

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

### Production Engineering

Third Year (Sem. V & VI) and Final Year (Sem. VII & VII)

Revised Syllabus (REV- 2012) w. e. f. Academic Year 2014 -  
15 and 2015-2016 respectively

Under

## FACULTY OF TECHNOLOGY

(As per Semester Based Credit and Grading System)

## **Deans Preamble**

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's) and course objectives and course outcomes to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Semester based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit and grading based system was implemented for First Year of Engineering from the academic year 2012-2013. Subsequently this system will be carried forward for Second Year Engineering in the academic year 2013-2014, for Third Year and Final Year Engineering in the academic years 2014-2015 and 2015-2016 respectively.

**Dr. S. K. Ukarande**

**Dean,**

**Faculty of Technology,**

**Member - Management Council, Senate, Academic Council**

**University of Mumbai, Mumbai**

## Chairman Preamble

Engineering education in India is expanding and is set to increase manifold. The major challenge in the current scenario is to ensure quality to the stakeholders along with expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education and reflects the fact that in achieving recognition, the institution or program of study is committed and open to external review to meet certain minimum specified standards. The major emphasis of this accreditation process is to measure the outcomes of the program that is being accredited. Program outcomes are essentially a range of skills and knowledge that a student will have at the time of graduation from the program. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

As the Chairman, Board of Studies in Mechanical Engineering of University of the Mumbai, I am happy to state here that, the Program Educational Objectives were finalized in a brain storming session, which was attended by more than 20 members from different affiliated Institutes of the University. They are either Heads of Departments or their senior representatives from the Department of Mechanical Engineering. The Program Educational Objectives finalized for the undergraduate program in Mechanical Engineering are listed below;

1. To prepare the Learner with a sound foundation in the mathematical, scientific and engineering fundamentals.
2. To prepare the Learner to use modern tools effectively in order to solve real life problems.
3. To prepare the Learner for a successful career in Indian and Multinational Organisations and to excel in their Postgraduate studies.
4. To encourage and motivate the Learner in the art of self-learning.
5. To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

In addition to the above, 2 to 3 more program educational objectives of their own may be added by affiliated Institutes.

In addition to Program Educational Objectives, for each course of undergraduate program, course objectives and course expected outcomes from the point of view of a learner are also included in the curriculum to support the philosophy of outcome based education. I strongly believe that even a small step taken in the right direction will definitely help in providing quality education to the major stakeholders.

**Dr. S. M. Khot**

**Chairman, Board of Studies in Mechanical Engineering, University of Mumbai**

**B. E. (Production) Sem.-VII**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned				
		Theory	Pract.		Theory	Pract.	Total		
PEP701	Industrial Training and Project	--	5*8=40		--	20	20		
Course Code	Course Name	<b>Examination Scheme</b>							
		<b>Theory</b>					Term Work	Pract./ Oral	Total
		<b>Internal Assessment</b>			End Sem. Exam.	Exam. Duration (in Hrs)			
		<b>Presentation</b>		Avg.					
		Stage 1	Stage 2						
PEP701	Industrial Training and Project	50	50	50	--	--	100	50	200
<b>Total</b>		--	--	<b>50</b>	--	--	<b>100</b>	<b>50</b>	<b>200</b>

\* Industrial training and Project report should be of 24 weeks. (Learners load -8hours a day and 5days a week translates into 40 contact hours per week)

**Workload of Teacher: Contact teacher hours for project guidance – One hour per student per week.**

### B. E. (Production) Sem.-VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Pract.	Theory	Pract.	Total			
PEC801	Automation and Control Engineering	4	2	4	1	5			
PEC802	Computer Aided Manufacturing	4	2	4	1	5			
PEC803	Engineering Economics, Finance, Accounting and Costing	4	--	4	--	4			
PEC804	Total Quality Strategy	4	2	4	1	5			
PEC805	Industrial relations and Human Resource Management	4	--	4	--	4			
PEE801X	Elective-I	3	2	3	1	4			
<b>TOTAL</b>		<b>23</b>	<b>08</b>	<b>23</b>	<b>4</b>	<b>27</b>			
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract./ Oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (in Hrs)			
		Test1	Test2	Avg.					
PEC801	Automation and Control Engineering	20	20	20	80	03	25	25	150
PEC802	Computer Aided Manufacturing	20	20	20	80	03	25	25	150
PEC803	Engineering Economics, Finance, Accounting and Costing	20	20	20	80	03	--	--	100
PEC804	Total Quality Strategy	20	20	20	80	03	25	25*	150
PEC805	Industrial Relations and Human Resource Management	20	20	20	80	03	--	---	100
PEE801X	Elective-I	20	20	20	80	03	25	--	125
<b>Total</b>		<b>--</b>	<b>--</b>	<b>120</b>	<b>480</b>	<b>--</b>	<b>100</b>	<b>75</b>	<b>775</b>

\* Only ORAL examination based on term work and syllabus

#### List of Electives

Course codes	Course Name	Course codes	Course Name
PEE8011	Sales and Marketing Management	PEE8016	Mechatronics
PEE8012	Logistics and Supply Chain Management	PEE8017	Industrial Robotics
PEE8013	Plastics Engineering	PEE8018	Product Design and Development
PEE8014	Entrepreneurship Development	PEE8019	Sustainable Engineering
PEE8015	World Class Manufacturing	PEE80110	Maintenance Engineering

Course Code	Course/Subject Name	Credits
<b>PEP701</b>	<b>Industrial Training and Project</b>	<b>20</b>

### Objectives

1. To help to correlate the lessons learnt in theory and actual practices followed in the industries.
2. To expose to an industrial environment.
3. To get tuned to work under the atmosphere of factory discipline.
4. To make aware of the psychology of the workers, their habits, attitudes and to prepare them to approach the problems, considering the practices followed in an industry.
5. To make appreciate the need for a co-ordinated effort of various persons at different levels in different departments for achieving the set goals and targets.

