

Courses of Study and Scheme of Assessment

M.E. LEAN MANUFACTURING

(2018 REGULATIONS)
(Minimum No. of credits to be earned: 71^{*})

Course Code	Course Title	Hours/Week			Credits	Maximum Marks			CAT
		Lecture	Tutorial	Practical		CA	FE	Total	
I SEMESTER									
18ML01	Applied Statistics and Reliability	3	-	-	3	50	50	100	FC
18ML02	Operations Management	3	-	-	3	50	50	100	PC
18ML03	Lean Manufacturing Tools and Techniques	3	-	-	3	50	50	100	PC
18ML04	Lean Supply Chain Management	3	-	-	3	50	50	100	PC
18ML05	Information Systems for Manufacturing	3	-	-	3	50	50	100	PC
18ML51	Manufacturing Simulation Laboratory	-	-	4	2	100	-	100	PC
Total 21 hrs		15	-	4	17				
II SEMESTER									
18ML06	Lean Six Sigma in Manufacturing and Service	3	-	2	4	50	50	100	PC
18ML07	Lean Product Design and Development	3	-	-	3	50	50	100	PC
18ML08	Total Productive Maintenance	3	-	-	3	50	50	100	PC
18ML09	Costing and Engineering Economics	3	-	-	3	50	50	100	PC
18ML--	Professional Elective 1	3	-	-	3	50	50	100	PE
18ML--	Professional Elective 2	3	-	-	3	50	50	100	PE
18ML52	Lean Manufacturing Laboratory	-	-	4	2	100	-	100	PC
18ML61	Industry Visit and Technical Seminar	-	-	4	2	100	-	100	EEC
Total 28 hrs		18	-	10	23				
III SEMESTER									
18ML--	Professional Elective 3	3	-	-	3	50	50	100	PE
18ML--	Professional Elective 4	3	-	-	3	50	50	100	PE
18ML--	Professional Elective 5	3	-	-	3	50	50	100	PE
18ML--	Professional Elective 6	3	-	-	3	50	50	100	PE
18ML53	Operations Research Laboratory	-	-	4	2	100	-	100	PC
18ML71	Project Work I	-	-	6	3	100	-	100	EEC
Total 22 hrs		12	-	10	17				
IV SEMESTER									
18ML72	Project Work II	-	-	28	14	50	50	100	EEC
PROFESSIONAL ELECTIVE COURSES									
18ML21	Human Factors Methods	3	-	-	3	50	50	100	PE
18ML22	Entrepreneurship Development	3	-	-	3	50	50	100	PE
18ML23	Agile Project Management	3	-	-	3	50	50	100	PE
18ML24	Management of Service Operations	3	-	-	3	50	50	100	PE
18ML25	Inventory and Warehouse Management	3	-	-	3	50	50	100	PE
18ML26	Human Resource Management	3	-	-	3	50	50	100	PE
18ML27	Marketing Management and Strategy	3	-	-	3	50	50	100	PE
18ML28	Facilities Design and Analysis	3	-	-	3	50	50	100	PE
18ML29	Sequencing and Scheduling	3	-	-	3	50	50	100	PE
18ML30	Enterprise Resource Planning	3	-	-	3	50	50	100	PE
18ML31	Advanced Optimization Techniques	3	2	-	4	50	50	100	PE
18ML32	Advanced Operations Research	3	2	-	4	50	50	100	PE

*Indicated is the minimum number of credits to be earned by a student.

CAT-Category; PC- Professional Core; PE- Professional Elective; EEC- Employability Enhancement Course

SEMESTER I

18ML01 APPLIED STATISTICS AND RELIABILITY vide Industrial Engineering 18MN01

18ML02 OPERATIONS MANAGEMENT vide Industrial Engineering 18MN05

18ML03 LEAN MANUFACTURING TOOLS AND TECHNIQUES

3 0 0 3

Course Objectives		Course Outcomes		Related Programme Outcomes
1	To impart knowledge for facilitating worker environment to identify hidden manufacturing wastes	CO1	Identify and Quantify the hidden manufacturing wastes in industries	PO4
		CO2	Analyze the effectiveness of lean manufacturing tools	PO5
2	To impart knowledge on systematic approach for implementing lean manufacturing practices	CO3	Develop a roadmap for successful implementation of lean principles	PO4,PO3
		CO4	Identify and organize the elements of just in time manufacturing	PO4

PRINCIPLES OF LEAN MANUFACTURING: Review of manufacturing paradigm; Objectives of lean manufacturing, key principles and implications of lean manufacturing, traditional versus lean manufacturing characteristics; Value creation and waste elimination-major kinds of manufacturing waste, concept of takt time, continuous flow , continuous improvement, single piece flow. (12)

LEAN MANUFACTURING TOOLS AND METHODOLOGIES: Values stream mapping: Current state and future state value stream mapping; Standard work: Communication of standard work to employees, visual controls; Quality at the source, 5S principles, Total Productive Maintenance, Changeover and setup time reduction; Production leveling-Failure mode and effect analysis, line balancing, mistake proofing, case studies. (11)

GROUP TECHNOLOGY AND JUST IN TIME MANUFACTURING: Group technology philosophy: Part family, Machine cell design and analysis; JIT-Elements of JIT, Kanban, case studies. (11)

