIT SCHEME							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**Credit Allocation**			
				L	**T**	**P**	**Credits**
1.	18MPD31	Advanced Materials & Processes	ME	4	1	0	**5**
2.	18MPD32	Internship	ME	0	0	5	**5**
3.	18MPD33	Major Project : Phase I	ME	0	0	5	**5**
4.	18XXX3EX	Elective -E	ME	4	0	0	**4**
Total number of Credits				**8**	**1**	**10**	**19**
Total Number of Hours / Week				**8**	**2**	**20**	

SEMESTER : III		
GROUP E: PROFESSIONAL ELECTIVES		
Sl. No.	**Course Code**	**Course Title**
1.	18MPD3E1	Sheet Metal Forming and Plastic Moulding
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.	18MPD41	Major Project : Phase II	ME	0	0	20	20
2.	18MPD42	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						
ADVANCED MATERIALS & PROCESSES (Theory)						
Course Code	**:**	**18MPD31**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:1:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	**10 Hrs**

Structure-Property Relations & Newer Materials: Introduction, Atomic structure, atomic bonds, secondary bonds, crystal structure, **C**rystal structure, crystal defects, grain structure, elastic and plastic deformation in single crystals, strain /work hardening, plastic deformation in polycrystalline metals, fracture of metals.

Newer Materials: Plastics, polymerization thermosetting and thermoplastic materials and properties. Ceramic materials and their properties. Composite materials – classification, matrix and reinforcement materials, properties, rule of mixtures, longitudinal strength and modulus (isostrain model), transverse strength and modulus (isostress model), applications of composites.

Unit – II	**12 Hrs**

Processing of Composites: Processing of MMCs : matrix and reinforcement materials, diffusion bonding, squeeze casting, reocasting, arc spray forming, superplastic forming, in situ process. Processing of CMCs : matrix and reinforcement materials, fabrication of glass fibers, boron fibers, carbon fibers, alumina fibers, silicon carbide fibers. Processing- slurry infiltration process, melt infiltration process, direct oxidation or Lanxide process.

Processing of PMCs: matrix and reinforcement materials, processing of polyethylene fibers, aramid fibers. Processing of PMCs – hand layup process, spray-up technique, filament winding process, pultrusion process, autoclave moulding.

Unit – III	**12 Hrs**

Powder Metallurgy: Introduction, Production of Powder, Characterization & Testing of Powders, Powder Conditioning, Powder Compaction, Sintering, Finishing operations, Applications of PM components.

Surface Treatment: Introduction, Surface Engineering, Surface quality & integrity concepts, Mechanical treatment, Thermal spraying processes and applications, Vapour depositions processes and applications, Ion-implantation.

Unit – IV	**08 Hrs**

Environmental Degradation of Materials: Different forms of environmental degradation, cost of corrosion, electrochemical nature, forms of corrosion- Galavanic, Intergranular, pitting, stress related corrosion. Corrosion control- Materials selection, protective coating.
Smart materials : Smart materials and their properties, Piezoelectric, magneto structure, shape memory materials, Electro Rheological fluids, optical fibres.

Unit – V	**10 Hrs**

Thin film: Sol-gel, spin coating**,** sputtering deposition, ion implementation, cathedoic arc deposition, pulsed laser deposition
Characterization–Scanning probe microscopy, Atomic force microscopy, Scanning tunneling microscopy, Profilometer, applications of thin films in different areas.

Course Outcomes:	
After going through this course the student will be able to:	
CO1	Explain the concepts and principles of advanced materials and manufacturing processes
CO2	Analyze the materials and processes for particular application
CO3	Understand the concept of powder metallurgy technique
CO4	Evaluate the principles and application of surface treatment methods

Reference Books:	
1	Materials and Processing in Manufacturing, E. Paul Degarmo, J.T. Black, and Ronald A Kohser, John Wiley and Sons Inc., 12th Edition, 5th July 2017, ISBN: 978-1118987674.
2	Composite Materials: Science & Engineering, K.K.Chawla, Springer-Verlag, New York, 3rd Edition, 2012, ISBN: 978-0387743646.
3	Structure and Properties of Engineering Materials, V. S. R Murthy, A. K. Jena, K. P. Gupta and G.S.Murthy, Tata McGraw Hill Education, 2003, ISBN: 9780070482876.
4	Nanotechnology, Rakesh Rathi, S.Chand and Company, 1st December 2010, ISBN: 978-8121930826.