### Outcomes: Learner will be able to...

1. Get familiarized with various technological trends, approaches and applications along with managerial exposure.
2. Appreciate and realize the size and scale of operations in Industry.
3. Get an opportunity to apply their knowledge in problem solving and eventually develop that skill.
4. Demonstrate understanding of relevant application oriented subjects in a better prospective.
5. Demonstrate understanding of various constraints of time and cost, within which goods are produced and services rendered in a specified quantum.
6. Describe the scope, functions and job responsibilities in various departments of an organization.
7. Develop a positive attitude, which will bring in a visible change in their approach while dealing with technical and interpersonal issues.

### Guidelines for Evaluation/Assessment

The total duration for each presentation shall be maximum 30 minutes, inclusive of 20 minutes for presentation and 10 minutes for discussion. 50 marks each for stage I and stage II to be awarded based on the points furnished below and as per the discretion of the internal project guide.

1. Content of the presentation.
2. Presentation skill.
3. Interest taken, personal involvement and contribution.
4. Headway/progress made in the project execution.

### Evaluation/Assessment of the Term Work

1. Introduction, Acknowledgements, references.	}	15
2. Company background/ activities.		
3. Training areas / Training details.		
4. Synopsis / Abstract of the Project.		
5. General presentation, neatness and accuracy of the data furnished.		15
6. Technical contents of the report with data / observations, graphs, drawings, etc		25
7. Quality of work carried out and details furnished based on personal Observations/involvement.		35
8. Result/ Conclusion.		10
Total -		100

**Note: Report shall be prepared using University of Mumbai approved Guidelines.**



Course Code	Course/Subject Name	Credits
<b>PEC801</b>	<b>Automation and Control Engineering</b>	<b>4+1</b>

### Objectives

1. To acquaint with basic concepts of industrial automation involving pneumatic and hydraulic controls.
2. To familiarize with the elements of electro-pneumatic interface with control systems.
3. To learn about the application of microprocessors and microcontrollers.

### Outcomes: Learner will be able to...

1. Apply automation techniques to manufacturing set-ups.
2. Design and develop pneumatic and hydraulic control circuits of medium complexity.
3. Illustrate the use of PLC in control systems.
4. Model the system and check the stability of a mechanical system.

Modules	Details	Hrs.
<b>01</b>	<b>Automation</b> Definition; Automation in production systems; Automation principles and strategies; Basic elements of an automated system; Advanced automation functions; Levels of automation; Types of automation; Benefits and Impact of Automation in Manufacturing and Process Industries. Architecture of Industrial Automation Systems.	<b>06</b>
<b>02</b>	<b>Pneumatic control systems</b> Overview of different types of valves and Actuators in Pneumatics, their applications and their ISO symbols. Design of Pneumatic circuits using Cascade method and Shift register method (up to 3 cylinders). Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves with and without grouping. Design of Pneumatic circuits using PLC Control (ladder programming only and up to 3 cylinders) with applications of Timers and Counters and concept of Flag and latching.	<b>11</b>
<b>03</b>	<b>Hydraulic control systems</b> Overview of different types of valves, Actuators and Accumulators used in Oil hydraulic circuits, their applications and their ISO symbols. Basic hydraulic circuits involving linear and rotary actuators (No sequential circuits). Fundamental concepts of digital and servo hydraulic controls. Comparison between proportional, digital and servo hydraulic control systems.	<b>07</b>
<b>04</b>	<b>Digital logic:</b> Number systems; Logic Gates; Boolean Algebra; Simplification of Boolean equations using Karnaugh Maps. <b>Microprocessors and Microcontrollers (Only basic understanding and applications)</b> Concept of Microprocessor based control and its application; Parts of a Microprocessor system with block diagram of the general form of a microprocessor system; Data bus, Address bus and Control Bus; General internal Architecture of a Microprocessor; Functions of constituent parts such as ALU, Various Registers and the Control unit. Difference between a Microprocessor and a Microcontroller. General Block diagram of Microcontroller.	<b>11</b>

<b>05</b>	<b>Sensors and Transducers</b> Fundamentals of displacement, position and Proximity Sensors; Velocity and Motion Sensors; Force and Fluid Pressure Sensors; Liquid level and Flow sensors; Temperature and light Sensors; Control of stepper motors.	<b>02</b>
<b>06</b>	<b>Fundamentals of Control System</b> Control system concepts, classification of control systems, mathematical representation of system equations, response characteristics of components and systems through classical solution. Analog computer and Laplace transformation, Frequency response analysis, polar plots, Testing of System's stability using Routh's criteria, Bode plots, Nyquist plot and Root locus method of analysis.	<b>11</b>

### List of Experiments

1. Experiments based on modules 2 & 3 on fluid simulation kit.
2. Pneumatic and electro pneumatic sequencing circuits simulation on simulation software.
3. Introduction to mathematical programming softwares like Matlab or Scilab. Introduction to the GUI working; basic codes; introduction to the graphing tools; Implementation of bode plot and root locus.

### Term Work

Term work shall consist of at least six experiments based on sr. no. 1 and 2 from list of experiments, minimum two exercises based on sr. no.3 from list of experiments and at least one assignment from each module of syllabus.