LEAN MANUFACTURING IMPLEMENTATION: Road map for lean manufacturing implementation; Reconciling lean with other systems-Lean six sigma, integrating lean principles in ERP and PLM; Lean production in Industry 4.0: Impact of industry 4.0 on lean production system, case studies. (11)

Total L: 45

REFERENCES:

1. Askin R G, Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons Inc., 2003.
2. S. R. Devadasan, V. Sivakumar, "Lean and Agile Manufacturing: Theoretical, Practical and Research futurities", PHI, 2012.
3. Micheal Wader, "Lean Tools: A Pocket Guide to Implementing Lean Practices", Productivity and Quality Pub, 2002.
4. Kenichi Sekine, "One-Piece Flow", Productivity Press, Portland, Oregon, 1992.
5. Alan Robinson, "Continuous Improvement in Operations", Productivity Press, Portland, Oregon, 1991.
6. Beata Mrugalska, Magdalena K. Wyrwicka, "Towards Lean Production in Industry 4.0", Procedia Engineering, 182, 2017.

18ML04 LEAN SUPPLY CHAIN MANAGEMENT

3 0 0 3

Course Objectives		Course Outcomes		Related Programme Outcomes
1	To impart knowledge on Lean supply chain and inventory management	CO1	Identify the lean opportunities in supply chain and manage inventory through lean tools	PO4,PO5
		CO2	Develop lean supply chain design through lean logistics, lean warehousing and supply chain tools	PO5

2	To develop lean supply chain design ,execute and solve case studies	CO3	Execute Lean supply chain design through E procurement tools and integrate Global supply chain	PO5
		CO4	Solve the case studies by applying the concept of Lean supply chain	PO4

LEAN SUPPLY CHAIN AND INVENTORY MANAGEMENT: Lean opportunities in supply chain and logistics, Examples of JIT in the Supply chain, competitive strategy, logistics and customer value, measuring logistics cost and performance; Traditional inventory management versus lean inventory management, kanban sizing, WIP inventory: FIFO management, lot sizing in lean ,one piece, Every Part Every Interval ,lot sizing as part of scheduling, reducing pipeline inventory: kanban, visual car, inventory reduction through reducing lot sizes, point of sales data. (12)

LEAN SUPPLY CHAIN DESIGN: Principles, lean layouts, lean production schedules, lean service, traditional physical control of inventories, traditional relationships packaging, preparing an item for shipment, overall warehouse setup and item locations, traditional logistics, skill, freight cost, distribution requirements planning, lean warehousing, contractor management: selection of contractors, induction, onsite management, risk management, lean logistics : product availability and its effect on logistics ,collaboration: visibility and reliability, the impact of globalization, enterprise resource planning, leveraging enterprise resource planning in supply chain, sales and operations planning, lean supply chain tools for the perfect order (12)

LEAN SUPPLY CHAIN EXECUTION : E-Commerce, QR, ECR, and CPFR, collaborative planning, forecasting, replenishment, vendor-managed inventory, other potential areas for collaboration, future opportunities , logistics of a global supply chain, value stream mapping to identify waste, areas to reduce waste policies and procedures, relevant lean supply chain and logistics metrics, balanced scorecard, display and control metrics, barriers to supply chain integration ,trends in lean supply chain, data analytics, supply chain analytics and lean, potential obstacles to lean thinking in the supply chain. (11)

CASE STUDIES: Reverse logistics, warehouse management using lean concept, lean supply chain management of an automobile component manufacturing industry, introducing lean concept in E-procurement. (10)

Total L: 45

REFERENCES:

1. Paul Myerson "Lean Supply Chain and Logistics Management", McGraw-Hill Education, 2012.
2. Martin Christopher, "Logistics and Supply Chain Management, Pearson publications, 2011.
3. Robert Jacobs F,Richard B Chase "Operations and Supply Chain Management" McGraw-Hill Irwin, 2012.
4. Bill Kerber, Brian J Dreckshage, "Lean Supply Chain Management Essentials: A Framework for Materials Managers", CRC Press, 2011.
5. Baudin Michel, "Lean Logistics: The Nuts and Bolts of Delivering Materials and Goods", Productivity Press, New York, 2005.

18ML05 INFORMATION SYSTEMS FOR MANUFACTURING

3 0 0 3

Course Objectives		Course Outcomes		Related Program Outcome
1	To impart knowledge on information systems, networking and analyze product development and related issues	CO1	Determine the role of information technology in manufacturing	PO4
		CO2	Model the product development process using information technology	PO4
2	To develop manufacturing models and to plan resources for manufacturing through Information technology	CO3	Develop manufacturing models and collaborative engineering approaches for product design	P03,PO4
		CO4	Plan process and resources for manufacturing with the aid of information technology	PO3

INFORMATION SYSTEMS AND NETWORKING: Role of information technology in manufacturing: Role of internet, Intranet and extranet, present market constraints, extended enterprises, B2C and B2B. Types of server: Client/Server, architecture, database, data model, database management systems. Networking concepts: Networking devices, Network topologies, Wireless communication (12)

PRODUCT DEVELOPMENT AND ISSUES: Software Engineering: Software development life-cycle, Product life cycle management- Sequential engineering versus concurrent engineering - Global product - Product development – Quality assurance issues and complexity (12)

MANUFACTURING MODELS: Engineer to order, make to order, assemble to order, made to stock, and configure to order. Faster design throughput: Web based design, changing design approaches, engineering change management, product configuration management. Enterprise application and integration for product lifecycle management, risk management - case studies (10)

IT ENABLED PROCESS AND RESOURCE PLANNING: Process planning: Structure of process planning software, Information requirements for process planning. Role of Manufacturing Resource Planning (MRP), Enterprise Resource Planning (ERP) – case studies

REFERENCES:

1. Franjo Cecelja, "Manufacturing Information and Data systems, Design and Practice" Penton Press Publisher, 2002.
2. John Stark, "Global Product Strategy, Product Lifecycle Management and Billion Customer Question", Springer Publisher, 2007.
3. John Stark, "Product Lifecycle Management: 21st century for Product Realisation", Springer Publisher, 2005.
4. Radhakrishnan P, Subramanyan P, Raju V, "CAD/CAM/CIM", New Age International Publishers, 2002.

