SYLLABUS

With effect from 2018-2019
Outcome Based Education and Choice Based Credit System

ಪಠ್ಯಕ್ರಮ

ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2018–19
ಫಲಿತಾಂಶ ಆಧಾರಿತ ಶಿಕ್ಷಣ ಹಾಗೂ ಐಚ್ಛಿಕ ವಿಷಯಾಧಾರಿತ ಗಳಿಕೆ ಪದ್ಧತಿ

VII and VIII Semester

BACHELOR DEGREE
IN
INDUSTRIAL & PRODUCTION ENGINEERING

P.E.S. College of Engineering

Mandya - 571 401, Karnataka
(An Autonomous Institution under VTU, Belagavi)
Grant-in-aid Institution (Government of Karnataka). World Bank Funded College (TEQIP)
Accredited by NBA (6 PGM), NAAC and Approved by AICTE, New Delhi.

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ

ಮಂಡ್ಯ–571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

Preface

PES College of Engineering, Mandya, started in the year 1962, has become autonomous in the academic year 2008-09. Since, then it has been doing the academic and examination activities successfully. The college is running **Eight undergraduate** and **Eight Postgraduate** programs. It consists of Six M.Tech programs and other two postgraduate programs are MBA and MCA, which are affiliated to VTU.

India has recently become a Permanent Member by signing the Washington Accord. The accord was signed by the National Board of Accreditation (NBA) on behalf of India on 13th June 2014. It enables not only the mobility of our degree globally but also establishes equivalence to our degrees with that of the member nations such as Taiwan, Hong Kong, Ireland, Korea, Malaysia, New Zealand, Russia, Singapore, South Africa, Turkey, Australia, Canada and Japan. Among other signatories to the international agreement are the US and the UK. Implementation of Outcome Based Education (OBE) has been the core issue for enabling the equivalence and of Indian degrees and their mobility across the countries.

Our Higher Educational Institution has adopted the Choice Based Credit System (*CBCS) based semester structure with OBE scheme and grading system.*

The credit based OBE semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

The OBE, emphasize on setting clear standards for observable, measurable outcomes of programs in stages. There lies a shift in thinking, teaching and learning processes moving towards Students Centric from Teacher Centric education. OBE standards focus on mathematics, language, science, attitudes, social skills & moral values.

The key features which may be used to judge, if a system has implemented an outcome based education system is mainly Standard based assessments that determines whether the students have achieved the stated standard. Assessments may take any form, so long as the process actually measure whether the student knows the required information or can perform the required task. Outcome based education is a commitment that all students of all groups will ultimately reach the same minimum standards. Outcome Based Education is a method or means which begins with the end in mind and constantly emphasizes continuous improvement.

Choice Based Credit System (CBCS) provides choice for students to select from the prescribed courses (core, Foundation, Foundation Elective, elective, open elective and minor or soft skill courses). The CBCS provides a 'cafeteria' type approach in which the students can Choose electives from a wide range of courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits, adopt an interdisciplinary approach to learning which enables integration of concepts, theories, techniques, and, perspectives from two or more disciplines to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline. These greatly enhance the skill/employability of students.

In order to increase the Industry/Corporate readiness, many Soft Skills and Personality Development modules have been added to the existing curriculum of the 2015 scheme. Industry Interactions have been made compulsory to enhance the field experience. In order to enhance creativity and innovation Mini Project and Industrial visit & Interaction are included in all undergraduate programs.

Dr D R Umesh
Deputy Dean (Academic)
Associate Professor,
Dept. of Computer Science & Engg

Dr.R Girish
Dean (Academic)
Professor,
Dept. of Computer Science & Engg

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Vision and Mission of the Institution

Vision

"PESCE shall be a leading institution imparting quality engineering and management education developing creative and socially responsible professionals."

Mission

- Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.
- Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.
- Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.
- Promote research, product development and industry-institution interaction.

DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

About The Department

The Department of Industrial & Production Engineering was started during the year 1982 with a mission to produce the students of good management skill to cater the need of the advanced and globalized market which demand quality management people. The program offered in the department is B.E. in Industrial & Production Engineering. The department has very well experienced qualified teaching faculty among which three doctoral degree holders one is submitting his thesis and two are pursuing Post graduate courses.

The department strives hard to bring out well qualified students through all the available sources of teaching audio visual, interactive methods in teaching-learning process. The department has well-equipped laboratories, latest software facilities, to prepare the students industry ready when they become graduates.

The curriculum is designed involving industry, academia personnel to meet the demands of the current scenario and updated constantly according to industrial needs. The department regularly organizes technical talks by inviting experts from various industries and institutes, organizes industrial visits to enhance the practical knowledge of the students.

Vision and Mission of the Department

VISION

Contribute to achieve academic excellence for imparting quality education in I & P Engineering and to carry out the research activity on continuous basis to develop competent and social responsible engineers and managers.

MISSION

1. To educate them in the fundamental concept, knowledge, skills in theory and practices.
2. To prepare them through skilled programmes for better Employment as engineers and managers or pursuit of advanced degrees in Industrial, Production and Mechanical Engineering fields.
3. To inculcate qualities of communication skills, professional personality and ethical values to make them the responsible and competent professionals.

Program Educational Objectives (PEO)

PEO1: Industrial and Production Engineering program will prepare graduates who will have the ability to apply the principles and techniques of traditional and modern quantitative, qualitative analysis, synthesis and effectively interpret, evaluate, select, and communicate the desired alternative in both manufacturing and service industries.

PEO2: Industrial and Production Engineering program will prepare its graduates who will possess the required engineering competence in industrial engineering, production engineering and managerial skills.

PEO3: Industrial and Production Engineering program will prepare graduates, who possess communication skills, professional personality and ethical

Program Outcomes

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs):

PSO 1: Industrial & Production Engineering graduates will be able to apply the knowledge acquired in the program about materials and finishing process.

PSO2: Industrial & Production Engineering graduates will be able design product based on Ergonomic Principles

VII – Semester										
Sl. No	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P18IP71	Supply Chain Management	IP	4	-	-	4	50	50	100
2	P18IP72	Additive Manufacturing	IP	4	-	-	4	50	50	100
3	P18IP73	Operations Research	IP	4	-	-	4	50	50	100
4	P18IP74X	Professional Elective - III	IP	2	1	-	3	50	50	100
5	P18IPO75X	Open Elective-I I	IP	3	-	-	3	50	50	100
6	P18IPL76	CNC & Robotics Lab	IP	-	-	3	1.5	50	50	100
7	P18IPL77	Machine Tools Testing and Design Lab	IP	-	-	3	1.5	50	50	100
8	P18IPL78	Project Work Phase-I and Project Seminar	IP	-	-	4	2	100	--	100
Total							**23**	**450**	**350**	**800**

Professional Elective-III		
Sl. No	**Course Code**	**Course title**
1	P18IP741	Operations Management
2	P18IP742	Product Design and Manufacturing
3	P18IP743	Concurrent Engineering
4	P18IP744	Materials Management

Open Elective-1I		
Sl. No	**Course Code**	**Course title**
1	P18IPO751	Just In Time Manufacturing
2	P18IPO752	Database Management System
3	P18IPO753	Project Management
4	P18IPO754	Production Planning & Control.

VIII – Semester										
Sl. No	Course Code	Course Title	Teaching Department	Hrs / Week			Credits	Examination Marks		
				L	T	P		CIE	SEE	Total
1	P18IP81	Total Quality Management	IP	4	-	-	4	50	50	100
2	P18IP82X	Professional Elective - IV	IP	2	1	-	3	50	50	100
3	P18IP83	Internship	IP	-	-	-	2	50	50	100
4	P18IP84	Project Work Phase-II	IP	-	-	-	6	100	100	200
5	P18IP85	Self-Study Course & Seminar	IP	-	-	4	2	50	-	50
Total							**17**	**300**	**250**	**550**

Professional Elective-III		
Sl. No	**Course Code**	**Course title**
1	P18IP821	Agile Manufacturing.
2	P18IP822	Engineering System Design
3	P18IP823	Design of Experiment
4	P18IP824	Hydraulics & Pneumatic

Course Title: **Supply Chain Management.**			
Course Code: P18IP71	Semester: VII	L-T-P-H : 4 -1 -0 -4	Credit: 4
Contact Period - Lecture: 52Hrs.; Exam:3 Hrs.		Weightage: CIE: 50%; SEE: 50%	

Prerequisites:

Students should have the knowledge of management and entrepreneurship, human resource management, knowledge of reading Supply Chains is essential.

Course Learning Objectives:
At the end of the Course the students should be able to:

The aim of the course is to provide the students an opportunity to gain the knowledge in the field of management.

1. Apply the fundamental concepts of management principal and to solve the problems.[L2]
2. To demonstrate the operation principles, advantages, applications, limitations of the several of source and transportation. [L2]
3. To gain the knowledge for Supply Chain management.[L1]
4. The students gain the knowledge of different Supply chain flows.[L1]
5. The students understand the different methods of IT supply Chain.L2]
6. Develop the skill to apply, analyze basic of Role, Design. Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions.[L3]

Relevance of the Course:
Supply chain management is an application course in BE (Industrial and Production) program that builds Supply chain and management ideas for Supply chain management application. The course aims at developing the understanding of advanced Supply chain management. It helps the student's skill in Supply chain management.

Course Content

Unit – I

Building a Strategic Frame Work to Analyze Supply Chains: Supply chain stages and decision phases process view of a supply chain. Supply chain flows. Examples of supply chains. Competitive and supply chain strategies. Achieving strategic fit. Expanding strategic scope. Drivers of supply chain performance. Framework for structuring drivers – Inventory, Transportation, Facilities, Information. Obstacles to achieving fit Case discussions. **10 Hours**
SSC: Case Study on Achieving Strategic Fit.

Unit – II

Designing the Supply Chain Network: Distribution Networking – Role, Design. Supply Chain Network (SCN) – Role, Factors, Framework for Design Decisions. Models for facility location and capacity allocation. Impact of uncertainty on SCN – discounted cash flow analysis, evaluating network design decisions using decision using decision trees. (**No Problems** on Designing the supply chain network) **11 Hours**
SSC: Case Study on discounted cash flow analysis.

Unit – III

Planning and Managing Inventories in a Supply Chain: Role of cycle inventory. Trade promotions. Managing multi echelon cycle inventory, Role of safety inventory. Impact of supply uncertainty aggregation and replenishment policies on safety inventory. Optimum level of product availability. Managerial levers to improve supply chain profitability. **(No problems)** **10 Hours**

SSC: Case Study on TCSR – Trend, Cyclic variation, Seasonal Variation and Random Variations effect on Managing Inventory.