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiment/ programs and journal) : **10 marks**
- Assignments: **10 marks**
- Attendance (Theory and Practical): **05 marks**

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

### Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

### Practical/Oral examination

1. Practical examination shall be conducted based on the experiments conducted as part of term work. Examination shall be based on simulations experiment.
2. Examiners are expected to evaluate learners' skill of programming and machining and conduct oral based on the syllabus.
3. The distribution of marks for practical/oral examination shall be as follows:
  - i. Practical performance ..... 15 marks
  - ii. Oral ..... 10 marks
4. Students work along with evaluation report to be preserved till the next examination



## Theory Examination

In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## References

1. *Automation, Production Systems, and Computer-integrated Manufacturing (3<sup>rd</sup> Edition)*, by Mikell P. Groover, PHI Learning Private Limited, New Delhi.
2. *Pneumatic Controls*, by Joji P., Wiley India Pvt. Ltd.
3. *Principles Of Control Systems*, by U.A.Bakshi, V.U.Bakshi, Technical Publications Pune .
4. *Pneumatics Basic Level*, by Peter Croser, Frank Ebel, Festo Didactic GmbH & Co. Germany
5. *Electropneumatics Basic Level*, by G. Prede, D. Scholz, Festo Didactic GmbH & Co. Germany.
6. *Programmable logic controllers Basic Level*, by R. Bliesener, F. Ebel, C. Löffler, B. Plagemann, H. Regber, E. V. Terzi, A. Winter, Festo Didactic GmbH & Co. Germany.
7. *Vickers Industrial Hydraulics Manual (3rd Edition)*, Vickers Inc.; Maumee, OH. *Hydraulic and Pneumatic Controls (2<sup>nd</sup> Edition)*, by R. Srinivasan, Vijay Nicole Imprints Pvt. Ltd. Chennai.
8. *Introduction to Hydraulics and Pneumatics*, by S. Ilango and V. Soundararajan, PHI Learning Pvt. Ltd. New Delhi.

Course Code	Course/Subject Name	Credits
<b>PEC802</b>	<b>Computer Aided Manufacturing</b>	<b>4+1</b>

### Objectives

1. To familiarize with concepts of computer aided manufacturing and its significance.
2. To familiarize with interfacing of drive systems with the machines.

**Outcomes:** Learner will be able to...

1. Develop expertise in computer-aided manufacturing.
2. Illustrate basic concepts of control systems.
3. Write /Select the appropriate code for performing particular tasks in a CNC.

Module	Details	Hrs.
<b>01</b>	<b>Introduction</b> Elements of CAM system, Computer Numerical control of Machine Tools, Fundamental elements of CNC, Benefits of CNC, Computer control concepts, Data processing units & Binary calculation.	<b>05</b>
<b>02</b>	<b>Rapid prototyping</b> Introduction to rapid Prototyping and rapid tooling.	<b>04</b>
<b>03</b>	<b>Basics of control systems</b> Motion controller, Interpolation-Linear & Circular, Positioning & Contouring control loops, Incremental & Absolute system, DNC & CNC systems and Adaptive control system. <b>CNC Hardware Basics</b> CNC drives, Spindle design, Actuation and Feedback devices	<b>06</b>
<b>04</b>	<b>CNC Tooling</b> Turning tools, Milling tools, Tool pre setter, ATC, work holding devices and Cutting process parameters.	<b>05</b>
<b>05</b>	<b>CNC Programming</b> Introduction to CNC Lathe & Milling, Touch probe system, Tool length, nose radius & Diameter compensation, Turning & Machining centre programming, CNC part programming using ISO controllers, Canned cycles, Looping Jumping Subroutines Macros, Parametric programming, Computer aided part programming using APT and Post processing.	<b>16</b>
<b>06.</b>	<b>CIM</b> Computer applications in manufacturing, Automation and Integrated Production management systems. Automated Material handling systems, Conveyors, AVG, AS/RS, Automated inspection procedure, Distributed Numerical control & Benefits of CIM and implementation & computer aided shop floor control system. Concept of "Ghost" factory.	<b>12</b>

## Term Work

Term work shall consist of minimum 06 experiments based on topics from syllabus to be conducted and presented with inferences and at least one assignment from each module of syllabus.

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiment/ programs and journal): **10** marks
- Assignments: **10** marks
- Attendance (Theory and Practical): **05** marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

## Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

## Practical/Oral examination

1. Practical examination shall be conducted based on the experiments conducted as part of term work. Examination shall be based on tool path generation for planer machining, contour machining, drilling, turning etc. & post processing modulus for different CNC controllers.
2. Examiners are expected to evaluate learners' skill of programming and conduct oral based on the syllabus.
3. The distribution of marks for practical/oral examination shall be as follows:
  - i. Practical performance ..... 15 marks
  - ii. Oral ..... 10 marks
4. Students work along with evaluation report to be preserved till the next examination

## Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## References

1. *Mastering CAD/CAM*, Ibrahim Zeid
2. *CAD/CAM*, P.N. Rao
3. *Computer aided design and manufacturing*, Mikel.P.Groover
4. *CNC & CAM*, G.E.Thyer.
5. *Numerical Control and computer aided Manufacturing*, T.K.Kundra, R.N.Rao, and N.K.Durai.
6. *CAD/CAM/CIM*, P.Radha Krishnan and S.Subramanyam.
7. *CAD/CAM Hand Book*, Machever c and Baluth R.E.
8. *Programming for Numerical control of machines*: Roberts A.D and Prentice R.C.
9. *Computer Integrated Manufacturing*, Alan Weatherall.
10. *CAD/CAM systems, Planning and Implementation*: Charles S Knox.
11. *CAD/CAM Handbook*, Erich Teicholz.

Course Code	Course/Subject Name	Credits
<b>PEC803</b>	<b>Engineering Economics, Finance, Accounting and Costing</b>	<b>4</b>

### Objectives

1. To acquaint with the concepts of Micro and Macro Economics.
2. To familiarize with the need, definition, functions and economic significance of financial institutions and markets.
3. To familiarize with the concept of Fiscal and Monetary Policy.
4. To acquaint with financial statements and Annual Reports of industries.
5. To familiarize the students with cost records / statements.

### Outcomes: Learner will be able to...

1. Correlate various micro and macro economic variables.
2. Illustrate Economic policies and understand their implications.
3. Get familiarized with the roles played by various financial institutions/banks.
4. Get exposure to various business strategies.
5. Get familiarized with accounting and costing practices.