18ML51 MANUFACTURING SIMULATION LABORATORY**0 0 4 2**

Course Objectives		Course Outcomes		Related Program Outcome
1	To impart knowledge on manufacturing simulation in order to effectively solve real time problems	CO1	Demonstrate an understanding of the concepts of manufacturing towards solving productivity related problems	PO3,PO4
		CO2	Develop a virtual model to solve industrial engineering related issues such as capacity utilization, line balancing	PO3,PO4,PO5

In this course, students will be provided with an orientation on the following topics for a duration of 12-16hours. Each student is expected to perform a case study by formulating and completing an activity of interest derived from the orientation under the guidance of faculty. The details expected in the final report to be submitted at the end of the semester are: Problem definition, literature review, objectives, methodology, analysis and interpretation of results and conclusions.

TOPICS FOR ORIENTATION

1. Manufacturing system simulation and performance measurement using simulation software
2. Solving inventory problems using simulation software
3. Solving transportation and assignment problems
4. Project evaluation and review based on time and cost
5. Measurement system analysis , process capability analysis , gauge repeatability and reproducibility using statistical software

CASE STUDY

- Manufacturing simulation of advanced manufacturing systems

Total P: 60**REFERENCES:**

1. W. David Kelton, Randall Sadowski, David T. Sturrock, "Simulation with Arena", McGraw Hill Higher Education, 2005.
2. Jerry Banks, John S, Carson II, Barry L Nelson, David M Nicol, "Discrete Event System Simulation", Prentice Hall Inc., 2006.
3. Law A M, "Simulation Modeling and Analysis", Tata McGraw Hill Companies Inc, 2008.
4. Francis Neelamkavil, "Computer Simulation and Modeling", John Wiley and Sons, 1987.

SEMESTER II

18ML06 LEAN SIX SIGMA IN MANUFACTURING AND SERVICE

3 0 2 4

Course Objectives		Course Outcomes		Related Programme Outcomes
1	To impart knowledge on lean six sigma philosophy and project methodology.	CO1	Demonstrate knowledge on lean six sigma principles, project selection and project management.	PO4
		CO2	Develop the project charter for the given project and apply measure tools to interpret results.	PO5
2	To measure and analyze the given problem and apply the lean six sigma tools.	CO3	Analyze the root causes and examine the hypotheses	
		CO4	Compare, select and evaluate the solutions.	

CONCEPTS OF LEAN SIX SIGMA: Overview of six sigma concept: definition, origin, terms. Foundations of lean six sigma –four keys, five laws of lean six sigma, types of lean six sigma: DMAIC versus DMADV – lean six sigma project selection: selection of team members, six sigma roles and responsibilities; Team stages: characteristics of effective teams, six sigma training plan; Six sigma metrics: DPMO calculation, quality cost, cost of poor quality- roadmap for implementation; Common implementation issues and management strategies. (12)

DEFINE AND MEASURE PHASE: Customer identification, Voice of customer (VOC), VOC data collection, Critical To Quality (CTQ) – Value Stream Mapping - SIPOC – project charter, types of measures, types of data, applications of QC tools, measurement system analysis, Process capability calculations. (12)

ANALYSE PHASE: Inferential and Descriptive Statistics, Patterns of Variation, Normality Analysis, Multi-Vari Analysis; Hypothesis testing for Normal Data: Selection and application problems; Introduction to statistical software, failure mode and effects analysis, analysis of lean wastes. (11)

IMPROVE AND CONTROL PHASE: Process redesign principles, Generating improvement alternatives, Quality Function Deployment (QFD), Theory of Inventive Problem Solving (TRIZ); Design of experiments; Waste elimination methods, Cycle time reduction, Cost/benefit analysis; Process scorecard – Control Plan. (10)

Total L: 45+15=60

REFERENCES:

- Jay Arthur, "Lean Six Sigma – Demystified", Tata McGraw Hill Companies Inc, 2011.
- Joseph De Feo, William Barnard, "Juran Institute's Six Sigma Breakthrough and Beyond", McGraw-Hill, 2004.
- Betsiharris Ehrlich, "Transactional Six Sigma and Lean Servicing", St. Lucia Press, 2002.
- Michael L George, David T Rowlands, Bill Kastle, "What is Lean Six Sigma", McGraw Hill, New York, 2004.
- Kai Yangand Basem El, Haik, "Design for Six Sigma", McGraw Hill, New York, 2004.
- Donald W Benbow, Kubiak T M, "Certified Six Sigma Black Belt Handbook", Pearson Education, 2007.