Unit – IV

Sourcing, Transportation and Pricing Products: Role of sourcing, supplier - scoring &assessment, selection and contracts. Design collaboration. Role of transportation, Factors affecting transportation decisions. Modes of transportation and their performance characteristics. Designing transportation network. Trade-off in transportation design. Tailored transportation, Routing and scheduling in transportation. International transportation Role Revenue Management in the supply chain, Revenue management for: Multiple customer segments, perishable assets, seasonal demand, bulk and spot contracts. **11 Hours**

SSC: Case Study on Design Collaboration on SCM.

Unit – V

Coordination and Technology in the Supply Chain: Co-ordination in a supply chain: Bullwhip effect. Obstacles to coordination. Managerial levers to achieve co-ordination, Building strategic partnerships. The role of IT supply Chain, The Supply Chain IT framework, CRM, Internal SCM, SRM. The role of E-business in a supply chain, The E-business framework, E-business in practice. Case discussion.

Emerging Concepts: Reverse Logistics; Reasons, Activities, Role. Components, applications, implementation. Lean supply chains. **10 Hours**

SSC: Case Study on Implementation of Six Sigma in Supply Chains.

Text Book

1. Supply Chain Management – 2001, Strategy, Planning & Operation. Sunil Chopra & Peter Meindl; Pearson Education Asia, ISBN: 81-7808-272-1.

Reference Books

2. Supply Chain Redesign – Transforming Supply Chains into Integrated Value Systems, Robert B Handfield, Ernest L Nichols,Jr. 2002, Pearson Education Inc, ISBN: 81-297-0113-8
3. Modelling the Supply Chain- Jeremy F Shapiro, Duxbury 2002, Thomson Learning, ISBN 0-534-37363

Reference Material

1. Supply Chain Management – JNU, Jaipur.

Course Outcome

1. The students should learn and understand necessity of Supply Chain management.
2. Demonstrate ability to make use Supply Chain.
3. Students will be able to use different types of Dynamometers
4. The students get exposure to different types of Supply chain flows methods.
5. Students should be able to demonstrate the knowledge of Supply Chain management.

Course Articulation Matrix															
Course Outcomes-CO		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Apply the fundamental concepts of management principal and to solve the problems.	2	1	-	-	-							2		
CO2	The operation principles and applications Supply chain	1	2	-	-	-							2		
CO3	Different types of Supply chain flows methods.	3	2	3	-	3							2		
CO4	Advantages and limitations of the various of source and transportation	3	2	2	-	2							2		
CO5	Develop the skill to apply, analyze basic of Role, Design.	3	3	2	-	3							2		

1-Low, 2-Moderate, 3-High

Course Title: **Additive Manufacturing Techniques.**			
Course Code: P18IP72	Semester: VII	L-T-P-H : 4 -1 -0 -4	Credit: 4
Contact Period - Lecture: 52Hrs.; Exam:3 Hrs.		Weightage: CIE: 50%; SEE: 50%	

Prerequisites: The students should have undergone the course on Production Technology Courses.

Course Learning Objectives (CLO):

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

- Identify the role of RP in the Manufacturing Sectors.[L3]
- Understand the various techniques used in Additive manufacturing Process.[L2]
- Understand the usage of various materials used in the RP Process. [L2]
- Analyze the Problems encountered and to find the solutions during the Process. [L3]

Relevance of the Course:

Additive Manufacturing Techniques is a subject which deals with the concept of,

- Stereo lithography Systems, Selective Laser Sintering and Laminated Object Manufacturing processes.
- Applications of Additive Manufacturing Techniques in Various Manufacturing Sectors.
- Various Software and Tools Used in AM Process.
- Optimization Tools Used.

Course Content

Unit-I

Introduction: Need for the compression in product development, Types of prototypes history of AM systems and classification of AM systems, basic steps in AM, advantages and disadvantages of AM process.

LIQUID BASED AM PROCESS: Stereo lithography Systems: Principle, Process parameter, process details, merits and demerits, Applications. Solid Ground Curing: Principle of operation, process parameters, merits and demerits, Applications. **10 Hours**

SSC: Roles of a Prototype.

Unit-II

Powder Based AM Processes: Selective Laser Sintering: Principle of operation, process parameters, merits and demerits, Applications. Laser Engineering Net Shaping: Principle of operation, process details, merits and demerits, applications.

Solid Based AM Processes: Laminated Object Manufacturing: Principle of operation, LOM materials, process parameters, process details, merits and demerits, application. Fusion Deposition Modeling: Principle, Process parameter, Path generation, merits and demerits, Applications. **11 Hours**

SSC: Electron Beam melting Process.

Unit-III

Applications Of Additive Manufacturing: Functional Models, Pattern for Investment and Vacuum Casting, Medical Models, Art Models, Engineering Analysis Models. Concepts Modelers: Principle, types, difference between AM machine and Concept modeler, Thermal jet printer, Sander's model maker, 3- D printer. Genisys Xs printer, JP system 5, Object Quadra systems. **10 Hours**

SSC: Applications in Jewellery Industry.

Unit-IV

Rapid Tooling: Classification of Rapid tools, Soft Tooling vs. Hard Tooling. Indirect Rapid tooling: - Silicone rubber tooling, Aluminium filled epoxy tooling; Spray metal tooling, Cast kirksite, 3D keltool.

Direct Rapid Tooling: - Direct AIM, Quick cast process, RapidSteel1.0, RapidSteel 2.0, Copper polyamide, DMLS, Prometal, Sand casting tooling, Laminate tooling. DTM RapidToo1. **11 Hours**

SSC: Laminated Object Manufacturing Tools.

Unit-V

Rapid Manufacturing and Process Optimization: Factors influencing accuracy. Data preparation errors, errors due to Tessellation and slicing Part building errors in SL process and SLS process, Error in finishing, influence of part build orientation in SL process and SLS process. **10 Hours**

SSC: Additive Manufacturing Parts Finishing.

Text Books:

1. Paul F.Jacobs, "Stereo lithography and other RP & M Technologies" -SME, NY 1995.ISBN-13:9780872634671.
2. Pham D.T & Dimov, S.S Verlog, "Rapid Manufacturing" springer, London 9 November 2011, ISBN-13:9781447111825.

Reference Books:

1. Wohlers, Terry T, "Rapid Prototyping" Wohler's Report 2000, Wohler's Association 2000. Wohlers Report 2015, 314-page publication, Wohlers Associates, Inc., April 2015.
2. Gurumurthi, Rapid prototyping materials, IISc Bangalore Department of Mechanical Engineering VII & VIII Semester Syllabus 2017-2018 41.
3. LamOnt wood, "Rapid automated" Industrial press, New York, August 1, 1993, ISBN13: 9780831130473.

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. Explain AM systems based on raw materials used.
2. Compare various AM process.
3. Distinguish between AM machines and concept modelers.
4. Summarize various types of Direct and Indirect Rapid Tools.
5. Distinguish between part building errors in SL and SLS process.

Course Articulation Matrix															
Course Outcomes-CO		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Explain AM systems based on raw materials used.	2	1	2										1	
CO2	Compare various AM process.	2	1	1										2	
CO3	Distinguish between AM machines and concept modelers.	2	1	1										1	
CO4	Summarize various types of Direct and Indirect Rapid Tools.	2	1	1											
CO5	Distinguish between part building errors in SL and SLS process.	3	1	1											

1-Low, 2-Moderate, 3-High

Course Title: **Operation Research.**			
Course Code: P18IP73	Semester: VII	L-T-P-H : 4 -1 -0 -4	Credit: 4
Contact Period - Lecture: 52Hrs.; Exam:3 Hrs.		Weightage: CIE: 50%; SEE: 50%	

Prerequisites: The students should have undergone the course on Operations Management.

Course Learning Objectives (CLO):

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

- Identify and develop operational research models from the verbal description of the real system.[L3]
- Understand the mathematical tools that are needed to solve optimization problems.[L2]
- Use mathematical software to solve the proposed models. [L3]
- Develop a report that describes the model and the solving technique, analyses the results and propose recommendations in language understandable to the decision-making processes in Management Engineering. [L3]

Relevance of the Course:

Operations Research is a subject which deals with the concept of,

- Methodology of Operations Research.
- Linear programming: solving methods, duality, and sensitivity analysis.
- Integer Programming.
- Network flows. Multi-criteria decision techniques.
- Decision making under uncertainty and risk.
- Game theory.
- Dynamic programming.

Course Content

Unit - I

Introduction: OR methodology, Definition of OR, Application of OR to engineering and Managerial problems, Features of OR models, Limitation of OR. Models of OR.

Linear Programming Basics: Definition, mathematical formulation, standard form, Solution space, solution – feasible, basic feasible, optimal, infeasible, multiple, Redundancy, Degeneracy. Graphical method,. **09 Hours**

SSC: Duality in LPP

Unit - II

Linear Programming Methods: Simplex method, variants of simplex algorithm – Artificial basis techniques, Economic interpretation of Dual, Solution of LPP using duality concept. **10 Hours**

SSC: Dual simplex method

Unit - III

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

Assignment Problem: Formulation of the Assignment problem, unbalanced assignment problem, travelling salesman problem **12 Hours**

SSC: Applications of Transportation problems

Unit – IV

Replacement Analysis: Introduction, reasons for replacement**,** Individual Replacement of machinery or equipment with/without value of money, Group Replacement Policies, Problems.

Project Management Using Network Analysis: Network construction, determination of critical path and duration, floats. PERT- Estimation of project duration, variance and crashing **11 Hours**

SSC: Applications Replacement Analysis

Unit - V

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

Game Theory: Formulations of games, Two person zero sum game, games with and without saddle point, graphical solutions (2x n, mx2 game), and dominance property. **10 Hours**

SSC: Applications Queuing Theory

Text Books:

1. Operation Research and Introduction- Taha H A, Prentice Hall of India, 6th Edition, Latest Edition with ISBN:
2. Principles of Operations Research-Philips, Ravindram and Soleberg– Theory and Practice, PHI, 2nd Edition, 2007

Reference Books:

1. Hiller and Libermann, "Introduction to Operation Research", McGraw Hill 5th Edn.
2. S.D. Sharma, "Operations Research",Kedarnath Ramnath&Co, 1996
3. J K Sharma, "Operations Research Theory and Application", Pearson Education Pvt Ltd ,2nd Edn, ISBN-0333 92394-4
4. Kanthi Swarup & others, "Operations Research", Sultan Chand and Sons. 1992.