Module	Details	Hrs.
<b>01</b>	<b>Introduction</b> Definition of Economy, Central problems of an economy: what, how and for whom to produce; concepts of production possibility frontier and opportunity cost. Economics, its scope and importance. Introduction to Micro and Macro economics and their comparison.	<b>04</b>
<b>02</b>	<b>Micro Economics</b> 2.1 Consumer's Behaviour: meaning of utility, marginal utility and law of diminishing marginal utility. 2.2 Conditions of consumer's equilibrium using marginal utility analysis: Concept of ordinal utility, law of demand and relation between law of demand & law of diminishing marginal utility. 2.3 Producer's Behaviour: law of supply, variation in supply, Types of elasticity of supply. Types of Market: perfect competition, pure competition, Monopoly and Multi-plant monopoly.	<b>05</b>
<b>03</b>	<b>Macro Economics</b> 3.1 Concept of National Income: Circular flow of income, Distinction between Gross and Net National Income. Different Methods of Measuring National Income, Definition of Money, Functions of Money, Value of Money and Different concepts of Money. 3.2 Economic Policy: Monetary, Income and Fiscal Policies. 3.3 Functions of Central Bank, Functions of Commercial Banks credit Creation, Credit Control Methods, Theory of Inflation, Concepts of Inflation, Effects of Inflation and Anti-inflationary policies.	<b>05</b>
<b>04</b>	<b>Financial Environment of Business:</b> Financial Management-Sources of finance-long term and short term finance <b>Capital Markets</b> 4.1 Primary Market: Basics of capital market mechanism and instruments. Secondary Market: Basics of stock exchange and their role, Role of SEBI, Role of FIIs, MFs and Investment Bankers. 4.2 Money Markets: Basics of Money Market Mechanism, instruments, and institutions.	<b>06</b>

<b>05</b>	<b>Management Accounting:</b> Understanding of Financial Statements (Overview), Interpreting Financial Statements (overview). <b>Accounting Mechanics, Process and system:</b> Introducing Book Keeping and Record Maintenance, The concept of Double Entry and fundamental principles, Journal, Ledger, Trial Balance and Final Accounts. Financial Analysis, Ratio Analysis and comparative balance sheet.	<b>12</b>
<b>06</b>	<b>Cost and Management Accounting</b> Introduction to cost, Types of cost, Treatment of Overheads, Unit Costing (Cost Sheet), Joint Product Costing, Process Costing, Marginal Costing, Cost Volume Profit Analysis and Decision Making. Budgetary Controls, Standard Costing, concept and Importance of Depreciation and Methods of Depreciation.	<b>16</b>

### Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

### Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

### References

1. *Managerial and Cost Accounting*, Larry M. Walther , Christopher J. Skousen
2. *Strategic Financial Management*, Robert Alan Hill
3. *Basics of Accounting & Information Processing The Accounting Cycle*, Larry M. Walther , Christopher J. Skousen
4. *Introduction to Managerial Accounting*, Larry M. Walther , Christopher J. Skousen
5. *Managerial and Cost Accounting*, Larry M. Walther , Christopher J. Skousen
6. *Essentials of Microeconomics*, Krister Ahlersten
7. *Essentials of Macroeconomics*, Peter Jochumzen
8. *Banking: An Introduction*, Dr AP Faure, Rhodes University
9. *Financial System: An Introduction*, Dr AP Faure, Rhodes University
10. *Central Banking & Monetary Policy: An Introduction*, Dr AP Faure, Rhodes University.



Course Code	Course/Subject Name	Credits
<b>PEC804</b>	<b>Total Quality Strategy</b>	<b>4+1</b>

### Objectives

1. To acquaint with key features of the TQS philosophy.
2. To understand and assimilate the contribution rendered by quality gurus.
3. To familiarize with various quality tools and their uses in solving the problems.
4. To impress upon the ongoing global trend of quality focus to customer delight.

### Outcomes: Learner will be able to...

1. Identify and use proper quality tools in various manufacturing /service functions.
2. Integrate quality approaches for productivity improvement.
3. Realize the trade-off dimension of quality and cost.
4. Realize that quality should not be inspected, but should be inbuilt into the system.

Module	Details	Hrs.
<b>01</b>	<p><b>Introduction</b></p> <p>1.1 Evolution of Quality, Definition of Quality, Dimensions of Quality, Quality Planning, Principles of TQM, Quality in Manufacturing and Service Systems, Economic Issues, Quality and Market Share, Barriers to TQM Implementation.</p> <p>1.2 Cost of quality: prevention, appraisal &amp; failure costs and Hidden cost of quality.</p>	<b>06</b>
<b>02</b>	<p><b>Strategic planning for quality</b></p> <p>2.1 Need for quality policies &amp; objectives with examples.</p> <p>2.2 Leadership concepts, Importance of Top Management commitment, quality council and strategic planning.</p> <p><b>Quality improvement</b></p> <p>2.3 Juran's trilogy, management of controllable defects, operator controllable defects, sporadic and chronic problems of quality.</p> <p>2.4 Bench Marking: Introduction, definition and its significance. Collection of data for bench marking and its use.</p>	<b>09</b>
<b>03</b>	<p><b>Customer relation and satisfaction:</b></p> <p>3.1 Origin of consumerism - Product knowledge, definition and types of customers, their importance, Customer perception and quality expectations.</p> <p>3.2 Quality feedback and redressal.</p> <p>3.3 Definition and principles of reliability, reliability and product life cycle (boat curve/bath tub curve), trade-off between reliability, maintainability and availability.</p>	<b>06</b>
<b>04</b>	<p><b>Supplier Relations</b></p> <p>4.1 Treating Supplier as a partner, Principle and elements of Partnering.</p> <p>4.2 Selection of supplier, Performance measurement &amp; rating of supplier</p> <p>4.3 Push-Pull view of supply chain and Cycle view of supply chain management.</p>	<b>05</b>