18ML07 LEAN PRODUCT DESIGN AND DEVELOPMENT

3 0 0 3

Course Objectives		Course Outcomes		Related Programme Outcomes
1.0	To impart knowledge on integrated product design and development process and facilitate learning for the lean product development culture	CO1	Develop the integrated product design and development process	
		CO2	Analyze the lean product development organizational culture	
2.0	To impart knowledge on systematic approach lean product development process and lean journey in product development	CO3	Develop a roadmap for successful lean product development process	
		CO4	Identify the lean journey for breaking the roots from the traditional paradigm	

INTEGRATED PRODUCT DESIGN AND DEVELOPMENT: Product development system, process particularities, performance drivers, metrics; integrated product development-sequential product design and integrated product design; Rescue movement, tools and teams; lean thinking, value on product development, waste in product development. Green manufacturing: lean sustainability, continuous improvement. (12)

LEAN PRODUCT DEVELOPMENT- ORGANIZATIONAL CULTURE: Lean enabling organizational culture-hard on the problem, soft on the people; power of communication, lean product development organization knowledge management organized to learn (and to lean); knowledge identification-creation- representation-distribution, enabling; A3 report planning method- problem-solving A3. (11)

LEAN PRODUCT DEVELOPMENT PROCESS: Process and its phases, portfolio management activities; value identification, proposition, delivery planning, design and development, production/ramp-up, product/process follow-up and product process discontinuation activities; product development and visual management; value function deployment, identification activities , planning activities ;board to guide the value delivery planning; execution phase - board to guide the design and development-production. (11)

LEAN JOURNEY: Setting attitude and plan; breaking the roots from the traditional paradigm; thermo baby development project; robot based flight simulator development project; product development performance drivers, case studies. (11)

Total L: 45

REFERENCES:

1. Marcus Vinicius Pereira Pessoa, Luís Gonzaga Trabasso, "The Lean Product Design and Development Journey- A Practical View", Springer International Publishing AG 2017.
2. Ronald Mascitelli, "Mastering Lean Product Development-A Practical, Event-Driven Process for Maximizing Speed, Profits, and Quality", Technology Perspectives, 2011.
3. Ronald Mascitelli, "The Lean Product Development Guidebook", Technology Perspectives, 2014.
4. Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006.

18ML08 TOTAL PRODUCTIVE MAINTENANCE

3 0 0 3

Course Objectives		Course Outcomes		Related Programme Outcomes
1	To impart knowledge on total productive maintenance and its impact	CO1	Identify the importance of equipment availability and the role of TPM	PO4
		CO2	Analyze the tools for TPM implementation and eliminate equipment related losses	PO5
2	To impart knowledge on TPM implementation	CO3	Develop a roadmap for 'zero loss' culture in production environment	PO4
		CO4	Identify and organize the major elements of maintenance	PO4

PRINCIPLES OF TOTAL PRODUCTIVE MAINTENANCE: Review of TPM concept-Objectives and functions, Reliability centered maintenance, Maintainability prediction, availability and system effectiveness, maintenance cost. (12)

TPM IMPLEMENTATION: Developing the TPM implementation plan; Preventive maintenance, Minimal repair, Maintenance types, Balancing PM and breakdown maintenance. (11)

ZERO BREAK DOWN: Zero defects and TPM, Maximizing equipment effectiveness, Autonomous maintenance program, Pillars of TPM, TPM small group activities, TPM organization, Improving maintenance efficiency and effectiveness. (11)

HUMAN FACTORS IN MAINTENANCE: Maintenance manuals, Maintenance staffing methods, Simulation, Spare parts management; Maintenance planning and scheduling; Condition monitoring techniques. Maintenance management information systems, total economic maintenance, team-based maintenance, fault diagnosis, TPM online diagnostics. (11)

Total L: 45

REFERENCES:

1. Tina Kanti Agustyadi, Elizabeth A. Cudney, 'Total Productive Maintenance: Strategies and Implementation Guide', Productivity Press, 2015.
2. Kern Peng, 'Equipment Management in the Post-Maintenance Era: A New Alternative to Total Productive Maintenance (TPM)', Productivity Press, 2012.
3. David J. Sumanth, 'Total Productivity Management: A Systematic and Quantitative Approach to Compete in Quality, Price and Time', Productivity Press, 1997.
4. Fumio Gotoh, MasajiTajiri, 'Autonomous maintenance in Seven Steps: Implementing TPM on the Shop Floor', Productivity Press, 1999.
5. Japan Institute of Plant Maintenance, 'Autonomous maintenance for Operators', Productivity Press, 1997.

18ML09 COSTING AND ENGINEERING ECONOMICS

3 0 0 3

S.No	Course objectives	Course outcomes		Related POS
1.0	To impart knowledge on the types of error during measurement and calibration of instruments and an insight into the surface texture	CO1	Demonstrate an understand of the knowledge on types of error, calibration of instruments and surface texture	
2.0	To impart knowledge on the concepts of present economic policies and provides a basic knowledge of time value of money and its interest calculation.	CO2	Select an appropriate method and to Demonstrate an understand of the knowledge of time value of money with different cash flow techniques.	
		CO3	Demonstrate an understand of the knowledge on the replacement analysis and select an optimal replacement for the existing asset in different industrial scenario.	
3.0	To develop an ability for preparing project feasibility report	CO4	Analyse the project network.	