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	**:**	**18MPD32**		**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 going through the internship the student will be able to:

CO1: Apply engineering and management principles
CO2: Analyze 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	**:**	**18XXX33**		**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 4th 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 going through this 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						
SHEET METAL FORMING AND PLASTIC MOULDING (Elective-E1)						
Course Code	**:**	**18 MPD3E1**		**CIE Marks**	**:**	**100**
Credits L: T: P	**:**	**4:0:0**		**SEE Marks**	**:**	**100**
Hours	**:**	**52L**		**SEE Duration**	**:**	**3 hrs**

Unit – I	**10 Hrs**

Sheet Metal Operations: Classification of presses, sheet metal operations, shearing theory, cutting force, clearance between punch and die, shut height and daylight, press tonnage calculation.
Strip Layout: Basic rules, economic layout, bridge size, calculation of plug point/center of pressure

Unit – II	**10 Hrs**

Bending Die: Theory of bending, development of bend, spring back, correcting spring back, bending tools, U bending, V bending, bending on press brake, bending force, different methods of compensation for spring back in V-bending and U-bending.
Drawing: Theory of drawing, blank development, calculation of number of stages of drawing, circular draw, draw force calculation, lubrication.

Unit – III	**10 Hrs**

Design of Press Tool Elements: Design of die plates, punches, punch holder plates, stripper plates, and calculation of stripping force, bolster plates, pilots, ejectors, shedders, pillar, bush, slender punches, stock guides and feeding device and die sets.
Types of Press Tools: Stage tools, progressive tools, compound tools, and combination tools

Unit – IV	**12 Hrs**

Mould construction: Design of various injection mould elements, cores, cavities, and Inserts, fitting core and cavity inserts, guide pillars and bushes. Feed systems: Design of gates, runners, impressions, layout, sprue, sprue pullers. Parting Surfaces: Straight, stepped, curved parting surface.
Ejector System: Types of ejection, ejector pin, sleeve ejection, plate ejection, blade ejection, air ejection, ejection from fixed half, double ejection, delayed ejection. Cooling System: Need for cooling, cooling solid cores and cavities, insert cooling, cooling long cores, cooling elements, baffles etc., and cooling calculation.

Unit –V	**10 Hrs**

Design of Moulds with External under Cuts: Split moulds, Actuation of splits, Guiding of splits, side cores. Design of external threaded components. Special Moulds, 3 Plate moulds, hot runner moulds.
Moulds with internal under cuts: Form pins, split cores, side cores, and stripping internal undercut. Design of internally threaded component. Thermoset plastic moulding: Compression moulding tools, transfer moulding tools. Defects in moulding and its remedies.

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

CO1: Explain the necessity of press tool and mould for manufacturing of different tools
CO2: Analyse the design constraints in the given problem
CO3: Apply the design rule for manufacturing of press tools and moulds
CO4: Design of press tools and mould for considering real time issues of Manufacturing, Testing and Assembly

Reference Books:

1	Die Design Fundamentals, Paquin J.R. & Crowley, Industrial Press Inc. 3rdEd. 2006. ISBN 13: 9780831131197
2	Handbook of Die Design, Ivana Suchy, New York-Mc GRAW-HILL: 2nd Edition, 2005, ISBN**:** 9780071462716, 0071462716
3	Injection Mould Design, R. G. W Pye, Affiliated East-West Press Pvt. Ltd.-New Delhi, 4th Ed, 2000, ISBN: 9788176710107, 8176710105
4	Injection Molding Handbook, D.V. Rosato, Marlene G. Rosato, Springer, 3rd Edition, 2000, ISBN: 0792386191, 9780792386193

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	**:**	**18 MPD 3E2**		**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 **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 non ferrous materials : cast iron, carbon and alloy steels,aluminium and alloys, copper and alloys, magnesium and alloys. Nickel and alooys, **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; **Environmental protection issues**;Environmental regulation of surface engineering , cadmium elimination vapour degreasing alternatives, compient organic coating.	
Unit – IV	**10 Hrs**
Sputter technique – Methods, applications, plasma treatments, nitriding, carbonizing, boriding, titanising methods, applications **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, **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: Analyze tests for assessment of wear and corrosion behaviour.

Reference Books

1. Surface modification technologies - An Engineer's guide, Sudarshan T S, Marcel Dekker, Newyork, 1989
2. Electroplating and Other Surface Treatments - A Practical Guide, Varghese C.D, TMH, 1993
3. Surface Engineering Practice, Strafford, K.N., Datta, P.K., and Gray, J.S., Processes, Fundamentals and Applications in Corrosion and Wear, Ellis Harwood (1990).
4. Advanced Surface Coatings: A Hand book of Surface Engineering, Mathews, A., Spinger (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	**:**	**18 MCM 3E3**		**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	**12 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	**10 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 configruation

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
3	Adult Lean Thinking, James Womack, Simon & Schuster, ISBN: 0743249275, 2003.
4	The machine that changed the World - The story of Lean production, James P. Womack, Daniel T Jones, and Daniel Roos, Harper Perennial edition published -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	**:**	**18MPD41**		**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 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 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	**:**	**18MPD42**		**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.