Course Outcomes:

Upon successful completion of the course, the students will be able to

1. **Identify** and **Develop** operational research models that consider the key elements of the real world problem from the verbal description of the real system.
2. **Solve** the linear programming models for their optimal solution and interpret the model's solution.
3. **Analyze** and **Solve** managerial problems in industry so that they are able to use resources more effectively using assignment and transportation model.
4. Select mathematical and computational modeling of real decision making problems, including the use of modeling tools and computational tools, as well as analytic skills to **Evaluate** the problems under uncertainty.
5. **Design** new simple models: CPM, PERT, to improve decision-making and develop critical thinking and objective analysis of decision problems.

Course Articulation Matrix															
Course Outcomes-CO		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	**Identify** and **Develop** operational research models that consider the key elements of the real world problem from the verbal description of the real system.	2	2	1		2							2		
CO2	**Solve** the linear programming models for their optimal solution and interpret the model's solution.	3	2	2	2	2							2		
CO3	**Analyze** and **Solve** managerial problems in industry so that they are able to use resources more effectively using assignment and transportation model.	3	2	3		2							2		
CO4	Select mathematical and computational modeling of real decision making problems, including the use of modeling tools and computational tools, as well as analytic skills to **Evaluate** the problems under uncertainty.	3	3	3		2							2		
CO5	**Design** new simple models: CPM, PERT, to improve decision-making and develop critical thinking and objective analysis of decision problems.	2	2	2		3							2		

1-Low, 2-Moderate, 3-High

Course Title: **CNC & ROBOTICS LAB**			
Course Code: P18IPL76	Semester: VII	L – T – P-H : 0 – 0 – 3-3	Credit:1.5
Contact Period - Practical: 36Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %; SEE: 50%	

Course Learning Objective:
The course aims at prepare the students to use CNC Programs for different CNC machines to enhance their programing and operating skills in the field of Computer Aided Manufacturing.

Course Content

PART – A

Writing and execution of manual part programming using ISO codes:
CNC Turning Programming - Machining of simple turning, taper turning and thread cutting and canned cycles.

CNC milling Programming - Writing and execution of part program for profile and pocket milling. Application of Tool radius compensation Demonstration of basic CAD-CAM systems, generation of tool path from product geometry using CAD CAM simulation tools.

PART – B

Programming of robots by manual, lead through and off line methods. Use of robot programming languages to pick and place, stacking of objects in increasing or decreasing size. Experiment on robot programming and simple sensor experimentation.

Reference books:

1. Peter Smid, "CNC Programming Handbook" –Industrial Press Inc., New York.
2. P. N. Rao, "CAD/CAM", Tata McGraw-Hill, 2010, Edition 2, ISBN No. 0071337296, 9780071337298
3. Mikell P. Groover, Emory W. Zimmers, Jr. "CAD/CAM".
4. Appu KuttanK K, "Robotics", I K International Publishing house Pvt. Ltd.

Course Outcome

At the end of the course the students should be able to:
1. Write part programs for machining of simple parts turning, taper turning, form turning, thread cutting and Milling
2. Generate tool paths and CNC codes through Master CAM. Demonstrate the application of Robot through programming.

Course Articulation Matrix															
Course Outcomes-CO		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Write part programs for machining of simple parts turning, taper turning, form turning, thread cutting and Milling	3	2			3							3	1	
CO2	Generate tool paths and CNC codes through Master CAM. Demonstrate the application of Robot through programming	3	2			3							3	1	

1-Low, 2-Moderate, 3-High

Course Title: **Machine Tools Testing and Design Lab**			
Course Code: P78IPL77	Semester: VII	L – T – P-H : 0 – 0 – 3-3	Credit:1.5
Contact Period - Practical: 36 Hrs. Exam: 3Hrs.		Weightage: CIE: 50 %; SEE: 50%	

Course objective: To train the students with the practical knowledge of components of machine tools, the various parameters that can be influence on machining characteristics.
To study the process of Pressure distribution in Journal bearing, Performance of Governors and Gyroscope.

Prerequisites: Students should have studied Production Technology, Theory of Metal Cutting and Theory of Machines.

Course Learning Objectives (CLO): After completion of lab the student should be able to

- Identify the various parameters that can be influence machine tools.
- Identify, Assemble and disassemble the parts of machine tools.
- Learn the effect of chips on tool life.
- Evaluate the forces acting on different machine tools with conditions.
- Asses to select right tools, materials for the machining process.
- Study the Effects of Balancing of various parts of the machineries.
- Study and analyse the performance of Governors, Gyroscope and Bearings.

Course Contents

1. Acceptance tests on Lathe.
2. Acceptance tests on drilling machine.
3. Acceptance tests on milling machine.
4. Determination of Cutting forces using Lathe tool dynamometer.
5. Determination of Cutting forces using Drill tool dynamometer.
6. Measurement of cutting tool temperature using thermo-couples.
7. Determination of chip reduction co-efficient in lathe.
8. Disassembly and assembly of the following.
    - Lathe tool stock.
    - Tool head of a shaper.
    - 4 Stroke Bike Engine.
9. Performance study of governors.
10. Determination of a Pressure distribution in Journal bearing.
11. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
12. Determination of gyroscopic torque in a Gyroscope.

Course Outcome:

At the end of the course the students should be able to:

1. Demonstrate the importance of alignment on lathe, milling, and drilling machine.
2. Describe and identify Disassembly and assembly of different machine parts.
3. Understand the process of Pressure distribution in Journal bearing, Performance of Governors and Gyroscope.

Scheme of Examination:

2 Experiments: **40 Marks**
Viva – Voce: **10 Marks**
Total: 50 Marks.

Course Articulation Matrix															
Course Outcomes-CO		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Demonstrate the importance of alignment on lathe, milling, and drilling machine.	3	2			3							3	1	
CO2	Describe and identify Disassembly and assembly of different machine parts.	3	2			3							3	1	
CO3	Understand the process of Pressure distribution in Journal bearing, Performance of Governors and Gyroscope.	2	3			3							2	1	

1-Low, 2-Moderate, 3-High

Course Title: **Operations Management**			
Course Code: P18IP741	Semester: VII	L-T-P-H : 4 -0 -0-4	Credits: 4
Contact Period - Lecture: 52 Hrs.; Exam: 3 Hrs.	Weightage: CIE: 50 %; SEE: 50%		

Prerequisites: The students should have undergone the course on Production Engineering, Quality Control and Industrial Management.

Course Learning Objectives (CLOs):

In this course students will be able to,

1. Understand the Historical development of Operations Management concept, types of Manufacturing systems, concept of Productivity [L2].
2. Understand the importance of decision making in an organization and different methodologies and models [L2].
3. Identify the Objectives, variables and different methods used for Forecasting [L3].
4. Understand the importance of MRP and CRP techniques [L2].
5. Identify and analyze the different Scheduling and controlling techniques and Lean System concept [L3].

Relevance of the Course:

Operations Management is a subject which deals with the concept of,

- Operations in production and service organization,
- Productivity – concepts, methods to improve productivity,
- Importance of Decision making,
- Forecasting – concepts, methods and various models of forecasting,
- MRP and CRP concepts and
- Scheduling and Controlling techniques.

Course Content

Unit - I

Operations Management Concepts: Introduction, The trend: Information and Non-manufacturing systems, Operations management, Factors affecting productivity, International dimensions of productivity, the environment of operations. **04 Hours**

Operations Decision Making: Introduction, Management as a science, Framework for decision making, Decision methodology, Decision support systems, Economic models, Statistical models. **06 Hours**

SSC: *Historical development of OM, Characteristics of decisions.*

Unit - II

System Design and Capacity: Introduction, Manufacturing and service systems, Design and systems capacity, Capacity planning. **02 Hours**

Forecasting Demand: Forecasting variables, Opinion and Judgmental methods, Time series methods, Exponential smoothing, Regression and correlation methods, Application and control of forecasts. **06 Hours**

Aggregate Planning: Introduction- planning and scheduling, Aggregate planning methods. **04 Hours**

SSC: *Forecasting objectives and uses, Objectives of aggregate planning.*

Unit – III

Master Scheduling: Master scheduling objectives, Master scheduling methods. **03 Hours**

Material and Capacity Requirements Planning: Overview: MRP and CRP, MRP: Underlying concepts, System parameters, MRP logic, System refinements, and Capacity management. **07 Hours**

SSC: *CRP activities.*

Unit - IV

Scheduling and Controlling Production Activities: Introduction, scheduling strategy and guide lines, Scheduling methodology, priority control and capacity control. **05 Hours**.

Single Machine Scheduling: Concept, measures of performance, SPT rule, Weighted SPT rule, EDD rule and minimizing the number of tardy jobs. 0**5 Hours**

SSC: *PAC, Objectives and Data requirements.*

Unit – V

Flow –Shop Scheduling: Introduction, Johnson's rule for 'n' jobs on 2 and 3machines, CDS heuristic.

Job-Shop Scheduling: Types of schedules, Heuristic procedure, and scheduling 2 jobs on 'm' machines. **06 Hours**

Automated Material Handling and Storage: Material functions, types of material handling equipment, analysis of material handling systems, design of systems, conveyor system. **04 Hours**

SSC: *Automated Guided Vehicle Systems and Automated Storage / Retrieval Systems.* .

Text Books:

1. Operations Management- Monks, J.G., McGraw-Hill International Editions, 1987.
2. Production and Operations Management- Pannerselvam. R, 2nd edition PHI.
3. Productions & operations management - Adam & Ebert.5th edition PHI.

Reference Books:

1. Modern Production/Operations Management- Buffa, Wiely Eastern Ltd., 4th edition.
2. Production and Operations Management- Chary, S.N, Tata- McGraw Hill., 3rd edition.
3. Operations management - James Dilworth. PHI, 3rd edition.
4. Operations Management – Lee J Karjewski and Larry P Ritzman, strategy and Analysis, 6th Edn, Pearson Education Asia.

Course Outcomes:

After learning all the units of the course, the student is able to,

1. Define importance of management in the organization and the different types of in an organization. To identify and evaluate comparative approaches to operations management in a global context.

2. Distinguish between the Manufacturing and Service oriented organizations and solve the problems on decision making.
3. Define the different types of Forecasting Techniques and solve the different problems on Forecasting Technique.
4. Understand the concept of Break-even point and solve the different types of problems.
5. Understand the concept of Scheduling and solve the different types of problems on Scheduling.