COST CONCEPTS: Cost structure: Labor, material, overhead cost; Nature of overhead Cost, Overhead absorption methods: Direct labor, direct material, number of pieces, labor hour rate, machine hour rate methods – Cost control: labor, material, overhead variance analysis. (10)

ECONOMICS: Present economic policy: liberalization, privatization, globalization, scope for industrial growth, interest and time value of money, cash-flow diagram, simple interest, compound interest, single payments: uniform series payments - interest factors and tables - nominal and effective interest rates - continuous compounding - uniform continuous payments. Present worth comparison - equal, unequal lived assets - study period – assets with infinite life - capitalized cost. Equivalent uniform annual cost comparison – situations for EUAC. (12)

REPLACEMENT ANALYSIS: Review of conventional approach – group replacement - analysis with time value accounting – replacement due to deterioration, obsolescence, inadequacy – economic life for cyclic replacements - current salvage value of the defender - defender and challenger with different lives - additional one year assessment. (11)

PROJECT FEASIBILITY ANALYSIS: Case study - report preparation. Depreciation - reasons - depreciation accounts - causes of declining value - depreciation methods, multi product break even analysis. - review of project management - PERT - CPM - crashing - cost system. (12)

Total L: 45

REFERENCES:

1. James L Riggs, David D Bedworth, Sabah U Randhawa, "Engineering Economics", McGraw Hill Book Company, 2004.
2. Leland T Blank, Anthony J Tarquin, "Engineering Economy", McGraw Hill Book Company, 2012.
3. John A White, "Principles of Engineering Economic Analysis", John Wiley and Sons, 2012.
4. William G Sullivan, "Engineering Economy", Pearson Education Inc., 2010.
5. T.R. Banga, S.C. Sharma, "Mechanical Estimating and Costing Including Contracting", Khanna Publishers, 2011.

18ML52 LEAN MANUFACTURING LABORATORY

0 0 4 2

Course Objectives		Course Outcomes		Related Program Outcome
1	To impart knowledge on various lean manufacturing tools and techniques to effectively solve real time problems	CO1	Demonstrate an understanding of the concepts of lean manufacturing towards solving waste elimination issues	PO3,PO4
		CO2	Develop a lean production environment to increase the organizational productivity	PO3,PO4,PO5

In this course, students will be provided with an orientation on the following topics for a duration of 12-16hours. Each student is expected to perform a case study by formulating and completing an activity of interest derived from the orientation under the guidance of faculty. The details expected in the final report to be submitted at the end of the semester are: Problem definition, literature review, objectives, methodology, analysis and interpretation of results and conclusions.

TOPICS FOR ORIENTATION

1. Facility layout design and study of layout performance
2. Value Stream Mapping: Study of current state and future state diagrams
3. Ergonomic study of human performance
4. Study of lean factory (cycle time, WIP, time and motion study, Poka-Yoke)
5. Process capability study and use of six sigma
6. Study of failure mode and effects analysis

Case study:

- Implementation of lean techniques in a manufacturing industry and perform lean audit.

Total P: 60

REFERENCES:

1. Askin R G, Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons Inc., 2003
2. Micheal Wader, "Lean Tools: A Pocket Guide to Implementing Lean Practices", Productivity and Quality Pub, 2002
3. Beata Mrugalska, Magdalena K. Wyrwicka, "Towards Lean Production in Industry 4.0", Procedia Engineering, 182 (2017)

18ML61 INDUSTRY VISIT AND TECHNICAL SEMINAR

0 0 4 2

This course, likened to a min-intern, requires each student to identify a manufacturing or service industry and pursue the solution of an industrial problem consistent with the credits allotted for the course. Students are expected to study the problem, survey pertinent literature, gather relevant data and carry out engineering and scientific analysis followed by a detailed presentation both oral and written. The report submitted for final assessment should be in line with that required for Project Work.

Total P: 60

SEMESTER III

18ML53 OPERATIONS RESEARCH LABORATORY Vide Industrial Engineering 18MN51

18ML71 PROJECT WORK I

0 0 6 3

- a) Identification of real life problem in thrust areas
- b) Developing a mathematical model for solving the selected problem
- c) Finalisation of system requirements and specification
- d) Proposing different solutions for the problem based on literature survey
- e) Future trends in providing alternate solutions
- f) Consolidated report preparation

Total P: 90

IV SEMESTER 18ML72 PROJECT WORK II

0 0 28 14

The project work involves the following:

Preparing a project - brief proposal including

- a) Problem identification
- b) A statement of system / process specifications proposed to be developed (block diagram / concept tree)
- c) List of possible solutions including alternatives and constraints
- d) Cost benefit analysis
- e) Time Line of activities

A report highlighting the design finalization [based on functional requirements and standards (if any)]

A presentation including the following:

- a) Implementation phase (Hardware / Software / both)
- b) Testing and validation of the developed system
- c) Learning in the project

❖ **Consolidated report preparation**

ELECTIVES

18ML21 HUMAN FACTORS METHODS

3 0 0 3

Course Objectives		Course Outcomes		Related Programme Outcomes
1.0	To impart knowledge on human constraints and their influence on performing tasks	1.1	Identify and evaluate the series of tasks in a process	
		2.1	Determine the cognitive elements involved in every task	
2.0	To augment understanding of biomechanical models and utilizing automation to aid human effort	3.1	Ascertain the interplay between human and workspace	
		4.1	Analyze biomechanical models and suggest remedies in case of work overload	