<b>05</b>	<p><b>Quality / Productivity Improvement Tools</b></p> <p>5.1 Process Data Collection &amp; presentation – Bar Chart, Histogram and Run Charts.</p> <p>5.2 Process Variability – variables &amp; Process Variation (Measures of accuracy &amp; Centering, precision or spread, normal distribution and sampling averages).</p> <p>5.3 Process Control by Variable – using X bar and R Chart and control charts for standard deviation.</p> <p>5.4 Process Control by Attribute - for number of defectives or non-conforming units - <b>np</b>-charts, <b>p</b>-charts, <b>c</b>-charts and <b>u</b>-charts</p> <p>5.5 Process capability, OC curve, acceptance sampling AQL, LTPD, AOQL, producers and consumers risk (Single &amp; Double sampling plan only). (Note: Emphasize the explanation with Numerical problems).</p>	<b>11</b>
<b>06.</b>	<p><b>Quality Systems</b></p> <p>6.1 Quality standards</p> <ol style="list-style-type: none"> <li>a. The ISO9001:2000 Quality Management System Standard</li> <li>b. The ISO 14001:2004 Environmental Management System Standard</li> <li>c. ISO 27001:2005 Information Security Management System</li> <li>d. ISO/TS 16949:2002 for Automobile Industry</li> <li>e. Internal audit, surveillance audit, maintaining of certification.</li> </ol> <p>6.2 PDCA cycle, Problem solving tools (old &amp; new), JIT, Importance of 6sigma, DMAIC approach, SIPOC Process and Sample Calculation of sigma level.</p> <p>6.3 Approach to world class manufacturing (Toyota production system, Lean manufacturing, Zero defect supply concept), Quality Function Deployment (QFD), Failure Mode Effect Analysis (FMEA), Introduction to DoE, Shainin concepts of Quality and Customers / Suppliers voice</p> <p>6.4 Productivity improvement techniques -5S, POKAYOKE, SMED, Kaizen and concurrent engineering,</p>	<b>11</b>

## Term Work

Term work shall consist of at least one assignment from each module of syllabus and Seminar / Case study presentation with report in a group of not more than 4 students.

The distribution of marks for term work shall be as follows:

- Seminar / Case study Presentation: **10** marks
- Assignments: **10** marks
- Attendance (Theory and Practical): **05** marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

## Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

## Oral examination

1. Oral examination shall be conducted based on term work and syllabus content
2. Examiners are expected to give small task or ask questions either to evaluate understanding of basic fundamentals or to evaluate their capability of applying basic theory to practical applications.

## Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## References

1. *Quality planning and analysis*, J M Juran, FM Gryana, TMH
2. *Total Quality Management*, D. H. BesterField et al. prentice hall.
2. *Quality is free*, Philip B Crossbly, Mentor/ new American library.
3. *What is Total Quality Control? The Japanese way*, Ishikawa k, PH.
4. *Total Quality Control*, Armand V Feigenbaum.
5. *TQM in new product manufacturing*, HG Menon; TMH.
6. *Managing for total quality*, N. Logothetis / prentice hall
7. *Total quality management*, Dr.Uday K.Haldar/Dhanpatrai & co.
8. *Total quality management*, Dr.K.C.Aurora/S.K.Kataria & sons.
9. *Statistical Process Control*, John S. Oakland, Butterworth-Heinemann.

Course Code	Course/Subject Name	Credits
<b>PEC805</b>	<b>Industrial Relations and Human Resource Management</b>	<b>4</b>

### Objectives

1. To get an exposure to aspects pertaining to human resource and its relevance in industry.
2. To focus on the behavioral aspects and industrial relations.

### Outcomes: Learner will be able to...

1. Appreciate human resource as the most vital resource of an organization.
2. Develop skills in identifying, planning, and deploying of man power.
3. Develop inter personal and communication skills.
4. Develop skills in identifying training needs of employs at different levels.

Module	Details	Hrs.
<b>01</b>	<b>Evolution and Developments of thought</b> Evolution of managements thought, behavioral, contingency and Contemporary management approach. <b>Organization structure</b> Definition, need, types of organizational responsibility, authority, accountability, delegation and span of control.	<b>08</b>
<b>02</b>	<b>Decision Making</b> Types of decision, steps in rational decision making. <b>Functions of personnel Management</b> Managerial and operative functions.	<b>06</b>
<b>03</b>	<b>Communication</b> Significance of communication, Principles of effective communication and Barriers of communication. <b>Leaderships</b> Different styles of leadership and their suitability, Empowering employees and Manager as a leader.	<b>10</b>
<b>04</b>	<b>Human Behavior</b> Perception, attitude, Groups, Types of groups, Groups behavior, Morale and Job satisfaction. <b>Motivation</b> Theories of Motivation, Job design, Job enlargement and enrichment, Difference between manipulation & motivation and Performance appraisals.	<b>06</b>
<b>05</b>	<b>Human resource development</b> 5.1 Human resource planning, Job description, Job analysis and job evaluation, Recruitment and selection procedure. 5.2 Training and Development: Concepts and difference between training and development, Identification of training needs at different levels, Methods, Steps and Types of training. 5.3 Promotion: Basis for promotion and their merits and demerits. 5.4 Retaining of human resource: 5.6 Safety, steps in safety programme, Occupational hazards, and Accident prevention..	<b>12</b>

<b>06</b>	<p><b>Compensation and salary Administration:</b></p> <p>6.1 Factory act, Industrial dispute act, Salary and wage fixation and Workman's compensation act.</p> <p>6.2 Employee grievances, Machinery for addressing grievances, Collective bargaining, Industrial relations, Trade unions and managing Conflicts.</p>	<b>06</b>
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### Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

### Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

### References

1. *Personnel Management and Human Resources*, C.S. Venkataratnam, B,K, Srivastava
2. *Principles of Management*, P.C. Tripathi, P.N. Reddy
3. *Industrial and Business Management*, Martand T. Teslang
4. *Organization Behavior, Text and cases*, Uma Sekram
5. *Organizational Behavior*, F. Luthans
6. *Personnel Management*, C.B. Memoria.
7. *Factory Administration and Management*, A.S.Deshpande.
8. *The Change in world of the Executive*, Peter Drucker.
9. *In search of excellence*, Tom Peter and R, H.Waterman Harper.