Course Articulation Matrix															
Course Outcomes-CO		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Define importance of management in the organization and the different types of in an organization.	2	2			1						1	1	1	
CO2	Distinguish between the Manufacturing and Service oriented organizations and solve the problems on decision making.	2	2	1	1	1			1			2			
CO3	Define the different types of Forecasting Techniques and solve the different problems on Forecasting Technique.	2	2	1	1	1			1			2			
CO4	Understand the concept of Break-even point and solve the different types of problems.	2	2			2						2	2	2	
CO5	Understand the concept of Scheduling and solve the different types of problems on Scheduling.	2	2			2						2	2	2	

1-Low, 2-Moderate, 3-High

Course Title:: **Product Design & Manufacturing**			
Course Code: P18IP742	Semester: VII	L-T-P-H : 4 -0- 0-4	Credit: 3
Contact Period - Lecture: 52 Hrs Exam:3 Hrs.		Weightage: CIE: 50%; SEE: 50%	

Prerequisites: The students should have basic knowledge of design & production technology.

Course Learning Objectives (CLOs)

At the end of the Course the students should be able to,

1. Identify and explain the basic requirements to develop a new product, Phases involved in design and Role of Tolerance and Process capability in Product Design.
2. Explain the Role of Aesthetic and Role of 3'S in developing a new Product.
3. Define and Explain the Strength, Stiffness and Rigidity considerations in product design.
4. Explain the role of Design, Process engineers and the Problems faced by industrial Designer.
5. Explain the process involved in Designing Plastics, Rubber & Ceramics parts.
6. Identify the Economic factors influencing Design and how to add Value to product.

Course Content

Unit – II

Introduction to Product Design: Asimov's Model: definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production – Consumption Cycle, The Morphology of Design (The seven phases), Primary Design Phases and flowcharting, Role of Allowance, Process Capability, and Tolerance in Detailed Design and Assembly. Characteristics of successful product development, Design and development of products, duration and cost of product development. **10 Hours**

SSC: The challenges of product development.

Unit – II

Product Design Practice And Industry: Induction, Product Strategies, Time to Market, Analysis of the Product, The Three S's, Standardization, Renard Series (Preferred Numbers), Simplification, The Designer and His Role, The Industrial design Organization, Basic Design Considerations, Procedure adopted by Industrial Designers, Types of Models designed by Industrial Designers, Role of Aesthetics in Product Design, Functional Design Practice.

Modern Approaches to Product design: introduction, Definition, Advantages and Disadvantages of Concurrent Design, Agile Manufacturing Process. **11 Hours**

SSC: Flexible Manufacturing System.

Unit – III

Design For Production –Metal Parts, Plastics And Rubber Parts: Producibility Requirements in the Design of Machine Components, Forging Design, Pressed Components Design, Casting Design, Design for Machining Ease, Design for Powder Metallurgical Parts, Expanded Metals and Wire Forms. Approach to Design with Plastics, Plastics, Plastic Bush Bearings, Gears in Plastic, Fasteners in Plastic, Rubber Parts, Tolerances. **11 Hours**

SSC: Design Recommendations for Rubber Parts.

Unit – IV

Optimization in Design: Introduction, Siddal's Classification of Design Approaches, Optimization by differential Calculus, Lagrange Multipliers, Linear Programming (Simplex Method), Geometric Programming, Johnson's Method of Optimum Design.

Economic Factors Influencing Design: Product Value, Design for Safety, Reliability and Environmental Considerations, Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Economics of New Product Design (Samuel Eilon Model) **10 Hours**

SSC: Break-even Analysis.

Unit – V

Human Engineering Considerations in Product Design: Introduction, Human being as Applicator of Forces, Anthropometry: man as Occupant of Space, The Design of Controls, The Design of Displays, and Man/Machine Information Exchange.

Value Engineering and Product Design: Introduction, Historical Perspective, What is Value? Nature and Measurement of Value, Maximum Value, Importance of Value, The Value Analysis Job Plan, Creativity, Steps to Problem-solving and Value analysis, Value Analysis Test, Value Engineering Idea Generation Check-list. **10 Hours**

SSC: material and Process Selection in Value Engineering.

Text Books

1. A.C. Chitale and R.C. Gupta, "Product Design and Manufacturing", PHI.
2. Karl T. Ulrich & Steven D., Epinger, "Product Design & Development", Tata McGraw Hill, 3rd Edition, 2003

Reference books

1. Tim Jones, Butterworth Heinmann, "New Product Development", Oxford, UIC -1997.
2. Roland Engene Kinetovicz, New Product Development- Design & Analysis- John Wiley and Sons Inc., N.y. -1990.

Course Outcome

Upon successful completion of this course, students should be able to:

1. Describe, Interpret and apply the fundamental concepts of product design and manufacturing and the role of tolerance in product design.
2. Demonstrate the types of models designed by industrial engineer and role of aesthetic, Function and strength, stiffness and rigidity considerations in product design.
3. Select the different materials based on the functions of the product and complexity involved.
4. Explain the optimization parameters used for design and ergonomic factors influencing the success of the product.
5. Analyze the role of displays used and how to add value to the product and steps to be followed.

Course Articulation Matrix															
Course Outcomes-CO		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Describe, Interpret and Apply the fundamental concepts of product design and manufacturing and the role of tolerance in product design.	2	2		2	3			2	2		3		1	
CO2	Demonstrate the types of models designed by industrial engineer and role of aesthetic, Function and strength, stiffness and rigidity considerations in product design.	2		2	3					2					
CO3	Select the different materials based on the functions of the product and complexity involved.	3	3	2	2					2		2		3	
CO4	Explain the optimization parameters used for design and ergonomic factors influencing the success of the product.	2			2	2	3	3		2					3
CO5	Analyze the role of displays used and how to add value to the product and steps to be followed.	2	2	3	2	2				2					3

1-Low, 2-Moderate, 3-High

Course Title: **Concurrent Engineering**			
Course Code:P18IP743	Sem: VII	L-T-P-H: 4-0-0-4	Credits: 3
Contact Period: Lecture:52 Hrs Exam: 3Hrs		Weightage: CIE:50; SEE:50	

Prerequisites: Basic knowledge of Operation Management.

Course Learning Objectives (CLO):
This Course aims the students, should be able to

- Define overall cost and production cycle time, to improve better quality and delivery performance.
- Understand integrated product development, concurrent engineering and product models.
- Understand work methodology based on the parallelization of tasks, training people how to perform concurrent design effectively.

Course Content

Unit -I

Introduction: Introduction to concurrent engineering, Review of historical events, Push and Pull for new Paradigms: Competitive pressure push, Emerging technology push, Productivity improvement pull, Process reengineering pull. Areas of Manufacturing competitiveness, Products and Services, Process and Methodologies,, Infrastructure. **09 Hours**
SSC: Performance indicators.

Unit -II

Life-Cycle Management: Introduction, Shrinking Life Cycle, Refocusing product development efforts, Impact of Early Decision Making with cost functions-Exponential, Logarithmic & Parabolic, Life-Cycle Management- Risk management, Aspects of life cycle management.
Cycle Management Tools and Techniques: New Product Introduction, Managing Continuity, Managing revision changes, Life-Cycle Cost Drivers, Life-Cycle Management Tools-QFD, Focusing on customer satisfaction, QFD technique. **11 Hours**
SSC: Sequential Versus Concurrent Engineering.

Unit-III

Process Reengineering: Understanding and Managing Change-Traits, Reengineering Approaches, Work Flow Mapping, Information Flow-Charting, Enterprise Models, Process Improvement Methodology, Change Management Methodology, Concurrent Process Re-engineering. 5Hrs
Concurrent Engineering Definitions: Introduction, CE Definitions and Basic Principles of CE, Components of CE, Concurrency and Simultaneity, Modes of Concurrency. **11 Hours**
SSC: Benefits of Concurrent Engineering.

Unit -IV

Co-Operative Work Teams: Introduction, Co-operative concurrent teams, Program

organization, Supplier rationalization, Types of CE organization, Management styles or philosophies, Workplace organization and visual control.

System Engineering: Introduction, An Automobile Manufacturing Process, System Engineering, Systems Thinking, Approaches to System Complexity, Sharing and Collaboration in CE, Agile Virtual Company. **11 Hours**

SSC: Seamless Integration-Logistics integration.

Unit -V

Information Modeling: Information Modeling, Modeling Methodology, Concurrent Engineering Process Invariant, Enterprise Model-Class, Specification Model-Class, Product Model-Class, Process Model- Class, Cognitive Models, Merits and Demerits.

Concurrent Engineering Metrics for IT: Based manufacturing – process efficiency metrics, Case Studies on Concurrent Engineering. **10 Hours**

SSC: Process effectiveness metrics.

Text Books

1. Concurrent Engineering Fundamentals - Integrated Product and Process Organization, Prasad B, Prentice Hall, Englewood, Cliffs, New Jersey 2008.
2. Prasad.B, Concurrent Engineering Fundamentals, - Integrated Product and process organization Vol. 1 & 2, Prentice Hall Englewood, Cliffs, New Jersey 1996.

References

1. Shortening Lead Times, Raising Quality and Lowering Costs, ohan.R. Hartely, Concurrent Engineering, Productivity Press, Portland, Oregon, 1992.

Course Outcome:

1. Discuss the general concepts about Concurrent engineering.
2. Explain the life cycle management and its tools.
3. Describe the importance of process reengineering in concurrent engineering.
4. Explain importance of team work and system engineering approaches.
5. Explain about information modeling and matrix for IT.

Course Articulation Matrix

Course Outcomes-CO		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Discuss the general concepts about Concurrent engineering.	2	2	3		2							2		
CO2	Explain the life cycle management and its tools.	2	2	2		1							2		
CO3	Describe the importance of process reengineering in concurrent engineering.	1	1	2		2							2		
CO4	Explain importance of team work and system engineering approaches.	2	1	1		3							2		
CO5	Explain about information modeling and matrix for IT.	1	2	2		2							2		

1-Low, 2-Moderate, 3-High

Course Title: **Materials Management**			
Course Code:P18IP744	Semester: VII	L-T-P-H: 4-0-0-4	Credits: 3
Contact Period: Lecture:52 Hrs Exam: 3 Hrs		Weightage: CIE:50%	SEE:50%

Prerequisites: Students should have the knowledge of Management & Entrepreneur.