HUMAN FACTORS: Goals and Scope of human factors, Systems thinking, Human centered design, Steps in performing task analysis, Iterative design and refinement, Evaluation methods – Purpose and types of evaluation, Factorial designs with interactions, Analysis of data, Statistical and practical significance. (12)

COGNITIVE ELEMENTS: Visual environment and receptor system, sensory processing characteristics, Influence of vision on cognition, Auditory environment, Noise and annoyance, Tactile and Haptic senses; Information processing model of cognition, Working and Long term memory, Divided attention and time sharing. (11)

HOMINAL SYNERGY WITH WORKSPACE: Theories for interface and interaction design, Types of automation; Fifteen principles of human centered automation, problems with automation; Principles of workspace design, Use of anthropometric data in design, Standing and seated workplace. (11)

BIOMECHANICS OF WORK: Biomechanical models, Low-back problems, Cumulative trauma disorders, Work load assessment, Energy cost of work, Whole body fatigue, Work capacity, Environmental and Psychological stressors, Remedies for overload, Vigilance, fatigue and sleep disruption, Safety and accident prevention – OSHA and NIOSH. (11)

Total L: 45

REFERENCES:

1. John D. Lee, Christopher D. Wickens, Yili Liu, " An Introduction to Human Factors Engineering ", Create Space Independent Pub., 2017.
2. Neville A. Stanton, "Human Factors Methods: A Practical Guide for Engineering and Design", Taylor & Francis, 2013
3. L. P. Singh, Arvind Bhardwaj, "Human Factor Engineering", Galgotias Pvt. Ltd, 2016.
4. Stephen.J.Guastello, Human Factors Engineering and Ergonomics: A Systems Approach, Second Edition, 2017.
5. Chandler.A.Phillips," Human Factors Engineering", First edition, 2000.

18ML22 ENTREPRENEURSHIP DEVELOPMENT

3 0 0 3

Course Objectives		Course Outcomes		Related Programme Outcomes
1.0	To impart knowledge on the competencies necessary to establish new ventures	1.1	Innovate and solve challenges in business	
		2.1	Determine risks in the trade and respond effectively	

2.0	To inculcate strategic thinking and ethical behavior which are vital to enhance entrepreneurial skills	3.1	Utilize tools and develop strategies to manage business	
		4.1	Identify ethical issues, grievances and create redressal mechanisms	

FUNDAMENTALS OF ENTREPRENEURSHIP: Forms of ownership, systematic business transformation, innovation in entrepreneurship, seven sources for innovative opportunity, social and psychological factors, types, competencies and pre-requisites of entrepreneurs. (12)

ENTREPRENEURIAL MOTIVATION: Propensity to taking risks, McClelland's need-Achievement Theory, Herzburg's theory, McGrigor's Theory, thematic apperception test – stress management, use of E-commerce in business (11)

STRATEGIES FOR BUSINESS: Market assessment, value chain analysis, SWOT analysis, porter's 5-forces model, sources of finance, financial statement analysis, manpower planning, tools and techniques for performance appraisal, process of image building, promotion and distribution. (11)

ETIQUETTES AND ETHICS: Effective presentation styles and body language, employee rights and gender issues, customer care, grievance redressal, values and morals at workplace, case study of successful entrepreneurs. (11)

Total L: 45

REFERENCES:

1. Peter Drucker, "Innovation and Entrepreneurship", Harper Collins India, 2015
2. Byrd, Megginson, "Small Business Management: An Entrepreneur's Guidebook", McGraw Hill Education, 2013
3. Gordon E, Natarajan K, "Entrepreneurship Development", Himalaya Publications House, 2014
4. Sharma Sangeeta, "Entrepreneurship Development", PHI Learning Pvt. Ltd, 2016

18MN23 AGILE PROJECT MANAGEMENT

3 0 0 3

Course Objectives		Course Outcomes		Related Program Outcomes
1.0	To impart knowledge on selection and initiation of individual projects and portfolios of projects in the enterprise	1.1	Manage the scope, cost, timing and quality of the project	
2.0	To impart knowledge on effective organizational leadership and change skills for managing projects, project teams and stake holders.	2.1	Appraise the role of project management in organization change	
		3.1	Develop roadmap for successful PM	
		4.1	Identify to control, evaluate and terminate the project.	

PROJECT MANAGEMENT AND INITIATION: Definition of Project, Project Life Cycle, Selecting Projects Strategically – Project Management maturity, Project selection and criteria of choice, the nature of project selection models, types of project selection models, Role of project managers, Nature of negotiation, partnering, chartering and scope change, conflict and the project life cycle, requirements and principles of negotiation. (12)

PROJECT PLANNING, TOOLS AND TECHNIQUES: Initial project coordination and the project plan; Project costs and Budgets – estimating project budgets, expert opinion, analogy, parametric estimate; cost engineering – example, contingency amount, elements of budgets and estimates improving the process of cost estimation. Network diagram and Network Techniques; Risk analysis – objectives of risk analysis, identify the risk; Risk management – choosing, implementing and evaluating; Project control, evaluation and termination. (11)

AGILE PROJECT MANAGEMENT: Agile revolution's impact on product development- Agile Project Management, Agile values and principles for organization; Optimizing all five stages of the agile project: Envision, Speculate, Explore, Adapt, and Close (11)

AGILE ENTERPRISE FRAMEWORK: Governance, project and iteration management, technical practices; Organizational and product-related processes for scaling agile, agile project governance solutions; The "Agile Triangle": measuring performance, changing role of the agile project leader. (11)

Total L: 45

REFERENCES:

1. John M Nicholas, "Project Management for Business and Technology", Prentice Hall India Pvt. Ltd., New Delhi, 2002.
2. Jim Highsmith, "Agile Project Management: Creating Innovative Products", Addison-Wesley Professional, 2009
3. Mark C. Layton "Agile Project Management", John Wiley & Sons, Inc, 2012
4. Anastasia Pagnoni, "Project Engineering – Computer Oriented Planning and Operational Decision Making", Springer Verlag, 1990.
5. Dennis Lock, "The Essentials of Project Management", Gower Publishing Ltd., 1997.
6. Vasant Desai, "Project Management", Himalaya Publishing House, 2001.