Course Code	Course/Subject Name	Credits
<b>PEE8011</b>	<b>Sales and Marketing Management</b>	<b>3+1</b>

### Objectives

1. To make conversant with various principles and strategies of sales and marketing.
2. To acquaint with methodology for product pricing policies and distribution channels.
3. To make aware of promotional policies, advertising strategies and principles of market research.

### Outcomes: Learner will be able to...

1. Illustrate various selling strategies, pricing strategies and methodology of product positioning.
2. Get exposure about customer behavior and their implications in marketing.
3. Develop capability to assess, analyze and measure sales and marketing performance.
4. Get exposure to promotional policies and importance of advertising.
5. Evaluate effectiveness of advertising.

Module	Details	Hrs.
<b>01</b>	Definition of marketing, Understanding marketing, Sales, Company orientations, Journey from sales to marketing, New economy, Environmental forces, Marketing task, Marketing concepts and tools, Major drivers of the economy, Changing of business practices, Changing of marketing practices, E- business	<b>05</b>
<b>02</b>	Customer value and satisfaction, Organizational culture, Attracting and retaining customers, Cost of lost customer, Total customer satisfaction, Customer relationship management, Survey of customer needs, Consumers, Organizational and Government buyers.	<b>05</b>
<b>03</b>	Differentiation, Segmenting, Targeting, Positioning, Marketing decision support system, Product life cycle, Portfolio management, Customer perception of product features, New product development.	<b>07</b>
<b>04</b>	Competition, Market research, Management strategies, 4Ps of product marketing and 7Ps of service marketing, Product policies, Product brands, Services offering, Pricing, Customer perceived value, Distribution channels, Retailing, Marketing Plan and implementation, Market testing.	<b>08</b>
<b>05</b>	Marketing Organization, Selection of marketing staff, Specialized Training, Role of a salesman, Routine management, Salaries and incentives, Marketing intelligence, Marketing performance.	<b>05</b>
<b>06</b>	Customer focus, Advertising, Sales promotion, Motivation research, Consumer behavior, Buying decision process, Competitive strategies, Audit of customer satisfaction	<b>06</b>



## Term Work

Term work shall consist of at least one assignment from each module from syllabus and at least two (2) seminars / case study on the modules / trending scenario.

The distribution of marks for term work shall be as follows:

- Seminar / Case study Presentation & report **10 marks**
- Assignments: **10 marks**
- Attendance (Theory and Practical): **05 marks**

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

## Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

## Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## References

1. *Marketing Management: A South Asian Perspective*, Philip Kotler , Abraham. Koshy , Kevin Lane Keller , Mithileswar Jha.
2. *Marketing, A Managerial Introduction*, J. C. Gandhi.
3. *Principles and Practice of Marketing in India*, C. B. Mamoria, Raman Lal Joshi.
4. *Principles of Marketing and Salesmanship*, J. C. Sinha.
5. *Marketing management*, V. S. Ramaswamy, S. Namakumari.
6. *Indian Cases in Marketing*, M. D. Kakade.
7. *Advertising: Art and Ideas*, Dr. G. M. Rege.
8. *Advertising*, Chakaraborty.

Course Code	Course/Subject Name	Credits
<b>PEE8012</b>	<b>Logistics and Supply Chain Management</b>	<b>3+1</b>

### Objectives

1. To develop an understanding of key drivers of supply chain performance and their inter-relationships with strategy.
2. To impart analytical and problem solving skills necessary to develop solutions for a variety of supply chain management
3. To acquaint with design problems and develop an understanding of information technology in supply chain optimization.
4. To acquaint with the complexity of inter-firm and intra-firm coordination in implementing programs such as e-collaboration, quick response, jointly managed inventories and strategic alliances.

### Outcomes: Learner will be able to...

1. Know functions of supply chain management and its processes.
2. Study the flows of material, information and funds in a unified manner.
3. Evaluate the performance of supply chain management.
4. Illustrate complexity involved in coordination of inter-firm and intra-firm in implementing programs

Module	Details	Hrs.
<b>01</b>	<b>Building a Strategic Frame Work to Analyse Supply Chains</b> Supply chain stages and decision phases, Process view of 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.	<b>04</b>
<b>02</b>	<b>Designing the Supply Chain Network</b> Distribution Networking: Role, Design, Supply chain network (SCN): Role, Factors, framework for design decisions.	<b>05</b>
<b>03</b>	<b>Materials Management</b> Scope, Importance, Classification of materials, Procurement, Purchasing policies, Vendor development and evaluation. Inventory control systems of stock replenishment, Cost elements, EOQ and its derivative modules.	<b>05</b>
<b>04</b>	<b>Dimensions of Logistics</b> Introduction: A macro and Micro Dimensions, Logistics interfaces with other areas, Approach to analyzing logistics system, Logistics and systems analyzing: Techniques of logistics system analysis, factors affecting the cost and Importance of logistics.	<b>06</b>
<b>05</b>	<b>Warehouse and Transport Management</b> Concept of strategic storage, Warehouse functionality, Warehouse operating principles, Developing warehouse resources, Material handling and packaging in warehouses, Transportation Management, Transport functionality and principles, Transport infrastructure, transport economics and Pricing. Transport decision making	<b>06</b>

<b>06</b>	<p><b>IT in Supply Chain</b> IT framework, Customer Relationship Management(CRM),internal Supply chain management, Supplier Relationship Management (SRM),Transaction management,</p> <p><b>Coordination in A Supply Chain</b> Lack of supply chain coordination and the Bullwhip effect, Obstacle to coordination, Managerial levers, Building partnerships and trust.</p> <p><b>Emerging Trends and Issues</b> Vendor managed inventory-3PL-4PL, Reverse logistics: Reasons, Role, Activities; RFID systems: Components, Applications, Implementation; Lean supply chain, Implementation of Six Sigma in supply chain, Green supply chain.</p>	<b>10</b>
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### Term Work

Term work shall consist of at least one assignment from each module from syllabus and at least two (2) seminars / case study on the modules / trending scenario.