Course Learning Objectives (CLO):

This Course aims the students, should be able to

- Define the concept value of material handling and purchase management. [L1]
- Understand inventory management techniques. **[**L3**]**
- Define the concepts of EOQ and Inventory systems. [L1]
- Understand the applications of information system and productivity in material management [L3]

Relevance of the course

Materials Management is a subject which deals with the concept of,

- Materials management in organization and Purchasing Management
- Stores Management and Material handling.
- Inventory management and techniques.
- Economical Ordering quality and Practical inventory systems.
- Materials management information system and computer and Materials management and Productivity.

Course Content

Unit – 1

Introduction to materials management: Role, scope and importance of material control function, materials management in organization, cost aspects, materials management organization, specifications of materials, Advantages in integrated MM concept, waste control and materials research.

Purchasing Management: Importance and goals of Purchasing**,** Purchase systems, Pre purchase system, Ordering system, **11 Hours**

SSC: Post purchase system and Special purchasing systems.

Unit – II

Stores Management: Layout of stores, Purpose of stores, Cost aspects and Productivity, Problems and development, new developments in storing.

Materials handling: Influencing factors and control, Equipment's, Evaluation of material handling, definition and scope. **10 Hours**

SSC: value analysis origin

Unit -III

Inventory management and techniques: Introduction, Raw material, WIP, Finished goods, Norms for inventory, Peculiars in India, Relevant costs, cost of ordering, cost of inventory carrying. **10 Hours**

SSC: Understocking cost and overstocking cost.

Unit –IV

Economical Ordering quality: Static risk model, Dynamic certain model (EOQ), Cost sensitivity analysis, Importance of EOQ

Practical inventory systems: Systems design, Q-system, P-system, 8s optional replenishment system **10 Hours**

SSC: Safety stock.

Unit – V

Materials management information system and computer: MIS management and MM computer system for MIS and MM. In process materials and Management control

Materials management and Productivity Production, Productivity and modern industry, Interrelationship of profitability and productivity. Productivity I relation to materials. **11 Hours**

SSC: Total organizational effectiveness

Text books:

1. "Materials Management-Integrated approach", P.Gopalakrishnan, M.sundaresan, Published by Prentice Hall of India Private limited, 2017
2. "Materials Management-Procedures", Text and cases, 2nd edition by AK.Datta, PHI learning private limited, 2010.

Reference books:

1. **"**Introduction to Materials Management" by Sterechapman, Tony k.Arnold, Ann.K.Gatewood, Cloyd Clive., 7th edition, published by Pearson, 2012.

Course Outcomes:

At the end of the course the students should be able to:

1. Describe scope and importance of material and purchasing management
2. Analyse value of material handling and store management.
3. Describe the inventory management techniques.
4. Illustrate concepts of EOQ and Inventory systems.
5. Explain applications of information system and productivity in material management.

Course Articulation Matrix (CAM)															
Course Outcomes-CO		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Describe scope and importance of material and purchasing management	2	2	2		1							2		
CO2	Analyse value of material handling and store management	2	2	2		1							2		
CO3	Describe the inventory management techniques.	2	2	1		1							2		
CO4	Illustrate concepts of EOQ and Inventory systems.	2	2	1		1							2		
CO5	Explain applications of information system and productivity in material management.	2	2	1		2							2		

1-Low, 2-Moderate, 3-High

Course Title: **Just In Time Manufacturing**			
Course Code: P18IPO751	Semester: VII	L-T-P -H: 4 -0 - 0-4	Credits: 3
Contact Period - Lecture: 4Hrs.;Exam: 3 Hrs.		Weightage: CIE: 50 %; SEE: 50%	

Prerequisites:
Students should have the knowledge of activities of Basics of production Management, Statistics.

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Course Learning Objectives (CLOs):
This Course aims to;

1. Illustrate the basics of JIT manufacturing and its implementation at Toyota.[L2]
2. Discussing about the method of achieving the Production smoothing in JIT. [L6]
3. Summarize the JIT implementation in different type of organizations and at different countries.[L2]
4. Telling the Design, development and management of JIT manufacturing systems [L1]
5. Develop the Supply management systems for JIT manufacturing systems.[L6]
6. Design the framework for implementing the JIT manufacturing systems. [L6]

Relevance of the Course:
Just in Time Manufacturing is an Open Elective course in Industrial and Production program, which teaches recent trends in production techniques. It helps the students of all branches of engineering to become updated engineer who can survive and challenge the competitive world by practicing best production techniques at their organizations.

Course Content

Unit – I

Jit-In Introduction: The new production system research association of Japan, some definitions of JIT, core Japanese practices of JIT, basic elements of JIT, benefits of JIT

Modern Production System: Philosophy of Toyota's production system, basic framework of Toyota production system. KANBAN SYSTEM – other types of kanbans, kanban rules, adapting to fluctuations in demand through kanban, whirligig, A detailed kanban system example, supplier kanban and the sequence schedule for use by suppliers. **10 Hours**
SSC: Determining the number of kanbans in Toyota production system,

Unit – II

Production Smoothing In Toyota Production System: production planning, production smoothing, adaptability to demand fluctuations, sequencing method for the mixed model assembly line to realize smoothed production, Criticism of Toyota production system by the communist party of Japan. EDP system for support of the Toyota Production system, Shortening lead time in Toyota Production system, reducing the setup time. Automation in Toyota production system, **10 Hours**
SSC: Some comparisons with other manufacturers.

Unit – III

Global Implementation Of JIT: JIT in automotive industry, JIT in electronics, computer, telecommunication and instrumentation, JIT in process type industry, other manufacturing industries, JIT in service and administrative operations, conclusion.

Jit Implementation Surveys: JIT implementation in US manufacturing firms-analysis of survey results, just in time manufacturing in UK industries, just in time production in West Germany, just in time production in Hong Kong electronics industry, Conclusion. **11 Hours**
SSC: JIT in seasonal demand industry,

Unit – IV

Design, Development And Management of Jit Manufacturing Systems: plant configurations and flow analysis for JIT manufacturing, comparison of JIT's "demand pull" system with conventional "push type" planning and control systems, quality management system for JIT, product design for JIT, human resource management in JIT, flexible workforce system at Toyota, creation and maintenance of teams for JIT, union organization and conduct of industrial relations in JIT, interface of JIT with advanced manufacturing technology, assessing performance in JIT manufacturing systems, , potential for developing countries, potential for small manufacturers. **10 Hours**
SSC: Product costing information systems in JIT manufacturing, an example of overhead allocation in JIT

Unit – V

Supply Management For Jit: JIT purchasing-the Japanese way, some studies in JIT purchasing, surveys on JIT purchasing, buyer-seller relationship in JIT purchasing, Quality certification of suppliers in JIT purchasing, some problems in implementation of JIT purchasing, reduction freight costs in JIT purchasing, monitoring supplier performance for JIT purchasing, implementation of JIT to international sourcing, conclusion.

Framework For Implementation Of Jit: Implementation risks, some important activities to be performed during implementation, steps in implementation, a project network approach to implementation, conclusion. **11 Hours**
SSC: Audit in JIT purchasing,

TEXT BOOKS:

1. **Just In Time Manufacturing-** M.G. Korgaonker, Macmillan India Ltd.- 1992,
2. **Japanese Manufacturing Techniques** -Richard J. Schonberger, The Free Press – Macmillan Pub. Co., Inc. New York - 1988.

Course Outcomes:

1. Understanding the JIT Manufacturing and its implementation at Toyota.
2. Illustrating the method of achieving the Production smoothing in JIT.
3. Analyzing the JIT implementation in different type of organizations and at different countries.
4. Design, development and management of Jit manufacturing systems
5. Preparing the Supply management systems and constructing the framework for implementing the JIT manufacturing systems.

Course Articulation Matrix															
Course Outcomes-CO		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Understanding the JIT Manufacturing and its implementation at Toyota	3				1				1					
CO2	Illustrating the method of achieving the Production smoothing in JIT.	2	2	2	1					1			1		1
CO3	Analyzing the JIT implementation in different type of organizations and at different countries.	1	2		1						1		1		
CO4	Design, development and management of JIT manufacturing systems		1		2	2				1			1		
CO5	Preparing the Supply management systems and constructing the framework for implementing the JIT manufacturing systems.	1	1	2	1					1	1	3		1	

1-Low, 2-Moderate, 3-High

Course Title: **Data Base Management System**			
Course Code: P18IPO752	Semester: VII	L–T–P–H : 4 –0 – 0 –4	Credits: 3
Contact Period - Lecture: 52Hrs.; Exam: 3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

Prerequisites:
Students should have the knowledge of activities of Basics of Management, Programming

Course Learning Objectives (CLOs):
This Course aims to;

1. Illustrating the Database and its user, concept and Architecture.[L2]
2. Citing and designing the Data models.[L5]
3. Describing the Primary file organization and Index structure of files[L2]
4. Creating the Relational data model, constraints algebra and SQL99 statements[L3]
5. Developing the Database and its implementation[L3]
6. Telling about the advanced and emerging Database technologies[L1]

Relevance of the Course:
A Data base management system is an Elective course in BE (Industrial and Production) program, which teaches basics of Data base Management, modeling, programming skills and its latest techniques. It helps the students to become perfect engineer/Manager who can use his/her knowledge of DBMS in creating Databases and managing it and makes him/her competitive with software engineers

Course Content

Unit - I

Databases And Database Users: Introduction, characteristics of data base approach, Actors on the scene, workers behind the scene, Advantages DBMS approach.
Database Systems Concepts and Architecture: Data models, Schemas and instances, DBMS architecture and data independence, database languages and interfaces, database system environment, classification of data base management systems.
Data Modeling: High level conceptual data models for database design. Entity types, entity sets, attributes, and keys, Relationship types, relationship types, roles and structural constraints. Weak entity types. **11 Hours**
SSC: ER diagrams.

Unit -II

Data Storage And Primary File Organizations: Introduction, Secondary storage devices, buffering of blocks, placing file records on disk, operations on files, heap files and sorted files, hashing techniques.
Index Structure of Files: Single-level and multilevel ordered indexes, dynamic multi-level indexes using B-trees and B^+ - trees. **11 Hours**
SSC: RAID technology, Network attached storage.

Unit – III

Relational Data Model, Relational Database Constraints and The Relational Algebra: Relational model concepts, constraints, and Database schemas. Update operations, Transactions and dealing with constraint violations, Unary, Binary & Additional relational operations, Use of Set theory.

SQL-99: Data definition & Types, constraints, and schema changes in SQL, Basic and complex queries in SQL. Insert, delete and update statements in SQL, views in SQL, Additional features of SQL. **10 Hours**

SSC: Queries in relational algebra.