18ML24 MANAGEMENT OF SERVICE OPERATIONS

3 0 0 3

Course Objectives		Course Outcomes		Related Program Outcome
1.0	To impart knowledge on service sector concepts	1.1	Determine the types of services, processes, customer and supplier relationship in terms of service	
2.0	To impart knowledge about service delivery and service management	2.1	Understand the nature of service processes and critical factors in delivery	
		3.1	Identify and utilize the resource for managing service, technology and information	
3.0	To impart knowledge on service strategical change	4.1	Manage the service strategy, culture and operational features	

SERVICE CHARACTERISTICS: Services – Importance, role in economy, service sector – growth; Nature of services -Service classification , Service Package, distinctive characteristics , open-systems view; Service strategy – Strategic service vision, competitive environment, generic strategies, winning customers; Role of information technology; stages in service firm competitiveness; Internet strategies - Environmental strategies. (12)

SERVICE DESIGN: New service development: Design elements, Service blue-printing, process structure, generic approaches, value to customer. Retail design strategies: store size- Network configuration; managing service experience: economy, key dimensions, vehicle routing and scheduling. (11)

SERVICE QUALITY: Service quality- dimensions, service quality gap model; measuring service quality- quality service by design - service recovery - service guarantees; service encounter – triad, creating service orientation, service profit chain; front-office back-office interface – service decoupling. (10)

SERVICE STRATEGIC CHANGE: Managing demand – strategies; managing capacity – basic strategies, supply management tactics, operations planning and control; yield management; inventory management in services– retail discounting model, newsvendor model; managing waiting lines –queuing systems, psychology of waiting; managing for growth- expansion strategies, franchising , globalization. (12)

Total L: 45

REFERENCES:

1. Robert Johnson, Graham Clark, "Service Operations Management: Improving Service Delivery", Pearson Education Ltd., 2005.
2. Bill Hobins, Sadie Shinkins, "Managing Service Operations", Sage Publications India Ltd., New Delhi, 2006.
3. Nevan Wright J, Peter Race, "The Management of Service Operations", Thomson Learning, 2005.
4. William J Glynn, James G Barnes, "Understanding Service management: Integrating marketing, Operational Behavior", Wiley Publishers, 1995.

18ML25 INVENTORY AND WAREHOUSE MANAGEMENT

3 0 0 3

Course Objectives		Course Outcomes		Related Programme Outcomes
1.0	To introduce the concepts of inventory and warehouse process, management, and inventory management tools for an industry	CO1	Demonstrate the knowledge of various operations involved in inventory management and apply various inventory management tools for inventory management	
		CO2	Apply the concepts of various operations involved in warehouse process and warehouse management	
2.0	To impart the knowledge on warehouse management tools, outsourcing, automation and role of information technology for an industry	CO3	Apply various warehouse management tools required for warehouse management	
		CO4	Analyze the need for outsourcing, coding applications and various information technology involved in electronic commerce	

INVENTORY MANAGEMENT AND TOOLS: Types of inventory, types of inventory demand, reorder point, techniques, safety stock, safety time, Economic Order Quality; Inventory cost-purpose of inventory, types of stocks; Inventory Strategy: replenishment, fulfillment, customization and outsourcing, framework of Inventory management; Obsolete Inventory: obsolete inventory identification, disposal, presentation and NCNR inventory reduction; Case study on total landed cost. Inventory record accuracy - fill rates; Tools to uncover system dysfunction: run charts, flow charts, logic charts, variance report - cycle count: annual inventory, cycle count methodologies. (12)

WAREHOUSE MANAGEMENT AND PROCESS: Types of warehouse operations, supply chain trends affecting warehouse, transportation issues; Assets, activities; Warehouse manager role: warehouse trade-offs, challenges, people management, attracting and retaining warehouse employees and training: receiving, pre-receipt, in-handling, preparation, offloading, checking, cross-checking; Pick preparation: preparation and warehouse layout. (12)

WAREHOUSE MANAGEMENT TOOLS: Warehouse audit, 5S or 5C (Gemba Kanri), Pareto analysis, ABC analysis and XYZ analysis for warehouse design, Order picking strategy, choice of picking system, cross docking, slotting or item profiling, resource planning, task inventory, selection of warehouse storage equipment, warehouse location number, selection of material handling equipments, warehouse space calculation, selection of warehouse management system. (11)

OUTSOURCING, AUTOMATION IDENTIFICATION AND ROLE OF INFORMATION TECHNOLOGY: Decision for outsourcing, core activity/ core competence, cost reduction, labor relation, financial strategy, flexibility; Role of third-party contractors, future of outsourcing, basics of bar coding - elements of bar code symbols - bar code applications. (10)

Total L: 45

REFERENCES:

1. Steven Bragg, "Inventory Management", Accounting Tools LLC, USA, 2013.
2. Gwynee Richards, Susan Grinstead, "The logistics and Supply chain toolkit", Gwynee Richards Publications, USA, 2013.
3. Russell G Broeckelmann, "All in Inventory Classification Innovation: Paving the way for Electronic commerce and Vendor managed inventory", CRC Press, 1999.
4. Max Muller, "Essentials of Inventory Management", American Management Association, 2011.