The distribution of marks for term work shall be as follows:

- Seminar / Case study Presentation & report **10** marks
- Assignments: **10** marks
- Attendance (Theory and Practical): **05** marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

### Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

### Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

### References

1. *Supply Chain Management Strategy, Planning, and operations*, Sunil Chopra and Peter Meindl.
2. *Materials Management & Purchasing*, Ammer D.S. Taraporawala.
3. *Designing & Managing Supply chain*, David Simchi Levi, Philip Kaminsky & Edith Smichi Levi.
4. *Supply Chain Redesign: Transforming Supply Chains into Integrated Value Systems*, Robert B Handfield, Ernest L Nicholas.
5. *The Management of Business Logistics: A Supply Chain Perspective*, Coyle, Bardi, Langley.

Course Code	Course/Subject Name	Credits
<b>PEE8013</b>	<b>Plastics Engineering</b>	<b>3+1</b>

### Objectives

1. To appraise about the vast potential of plastics materials in domestic engineering and specialty application areas.
2. To introduce students to various processing techniques.
3. To familiarize with design of moulds and dies.

### Outcomes: Learner will be able to...

1. Get an exposure to the world of plastics
2. Develop competency in exploring possibilities of replacing conventional materials.
3. Acquire competency in designing various tools for plastics processing.

Module	Details	Hrs.
<b>01</b>	<b>Materials</b> Brief introduction to plastics materials. Introduction to plastics blends, alloys and composites. Principles of recycling of plastics and waste management.	<b>02</b>
<b>02</b>	<b>Processing Techniques</b> <b>2.1 Injection Moulding</b> Moulding materials, moulding cycle-phases, and significance. Moulding Machinery: types, constructional and design features, plasticizing screw, injection and clamping units, Technical specifications and selection. Processing Techniques: Process parameters and their influence on product quality, trouble shooting. <b>2.2 Extrusion Process</b> Constructional and design features of extrusion machinery plasticizing screw. Technical specification and selection. Extrusion lines for pipes, Films (monolayer and multilayer, blown and cast films), sheets, Extrusion coating, monofilaments, box strapping, cables/wires and profiles. [Coverage for the above should include materials, plant layouts, in line equipment, extrusion techniques, process parameter and their influence on extruded products and trouble shooting). <b>2.3 Blow Moulding</b> Materials for blow moulding application, Types of Machinery, technical specifications and selection. (Extrusion Blow Moulding, Injection blow moulding and stretch Blow moulding). Processing Techniques: Process parameters and their influence on product quality, trouble shooting Comparison between types of Blow Moulding Processes.	<b>10</b>
<b>03</b>	<b>Auxillary equipment for plastics processing</b> Hopper dryers, Dececant dryers, Granulators, Mould temperature controllers, Proportionating devices, chilling units, automatic material conveying systems. <b>Other Process:</b> Brief coverage of the following processes with relevant details like machinery, materials, processing techniques and applications. Thermoset Mouldings, Thermoforming, Rotational Moulding, calendaring, fabrication and decorating with plastics. <b>FRP Techniques:</b> Raw materials and ancillaries used techniques like Hand lay-up, spray up and filament winding processes, applications.	<b>05</b>

<b>04</b>	<b>Product designing with plastics</b> Mechanical behaviour of plastics, creep data and its significance in designing. Product designing tips for designing articles to be manufactured by injection moulding, blow Moulding and Extrusion Moulding	<b>02</b>
<b>05</b>	<b>Design of Moulds</b> 5.1 Compression and transfer moulds: General arrangement of compression moulds-flash, semi positive and positive versions. General arrangement of transfer moulds-moulds for integral pot and auxillary transfer. 5.2 Injection Moulds: General arrangement of two plate moulds. Design of mould components, design of feedings, cooling and ejection systems, three plate moulds, Designing for moulds for articles with undercuts-split moulds and moulds with side cores actuation techniques, moulds for internally threaded articles, fully automatic moulds, mould standardization and innovative mould components. 5.3 Hot runner systems: General arrangement, design of manifold blocks, flow ways and nozzles, advantages and limitations.	<b>11</b>
<b>06</b>	<b>Blow Moulds:</b> General arrangement and mould components, design of neck and base pinch offs and flash pockets, Venting of moulds, selection of parting lines. <b>Extrusion Dies:</b> Design of extrusion dies for pipes, films, sheets, cables and profiles. <b>Mould Materials of Construction:</b> Characteristics, Tool steels and alloys, non-ferrous materials.	<b>06</b>

### List of Design Exercises

- 1) Design and drawing of one injection mould.
- 2) Design and drawing of one extrusion die.

### Term Work

Term work shall consist of at least two assignments from each module from syllabus, design exercises as mentioned in above list and at least one presentation based on module 2<sup>nd</sup> and 3<sup>rd</sup> from syllabus.

The distribution of marks for term work shall be as follows:

- Design Exercises including drawing: **10 marks**
- Assignments/Presentation: **10 marks**
- Attendance (Theory and Practical): **05 marks**

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

### Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

## Theory Examination

In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## References

1. *Moulding of Plastics*, Bickales.
2. *Design of Extrusion dies*, M. V. Joshi.
3. *Injection of Mould Design*, R. G. W. Pyre.
4. *Plastic Materials*, Brydson.
5. *Extrusion Technology* – Allen Griff.
6. *Practical guide to Blow Moulding*, Lee.
7. *Injection Moulding: Theory and Practice*, Rubin.
8. *Handbook of Composite fabrication*, Akovali.
9. *Plastic product materials and process selection Handbook*, Rosato.