Unit - IV

Database Design: Informal design guidelines for relational schemas, functional Dependencies, Normal forms – First, second, Third, Boyce-Codd, fourth and fifth normal forms. Database design and implementation process, physical database design in relational databases

System Implementation Techniques: Transaction processing and system concepts, desirable properties of transactions, database recovery & database security **10 Hours**

SSC: Brief discussion on concurrency control.

Unit - V

BRIEF DISCUSSION ON: Object& Object-Relational Databases & Extended – Relational systems, Distributed databases, Deductive databases, Web database programming, data warehousing & mining. **10 Hours**

SSC: Emerging database technologies and applications.

Text books:

1. Fundamentals of database systems- Ramez Elmasri and Shamkant B. Navathe, 5th Edition, Pearson education, 2013

2. Database Management System-Raghu Ramakrishnan and Johannes Gehrke, 3rd Edition, TATA McGraw Hill, 2003

Reference books:

1. Modern Data base management – Fred R Mc Fadden, Jeferry A hoffer, Prescott, 8th edition, 2006

2. Database Management and Design- Gary W. Hansen and James V. Hanesn , 2nd Edition, PHI Pvt. Ltd,1998

Course Outcomes

After learning all the units of the course, the student is able to;

1. Defining and describing Database and its user, concept, Architecture and Data modeling.
2. Explaining the Data storage, Primary file organization and Index structure of files.
3. Illustrating the Relational data model, constraints algebra and SQL99 statements.
4. Designing the Database and its implementation.
5. Summarizing the advanced and emerging Database technologies.

Course Articulation Matrix															
Course Outcomes-CO		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Defining and describing Database and its user, concept, Architecture and Data modeling.	2	2		1					1	1	1			
CO2	Explaining the Data storage, Primary file organization and Index structure of files.	2	2							1	1				
CO3	Illustrating the Relational data model, constraints algebra and SQL99 statements	2	2								1				1
CO4	Designing the Database and its implementation			2		1							1		
CO5	Summarizing the advanced and emerging Database technologies.	2		1		2		1					1		

1-Low, 2-Moderate, 3-High

Course Title: **Project Management**			
Course Code: P18IPO753	Semester: VII	L-T-P -H : 4– 0 – 0 –4	Credits: 3
Contact Period - Lecture: 52Hrs.; Exam:3 Hrs.		Weightage: CIE: 50%; SEE: 50%	

Prerequisites: The students should have undergone the course on management course

Course Learning Objectives (CLO):

At the end of the Course the students should be able to,

1. Define the concept of project management and the steps in the process. (L1)
2. Understand the functions of project management. (L2)
3. Define the concept and methods used in project management techniques. (L1)
4. Understand the Authorities and responsibilities of project manager.(L2)
5. Understand Project evaluation and review Techniques (PERT) Planning. (L2)
6. Understand the Performance improvement for the CM & DM companies for better project management.(L2)

Course Content

Unit- I

Concepts Of Project Management: Concepts of a Project, Categories of projects, Phases of project life cycle, Roles and responsibility of project leader.

Project Planning and Estimating: Feasibility report phased planning, Project planning steps, Objective and goals of the project, preparation of cost estimation, and evaluation of the project profitability. **12 Hours**

SSC: Tools and techniques for project management.

Unit – II

Organizing and Staffing The Project Team: Skills / abilities required for project manager, Authorities and responsibilities of project manager, Project organization and types accountability in project execution, controls. **09 Hours**

SSC: Tendering and selection of contractors.

Unit – III

Project Scheduling: Project implementation scheduling, effective time management, different scheduling techniques,

Tools & Techniques of Project Management: Bar (GANTT) chart, bar chart for combined activities, logic diagrams and networks, Project evaluation and review Techniques (PERT) Planning, Computerized project management. **11 Hours**

SSC: Resources allocation method.

Unit – IV

Co-Ordination and Control: Project direction communication in a project, MIS project co-ordination, project control requirement for better control of project or role of MIS in project control, cost Control. **09 Hours**

SSC: Performance control and schedule control.

Unit – V

Performance Measures In Project Management: Performance indicators, Performance improvement for the CM & DM companies for better project management.

Case Studies on Project Management: Case studies covering project planning, scheduling, use of tools & techniques, performance measurement. **11 Hours**
SSC: Project management and environment.

Text Books:

1. Project Management a System approach to Planning Scheduling& Controlling- Harold Kerzner, CBS Publishers and Distributors. 2002.
2. Project Execution Plan: Plan for project Execution interaction-Chaudhry S., 2001.

References Books:

1. Project Management – Beningston Lawrence McGraw Hill 1970.
2. A Management Guide to PERT and CPM, WEIST&LeVY EasternEconomy of PH 2002. PERT &CPM.L.S.Srinnath, Affiliated East WestPress Pvt. Ltd. 2002.
3. Project Management with PERT and CPM- Moder Joseph and Philipscerel R., 2nd edition, New York VAN Norstrand, Reinhold - 1976.
4. Project planning analysis selection implementation &reviewprasannachandra, ISBNO-07-462049-5 2002.
5. Planning, Performing and Controlling- Angus, Project, 3rd End,Person Education, ISBN:812970020m, .2001
6. Project planning scheduling & control- jamesP.Lawis, MeoPublishing Company, 2001.
7. Project Management- Bhavesh M.Patel, ,Vikas Publishing House,ISBN 81-259-0777-7, 2002

Course Outcomes:

1. Defining the concept of project management and the steps of the process.
2. Understanding the functions of project management.
3. Illustrating the concept and methods used in project management techniques.
4. Outlining the duties, authorities and responsibilities of project manager
5. Planning the performance measures in project management.

Course Articulation Matrix															
Course Outcomes-CO		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Defining the concept of project management and the steps of the process.	2								2	2	3			
CO2	Understanding the functions of project management.	2	2							2		2			
CO3	Illustrating the concept and methods used in project management techniques.	2				2	1			1	2	2			
CO4	Outlining the duties, authorities and responsibilities of project manager	2					1	1	1	1	2	1			
CO5	Planning the performance measures in project management.	1	1	1	2					1		2	1		2

1-Low, 2-Moderate, 3-High

Course Title: **Production Planning and Control**			
Course Code:P18IPO754	Semester: VII	L-T-P-H: 4-0-0-4	Credits: 3
Contact Period: Lecture:52Hr Exam: 3Hr		Weightage: CIE:50; SEE:50	

Prerequisites: Students should have the knowledge of work study and Lean manufacturing.

Course Learning Objectives (CLO):

This Course aims the students, should be able to

- Define the concept of Production planning control and productivity.
- Understand the Objectives of plant layout and Plant location.
- Understand Applications of computers in production control.
- Define the concept of Record Management and Mechanizations

Course Content

Unit – I

Production planning control: Introduction, Forecasting/Sales forecasting, Importance of forecasting, Application of purposes of sales forecasts,.

Production planning: Definition, objectives of production planning, Factors influencing Process planning, Production control, principles and procedure of production control. **10 Hours**

SSC: Methods of sales forecasting.

Unit – II

Productivity: Definition, Productivity and production, Measurement of productivity, Productivity index, Importance of productivity, means of increasing productivity, Improving productivity by reducing work content, Relationship between productivity and standard of living, The benefits of increasing productivity **11 Hours**

SSC: Productivity improvement procedure.

Unit -III

Plant location: Introduction**,** Measuring the relative merits of single facility alternatives when the dominant factors are both tangible and intangible, single facility location decisions when the dominant factors are measurable costs.

Plant layout: Definition, types of plant layout problems, Factors affecting layout, steps in planning a plant layout. **11 Hours**

SSC: Objectives of plant layout.

Unit – IV

Applications of computers in production control: Introduction, Application of computer in production control, Role, Computer control in production process.

Management information systems: Introduction, Definition, Characteristics, need for information, structure of a management information system. **10 Hours**

SSC: Research and problem solving.

Unit – V

Record Management: Definition, Qualities of a good report, steps in report preparation, Mechanizations, Objectives of mechanizations, Filling, Advantages of a good filling system, steps in instituting a filling system, steps in filling routine. **10 Hours**

SSC: Purposes of records management.

Text books:

1. "Industrial Engineering and Production Management" by Mahajan, Dhanpat Rai &CO private limited, educational & Technical publishers, 2nd edition, 2001.
2. "Production Planning Control and Industrial Management" by K.C.Jain, L.N.Aggrawal, Khanna publications, 1995.

Reference books:

1. "Fundamentals of Production Planning and Control" by Stephen Chapman, 2007.
2. "Production planning and control" by R.Devaraj, L.Rasidhar, S.Ramachandran,Airwalk publications, 2017.

Course outcomes:

1. Describe concept of Production planning control and the Factors influencing Process planning
2. Define concept of Productivity and Explain productivity improvement.
3. Summarize plant layout and Plant location concept.
4. Explain the applications of computers in production control.
5. Explain the concept of Record Management and its Mechanizations.

Course Articulation Matrix															
Course Outcomes-CO		**Program Outcomes**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	Describe concept of Production planning control and the Factors influencing Process planning	2	2	2		1							2		
CO2	Define concept of Productivity and Explain productivity improvement	2	2	2		1							2		
CO3	Summarize plant layout and Plant location concept.	2	2	1		1							2		
CO4	Explain the applications of computers in production control.	2	2	1		1							2		
CO5	Explain the concept of Record Management and its Mechanizations.	2	2	1		2							2		

1-Low, 2-Moderate, 3-High

Course Title: **Total Quality Management**			
Course Code: P18IP81	Semester: VIII	L – T – P–H : 4 – 0 – 0 –4	Credits: 3
Contact Period - Lecture: 52Hrs.; Exam: 3Hrs.		Weightage: CIE: 50 %;	SEE: 50%

Prerequisites: Basic knowledge of Management & Entrepreneurship, supply chain management and Quality concepts.

Course Learning Objectives:

This Course aims the students, should be able to:

1. Understand Evolution and principles of TQM.[L1]
2. Understand management thinking process, models and tools for continuous improvement.[L2]
3. Know the General guidelines and steps for proactive improvement to develop new product. [L1]
4. Understand involvement of higher, middle and lower management for quality improvement.[L2]
5. Understand strategic planning in hosing management.[L2]
6. Know Regional and nationwide networking in TQM**.**[L1]

Relevance of the Course:

Total Quality Management is a subject which deals with the concept of,

1. Evolution and principles of TQM,
2. models and tools for continuous improvement,
3. Importance of Reactive and Proactive improvement,
4. Principles of Team and Teamwork,
5. Importance of Societal networking, a TQM model for skill development ,

Course Content

Unit – I

Overview of total quality management: History of TQM. Axioms of TQM, CONTRIBUTION OF Quality Gurus –Deming's approach, Juran,s quality trilogy, Crosby quality improvement, , and Feigenbaum's theory of TQC.