18ML26 HUMAN RESOURCE MANAGEMENT

3 0 0 3

Course Objectives		Course Outcomes		Related Program Outcomes
1.0	To impart knowledge on basic concepts and framework of HRM	1.1	Manage and plan key human resource functions within organizations	
2.0	To impart knowledge on societal challenges and legal responses to HR issues	2.1	Examine current issues, trends, practices, and processes in HRM	
		3.1	Record governmental regulations affecting employees and employers	
		4.1	Analyze the key issues related to administering the human elements	

NATURE AND SCOPE OF HUMAN RESOURCE MANAGEMENT: Meaning and definition of HRM, objectives and functions of HRM, models of HRM, HRM in a changing environment, role of globalization in human resource management; Job analysis – job specification – recruitment – induction – selection – placement: role in HRM, process, methods, selection and placement. (11)

TRAINING AND DEVELOPMENT: Principles of learning, objectives, types and training methods, multi-skilling, management development: meaning, scope and objectives; Process: methods, factors that distort appraisal, methods to improve performance, role of performance in the performance management process, performance appraisal versus potential appraisal. (12)

WAGE AND SALARY ADMINISTRATION: Principles and techniques of wage fixation, job evaluation, incentive schemes; Morale: importance of moral-employee attitudes and behaviour and their significance to employee productivity; Motivation methods of employees, empowerment: factors affecting empowerment – process – benefits. (12)

WORK ENVIRONMENT AND TERMS AND CONDITIONS OF EMPLOYMENT: Fatigue, safety, accident prevention accident records, industrial relations; Model variables that outline difference between local and international HRM: approaches to IHRM, linking HRM to international expansion strategies; HR outsourcing: Human resource information system – management of turnover and retention. (10)

Total L: 45

REFERENCES:

1. Gary Dessler, "Human Resource Management", Prentice Hall of India, New Delhi, 2003.
2. Dezenzo A David, Robbins P Robbins, "Human Resource Management", John Wiley and Sons, 2007.
3. Aswathappa K, "Human Resource and Personnel Management – Text and Cases", Tata McGraw Hill, 2002.
4. Bernardin H John, "Human Resource Management – An Experiential Approach", Tata McGraw Hill, 2008.
5. Rao V S P, "Managing People", Excel Books, New Delhi, 2002.

18ML27 MARKETING MANAGEMENT AND STRATEGY

3 0 0 3

Course Objectives		Course Outcomes		Related Program Outcome
1.0	To impart knowledge on key marketing concepts, theories and techniques for various marketing solutions.	CO1	Manage the scope, cost, timing and quality of the marketing.	
2.0	To impart knowledge on roles and functions of marketing within the range of organizations.	CO2	Appraise the role of marketing management in organization change	
		CO3	Synthesize ideas into a market plan	
		CO4	Justify the marketing strategies and its implementation	

MANAGEMENT OBJECTIVES: Objectives and success: stakeholders' objectives and constraints, developing balanced objectives, developing a strategy, criteria for strategic success, strategic intent core competences, organizational dimensions. Theory of marketing: the customer-led business, focus on needs, competitive advantage, customers as assets, creating the customer-led business. (11)

STRATEGIC MARKET PLANNING: Adapting to change, evolution of planning systems, corporate strategy, business unit strategy. Market dynamics and competitive strategy: cycles of confusion, market dynamics, evolution of markets, formulating marketing strategies, niche companies. (12)

COMMUNICATION STRATEGY: Communications and buyer behavior: advertising planning, direct response marketing, interactive marketing, sales promotion, public relations, communications mix. Sales management: selling process, negotiations, managing account relationships. (12)

MARKETING IN SERVICE: Nature of services: service characteristics, service tasks, services marketing strategy .Marketing: a recapitulation, changing marketing environment, market prediction, corporate responsibility .Case studies. (10)

Total L: 45

REFERENCES:

1. Peter Doyle and Philip Stern, "Marketing Management and Strategy", Pearson Education Limited, 2006.
2. Philip Kotler and Kevin Lane, "Marketing Management", PHI Publications, 2008.

3. Azhar Kazmi, "Strategic Management & Business Policy", Tata McGraw Hill, 2008.
4. Lawrence G. Hrebiniak, "Making strategy work", Pearson Education Limited, 2005.

18ML28 FACILITIES LOCATION AND DESIGN
vide Industrial Engineering 18MN25

18ML29 SEQUENCING AND SCHEDULING
vide Industrial Engineering 18MN35

18MN30 ENTERPRISE RESOURCE PLANNING
vide Industrial Engineering 18MN03

18ML31 ADVANCED OPTIMIZATION TECHNIQUES
vide Industrial Engineering 18MN24

18ML32 ADVANCED OPERATIONS RESEARCH
vide Industrial Engineering 18MN02