Evolution of Quality Concepts and Methods: Quality concepts. Development of four fitness's, evolution of methodology, evolution of company integration, quality of conformance versus quality of design from deviations to weaknesses to opportunities. Future fitness's, four revolutions in management thinking and four level of practice. **11 Hours**

SSC: Kaizen, Ishikawa's companywide quality control

Unit – II

Four Revolutions in Management Thinking: Customer focus, Continuous Improvement, Total participation, and Societal Networking.

Focus on Customers; Change in work concept marketing, and customers.

Continuous Improvement: Improvement As Problem Solving Process; Management By Process, WV Model Of Continuous improvement, process control, process control and process improvement, process versus creativity. QC tools; Identifying the problem, standard steps and tools. **10 Hours**

SSC: seven steps case study, seven QC tools.

Unit-III

Reactive Improvement: Management diagnosis of seven steps of reactive improvement. General guidelines for management diagnosis of a QI story.

Proactive Improvement; Introduction to proactive improvement, standard steps for proactive improvement, semantics, example-customer visitation, Applying proactive improvement to develop new products- three stages and nine steps. **10 Hours**

SSC: Discussion on case study for diagnosis of the seven steps.

Unit – IV

Total Participation: Teamwork skill. Dual function of work, teams and teamwork, principles for activating teamwork, creativity in team processes, Initiation strategies, CEO involvement Example strategies for TQM introduction. Infrastructure for mobilization. Goal setting (Vision/ Mission), organization setting, training and E education, promotional activities, diffusion of success stories, awards and incentives monitoring and diagnosis, phase-in, orientation phase, alignment phase,. **10 Hours**

SSC: evolution of the parallel organization

Unit – V

Hoshin Management: Definition, phases in Hoshin management strategic planning (proactive), Hoshin deployment, controlling with métiers (control), check and act (reactive). Hoshin management versus management by objective, Hoshin management and conventional business planning, Hoshin management as "systems Engineering" for alignment.

Societal Networking: Networking and societal diffusion – Regional and nationwide networking, infrastructure for networking, change agents, Center for quality Management case study, dynamics of a societal learning system. TQM as learning system, keeping pace with the need for skill. **11 Hours**

SSC: TQM model for skill development

Text books:

1. A New American TQM Four Practical Revolutions in Management – Shoji Shiba, Alan Graham and David Walden, ""Productivity Press, Portlans (USA), 2001.
2. Management for Total Quality- N Logothetis "" Prentice Hall of India, New Delhi.1994.

Reference books:

1. Total Quality Management- N.V.R Naidu, K.M.Babu, Rajendra,", 2006
2. Total Quality Management -Kesavan R - I K International Publishing house Pvt. Ltd, 2008

Course Outcomes

1. The students should learn and understand principles of Quality contributed by Quality guru's
2. The students should be able to understand different Quality control tools used for continuous improvement.
3. The students should be able to learn proactive improvement to develop new product.
4. Students should be able to understand the involvement of different levels of management in TQM.
5. Students should be able understand strategic planning in hosing management.

Course Articulation Matrix															
Course Outcomes -CO		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Ability to discuss the Evaluation of Quality Guru's approaches and Quality methods.	2	2			2									
CO2	Ability to explain concepts of focus on customers and continuous improvements with QC tools.	2				2									
CO3	Ability to explain concepts of reactive improvement &Proactive improvements with case studies.	2				2									
CO4	Ability to understand the involvement of different levels of management in TQM.	2				2									
CO5	Ability to explain objectives and phases in hosing management.	2				2									

1-Low, 2-Moderate, 3-High

Course Title: **Agile Manufacturing**			
Course Code: P18IP821	Semester: **VIII**	L -T -P-H : 4 -0- 0-4	Credit: 3
Contact Period: Lecture: 52 Hrs. Exam:3 Hrs.		Weightage: CIE: 50%; SEE: 50%	

Prerequisites:
Students should have the knowledge of Manufacturing Technology, CAD/CAM.

Course Learning Objectives:
At the end of the Course the students should be able to:
1. Relate the fundamental concepts of machines, and role of Robots in Manufacturing Sector.
2. Demonstrate the operation principles, advantages, and applications, limitations of agile Manufacturing, QFD, and CAPP.

Course Content

Unit - I

Agile Manufacturing: Definition, business need, conceptual frame work, characteristics, generic features. Developing Agile Manufacturing: Enterprise, Strategies, integration of organization, reference models, and examples. **09 Hours**
SSC: Workforce and technology.

Unit – II

Integration of Product /Process Development: Principles, Robust design approach, Approaches to enhance ability in manufacturing, Role of QFD, Managing people in agile organization, Approaches. Application of It/Is Concepts in Agile Manufacturing: Strategies, Management of complexities and information. Flow, approaches, system concepts.
11 Hours
SSC: Applications of multimedia to improve agility in manufacturing.

Unit – III

Computer Control Of Agile Manufacturing: CAPP for Agile Manufacturing, Aggregate capacity planning and production line design / redesign in agile manufacturing, and examples.
Corporate Knowledge Management In Agile Manufacturing: Strategies, strategic options in agile manufacturing, Role of standards. **11 Hours**
SSC: Cellular manufacturing.

Unit – IV

Design of Skill & Knowledge: Enhancing technology for Machine tool system, Resumption of design requirement geometry, definition, methods, design enhancements, parametric approach only. **10 Hours**
SSC: Decision support for selection of cutting parameters.

Unit -V

Agile Manufacturing Through Management Driver: Introduction, Organizational Structure for Achieving Agility, Employee Status in Agile Manufacturing, and Nature of Management Required for Implementing Agile Manufacturing Practices.
Agility through Technology Driver: Agile Manufacturing through Design Automation Technologies, Agile Manufacturing through Advanced Production Technologies. **11 Hours**
SSC: Agile Manufacturing Through Time Management.

Text books:

1. 'Agile Manufacturing- Forging Mew Frontiers', Poul T Kidd, Amagow Co. UK, ISBN-0-201-63163-6, 1994

2. ''Agile Manufacturing", A Gunasekharan, the 21st Century Competitive strategy, ISBN -13 978-0-08-04 3567-1, Elsevier Press, India 135

Reference books:

1. O Levine Transitions to Agile Manufacturing, Joseph C Moutigomery and Lawrurence – Staying Flexible for competitive advantage, ASQC quality press, Milwaukee. Wisconsiw, USA 1996

2. Agile Development for Mass Customization, David M Andeson and B Joseph Pine, Irwin Professional Publishing, Chicogo USa 1997

3. Lean and Agile Manufacturing by S.R Devadasan, V. Mohan Sivakumar. PHI Publication.

Course Outcome

At the end of the course the students should be able to:

1. Summarize the role of Agile Manufacturing in Manufacturing Sector.
2. Analyze the concept of Robust Design, QFD and Strategies used in Agile Manufacturing.
3. Enlighten the concept of CAPP, Cellular Manufacturing and Role of Computer in Agile Manufacturing.
4. Describe the Techniques, Skills and Factors Affecting Agile Manufacturing.
5. Analyze the Role of Employee in Agile Manufacturing and Role of Management in Implementing Agile Manufacturing.

Course Articulation Matrix

Course Outcomes -CO		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Summarize the role of Agile Manufacturing in Manufacturing Sector.	2	2	1		2							2	2	
CO2	Analyze the concept of Robust Design, QFD and Strategies used in Agile Manufacturing.	2	2	1		2							2	2	
CO3	Enlighten the concept of CAPP, Cellular Manufacturing and Role of Computer in Agile Manufacturing.	2	2	1		2							2	2	
CO4	Describe the Techniques, Skills and Factors Affecting Agile Manufacturing.	2	2	1		2							2	1	
CO5	Analyze the Role of Employee in Agile Manufacturing and Role of Management in Implementing Agile Manufacturing.	1	1	1		2							2		

1-Low, 2-Moderate, 3-High

Course Title: **Engineering System Design**			
Course Code: P18IP822	Semester: VIII	L – T – P–H : 4 – 0 – 0 –4	Credits: 3
Contact Period - Lecture: 52 Hrs.; Exam:3 Hrs.		Weightage: CIE: 50%; SEE: 50%	

Prerequisites: The students should have undergone the basic courses on design & management courses.

Course objectives:

1. Understand the design by evolution and Morphology of design
2. Analysis of need and design concept.
3. Illustrate the design of decisions.
4. Outlining the reliability and economic Considerations in Design
5. Composing the Man-Machine interaction

Course Contents

Unit-I

Introduction: What is designing, Man as a designer: Design by evolution, System approach of engineering problems: Need models: design
History of large scale existing system.
Morphology of Design: The three phases of design projects, the structure of design process, Decision making and iteration. **10 Hours**
SSC: inadequacies of Traditional design method.

Unit-II

Identification and analysis of Need: Preliminary need statement, analysis of need, specifications.
Origination Of Design Concept: Process of idealization, mental fixity, and some design Methods like morphological analysis, AIDA, brain storming etc. **10 Hours**
SSC: Standards of performance and constraints

Unit-III

Preliminary Design: Mathematical modeling for functional design: concept of sensitivity, Compatibility and stability analysis.
Evaluation of Alternatives And Design Decisions: Physical reliability, DESIGN TREE: Quality of design, Concept of utility, decisions under uncertainty and risk (Numerical). **10 Hours**
SSC: Multi criteria decisions,.

Unit-IV

Reliability Considerations in Design: Bath tub curve, exponential reliability function, System reliability concept (Numerical).
Economics and Optimization in Engineering Design: Economics in Engineering Design, Fixed and variable costs, (Numerical)
Optimization: Introduction to LPP. **12 Hours**
SSC: Break-even analysis.

Unit-V

Man-Machine Interaction: Designing for use and maintenance, Man-Machine Cycle, Design of displays and controls. **10 Hours**

SSC: Factors influencing displays and controls.

Text Books

1. V. Gupta and P. Murthy, An Introduction to engineering design method, Tata McGraw Hill, 2000. ISBN-0070964416.
2. T. Woodson, Introduction of Engineering Design, Mc Graw Hil1, 2001.

Reference books

1. D.D. Meredith, K.W. Wong, R.W. Woodhead and K.K. Worthman, Design &Planning of Engineering systems. 2000
2. M.A. Asimov, Introduction to Design, Prentice Hall. 1996
3. J. C. Jones, Design Methods, John Wiley & Sons Inc., 1992. ISBN: 0-471-28

Course outcomes:

1. Illustrating the design by evolution and Morphology of design
2. Outlining the need and design concept.
3. Compiling design of decisions.
4. Planning the reliability and economic Considerations in Design
5. Creating proper Man-Machine interaction

Course Articulation Matrix															
Course Outcomes -CO		Program Outcomes												PSO	
		1	2	3	4	5	6	7	8	9	10	11	12	01	02
CO1	Illustrating the design by evolution and Morphology of design	2	2	2		2									
CO2	Outlining the need and design concept	2	2	2		2									
CO3	Compiling design of decisions.	3	3	2		2									
CO4	Planning the reliability and economic Considerations in Design	2	2	3		2							2		
CO5	Creating proper Man-Machine interaction	2	2	2		2							2		

1-Low, 2-Moderate, 3-High

Course Title: **Design of Experiments**			
Course Code: P18IP823	Semester : VIII	L – T – P–H : 3 – 0 – 0 –4	Credits: 3
Contact Period – Lecture : 52 Hrs ; Exam : 03 Hrs		Weightage: CIE: 50%; SEE: 50%	

Prerequisites: The students should have undergone the course on Quality assurance and reliability and total quality management.

Course Learning Objectives (CLO) :

At the end of the Course the students should be able to,

1. Define the concept of quality engineering L1
2. Understand the Taguchi Approach to Quality. L2
3. Define the concept Full Factorial Designs. L1
4. Understand the dummy level technique. L2
5. Understand the classical statistical experiment design. L2
6. Understand the Matrix experiment and data analysis plan. L2

Course Content

Unit – I

Introduction: History of quality engineering: Japan versus U.S. track records. Taguchi Approach to Quality: Definition of quality. Loss function. Taguchi's quality philosophy.

Basic Designs: Completely Randomized Design, Randomized Block Design, Latin Square Designs, one way analysis of variance and two way analysis of variance. **11 Hours**
SSC: Offline and online quality control.

Unit – II

Factorial Experimentation-Two Levels: Full Factorial Designs: Experimentation as a learning process. Traditional scientific experiments. Two-factor design. Four-factor design, Factor interactions.

Factorial Experimentation-Eight And Sixteen Run experiments: Fractional factorial designs based on eight-run experiments, folding over an eight run and sixteen – run experiment. **11 Hours**

SSC: Replicating experiments.

Unit – III

Constructing Orthogonal Arrays: Counting degrees or freedom, selecting a standard orthogonal array, dummy level technique, and compound factor method. Linear graphs and interaction assignment. Modification of linear graphs, column merging method, branching design. Comparison with the classical statistical experiment design. **10 Hours**
SSC: Strategy for constructing an orthogonal array.

Unit – IV

Steps In Robust Design: case study discussion. Noise factors and testing conditions. Quality characteristics and objective functions. Control factors and their levels. Conducting the matrix experiment, data analysis, verification experiment and future plan. **09 Hours**
SSC: Matrix experiment and data analysis plan.

Unit – V

Signal-To-Noise Ratio For Static Problems: Evaluation of sensitivity to noise. S/N ratios for Smaller-the-better, Larger-the-better.

Signal-To-Noise Ratio For Dynamic Problems: S/N ratios for Continuous-continuous, continuous-digital, digital-continuous, digital cases. Introduction to Taguchi Inner and Outer Arrays **11 Hour**

SSC: Nominal-the-best and Asymmetric Cases

Text Books

1. Quality Engineering Using Robust Design-Madhav S. Phadke,Prentice Hall PTR, Englewood Cliffs, New Jersey 07632.
2. Design of Experiments- D.C. Montgomery, John Wiley and Sons,2002.

Reference Book

1. Designing for Quality -an Introduction Best of Taghuchi and WesternMethods or Statistical Experimental Design-Robert H. Lochner and Joseph E. Matar, Chapman and Hall Madras, 2ndedition.

Course Outcomes:

Design of experiments application subject which deals with the concept of,

1. Concept of quality engineering,
2. The Taguchi Approach to Quality
3. The dummy level technique
4. The classical statistical experiment design
5. The Matrix experiment and data analysis plan.

Course Articulation Matrix (CAM)														
Course Outcome (CO)	Program Outcome												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	01	02
Concept of quality engineering,	1	2	1	-	-	-	-	-	-	-		1	-	-
The Taguchi Approach to Quality	3	1	2	-	-	-	-	-	-	-			1	-
The dummy level technique	3	3	2	3	-	1	-	-	-	-			-	-
The classical statistical experiment design	3	3	2	2	-	2	-	-	-	-		2	1	-
The Matrix experiment and data analysis plan	1	1	1	2	-	1	-	-	-	-			-	-

1-Low, 2-Moderate, 3-High

Course Title: **Hydraulic And Pneumatic Systems**			
Course Code: P18IP824	Semester : VIII	L – T – P–H : 2 – 1 – 0 –4	Credits: 3
Contact Period – Lecture : 52 Hrs ; Exam : 03 Hrs		Weightage: CIE: 50%; SEE: 50%	

Prerequisites: Basic knowledge of elements of machine tool, control engineering and machine tool drive, MP-1, MP-2.

Course Learning Objectives (CLOs).

This course aims to:

1. The students will know the **importance** of hydraulic and pneumatic systems. [L3]
2. **Understand** and **demonstrate** the ability to identify the motor and pump. [L2]
3. **Understand** the concept of Direction Control Valve [L2]
4. **Apply** the basic concepts of hydraulic circuits. [L3]
5. **Understand** general properties of hydraulic fluids and maintenance of hydraulic system. [L2]
6. Learn to **demonstrate** the various types of compressors and actuators. [L2]

Relevance of the Course

- Hydraulic and pneumatic system deals with power application through hydraulic pressure and compressed air pressure systems.
- The course aims at understanding and application of these system in industry and general application like elevators, automotive systems etc. It helps students in applying these techniques to develop the hydraulic circuit.

Course Content

Unit-I

Introduction to Hydraulic Power: Pascal's Law, structure of Hydraulic control system, advantages and disadvantage of hydraulic system.

Pumps: Pumping theory, Pump Classification, Gear Pump, Vane Pump, Piston Pumps, Pump performance, Pump selection. (Problems)

Hydraulic Actuators and Motors: Linear Hydraulic Actuators (Cylinders), Mechanics of Hydraulic Cylinder Loadings,

Gear Motor, Vane Motor, piston Motor, Hydraulic Motor Theoretical Torque, Power and flow rate, Hydraulic Motor Performance. (Problems) **10 hours**

SSC: Classification of fluids

Unit-II

Control Components in Hydraulic systems: Introduction, Directional Control Valves (DCV), check valve, Pilot operated check valve, 2/2, 3/2, 4/2, 4/3 valves (Constructional features) and symbolic representation,

Pressure control valves – pressure relief valve, pilot controlled pressure relief valve, Pressure reducing valve, pilot operated sequence valve, counter balance valve, needle valve, pressure compensated flow control valve. **10 hours**

SSC: how do classify flow control valve

Unit-III

Hydraulic Circuit Design and Analysis: ANSI symbols of hydraulic components, Control of single and Double acting Hydraulic cylinder, Regenerative circuit, Counter balance Valve application, double pump Hydraulic system, Hydraulic Cylinder sequencing Circuits, Cylinder Synchronizing Circuits, speed control of a Hydraulic Cylinder, Meter-in circuit and Meter-out circuit, speed control of Hydraulic Motors, Accumulators types of accumulators, accumulator

as hydraulic shock absorber circuit, accumulator as an auxiliary power source, accumulator used as an emergency power source **12 hours**
SSC: ANSI symbols of hydraulic components

Unit-IV

Maintenance of Hydraulic systems: Hydraulic oils – Desirable properties, General type of fluids, Sealing Devices, Reservoir system, Filters and strainers, location of filters in hydraulic circuits, filter rating, Wear of Moving Parts due to Solid – Particle Contamination, Problem caused by Gases in Hydraulic Fluids, Temperature control, Trouble shooting.
SSC: Determine the hydraulic system containing a pump delivering high pressure **10 hours**

Unit-V

Introduction to Pneumatic Control: Choice of working medium, Characteristics of compressed air, Structure of Pneumatic control System, Production of compressed air – reciprocating compressor, double acting compressor, two stage compressor, screw compressor, vane compressor, centrifugal compressor, axial flow compressor, Preparation of compressed air, Methods of Air Dryers.
Pneumatic actuators: single and double acting actuator, gear motor, vane motor, piston motor
SSC: compressor analysis. **10 hours**

Text Books

1. Oil Hydraulic systems – Principles and Maintenance by S.R. Majumdar, Tata McGraw Hill Publishing Company Ltd., 2010.
2. Pneumatic systems by S. R Majumdar, Tata McGraw Hill Publishing Co. – 1995

Reference Books

1. Pneumatics Basic Level TP 101, by Peter Croser and Frank Ebel, Festo Didactic publication- 1999.
2. Fundamentals of Pneumatic Control Engineering by J P Hasebrink& R Kobbler, Festo Didactic publication, 3rd edition – 1989.
3. Pneumatic Control for Industrial Automation by Peter Rohner& Gordon Smith, John Wiley Sons publication – 1989.
4. Power Hydraulics by Michael J Pinches and John G Ashby, Prentice Hall – 1989.
5. Fluid Power With Applications, Anthony Esposito, Pearson Publications, 2012
6. Hydraulics and Pneumatics – Andrew Parr, Jaico Publishing House, 2004

Course Outcomes:

1. Students will be able solve the problems on performance of gear pump and gear motor in hydraulic system and able to understand the requirement of hydraulic systems.
2. Students will be able to determine the different control valves
3. Students will gain the knowledge of designing the hydraulic circuit
4. The students will be able to understand the concept of Pneumatic control system.
5. Students will be able to demonstrate various types of compressors and actuators.

Course Assessment Matrix (CAM)

Sl. No	Course Outcome – CO	Program outcome										PSO	
		1	2	3	4	5	6	7	8	9	10	11	12
01	Able solve the problems on performance of gear pump and gear motor in hydraulic system and able to understand the requirements of hydraulic systems.	3	2	1	1	1							
02	Able to demonstrate the different control valves	3	1	2	3								
03	Gain the knowledge of designing the hydraulic circuit	2	2	1	1	1							
04	Able to understand the concept of Pneumatic control system.	2	1	1	3	1							
05	Able to demonstrate various types of compressors and actuators.	2	1	2	1								

1-Low, 2-Moderate, 3-High