Course Code	Course/Subject Name	Credits
<b>PEE8014</b>	<b>Entrepreneurship Development</b>	<b>3+1</b>

### Objectives

1. To appraise the students with various aspects pertaining to entrepreneurship.
2. To instill in the minds of the students the significance of entrepreneurship and its role in industrial / economic development.
3. To make conversant with the systematic steps involved in identifying opportunities and initiating an enterprise.
4. To gain knowledge about finance, accounting and support organization.
5. To impart knowledge on various management issues and familiarize with various regulatory acts.
6. To serve as a knowledge base for aspiring entrepreneurs.

### Outcomes: Learner will be able to...

1. Acquire entrepreneurial competency.
2. Develop skills in carrying out market research, identifying business opportunities and preparing feasibility in projects reports.
3. Get motivated to venture entrepreneurship as an earlier option in the carrier.
4. Acquire requisite knowledge in setting up business enterprise from the start to accomplishment of the projects.
5. Gain competency in diversifying and enhancing existing business plans.

Module	Details	Hrs.
<b>01</b>	<b>Entrepreneurship Concepts:</b> Concepts of entrepreneurship, Characteristics of successful entrepreneurs, Functions of entrepreneurs, Types of entrepreneurs, Distinction between entrepreneur and manager, Growth of entrepreneurship in India and role of entrepreneurship in economic development <b>Types of entrepreneurship:</b> Women entrepreneurship, Rural entrepreneurship, Tourism entrepreneurship, Agripreneurship, social entrepreneurship & family business – Factors affecting entrepreneurship growth.	<b>04</b>
<b>02</b>	<b>Entrepreneurship Development:</b> Entrepreneurial motivation: Theories of entrepreneurial motivation, motivating factors, motivational process, motivational behavior, creativity, self efficiency, Risk taking, leadership, communication, decision making, major entrepreneurial competencies and development. Entrepreneurship development programmes: Objectives, contents and evaluation. Small Enterprises: Micro and macro units, scope of micro and small enterprises and their role in economic development – problems of micro and small enterprises – promotional packages.	<b>04</b>
<b>03</b>	<b>Opportunity / Product Identification:</b> Business opportunities in various sectors, identification of business. Opportunity- idea generation and opportunity selection. Steps in setting up of small business enterprises. Formulation of business plans and project appraisal. Contents of business plans, significance and formulation. Guide lines for formulating project reports: Methods of project appraisal –economic, financial, market analysis, technical feasibility and managerial competency environmental clearance. Forms of business ownership, sole proprietor ship, partnership, company, co-operative. Selection of appropriate forms of ownership structure.	<b>06</b>

<b>04</b>	<p><b>Financing of Enterprise</b></p> <p>4.1 Source of finance: internal and external sources, capitalization, term loans- short term finance, venture capital, export finance. Institutional finance- commercial banks, other financial institution, institutional support.</p> <p>4.2 Support Institutions: National small industries, corporation ltd, small industries development organization, small scale industry board, state small industry development organization, small industries service institutes, direct industry centre, technical consultancy organizations</p> <p>4.3 Government policy and taxation: Benefits to small scale industry, tax benefits, incentives and concession for small scale industries. Government policies for small scale enterprises and industrial policy resolutions.</p> <p>4.4 Accounting for small enterprises: Objectives of accounting, accounting process, journal ledger, trial balance, final accounts, balance sheet preparation.</p>	<b>06</b>
<b>05</b>	<p><b>Government strategies:</b></p> <p>5.1 Growth of enterprises: Objectives of growth, stages and types of growth- Expansion diversification, joint venture, mergers and acquisitions, sub contracting and financing.</p> <p>5.2 Sickness in small industries: Meaning of industrial sickness, signals and symptoms of industrial sickness, causes and consequences, corrective measures to curb sickness, government policies on revival of sick units.</p> <p>5.3 E-commerce: Basic concepts, advantages and disadvantages.</p>	<b>06</b>
<b>06</b>	<p><b>Management</b></p> <p>Importance and scope of management , elements of working capital management, Inventory management, production management, marketing management, TQM, Human resource management, Regulatory acts, Fundamentals of housekeeping and safety. Social responsibility of business.</p>	<b>10</b>

## Term Work

Term work shall consist of;

1. Preparation of feasibility report / project report pertaining to selected business opportunity.
2. One presentation based on one of the topics selected from the syllabus.
3. Exercise in accounting and preparation of balance sheet.
4. At least one assignment selected from each modules.

The distribution of marks for term work shall be as follows:

- Project report **10** marks
- Presentation and assignments: **10** marks
- Attendance (Theory and Practical): **05** marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

## **Internal Assessment**

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

## **Theory Examination**

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## **References**

1. *Entrepreneurship*, Roy, Rajiv, Univ. Press.
2. *Entrepreneurship*,/ Hisrich, McGraw Hill
3. *Entrepreneurship Development*, Kumar, New- Age.
4. *Entrepreneurship Development*, Kaulgud, Thomson Learning.
5. *Entrepreneurship: Theory & Practices*, Saini, Wheeler.
6. *Entrepreneurship Development*, Dr. S.S. Khanka S. Chand.

Course Code	Course/Subject Name	Credits
<b>PEE8015</b>	<b>World Class Manufacturing</b>	<b>3+1</b>

### Objectives

1. To familiarize with the concepts of Business excellence and competitiveness.
2. To apprise with the need to meet the business challenges and for being ready to meet the future manufacturing competition.
3. To acquaint with the current manufacturing scenario and the need to move from a domestic to a world class global manufacturer status.

**Outcomes:** Learner will be able to...

1. Illustrate relevance and basics of World Class Manufacturing.
2. Relate factors of competitiveness and performance measures based on which, global manufacturing success is bench marked.
3. Illustrate current Status of Indian Manufacturing scenario.
4. Design and develop a roadmap to achieve world class manufacturing status.

Module	Details	Hrs.
<b>01</b>	<b>Historical Perspective</b> World class organizations: Meaning of world class. Competitiveness and Performance measures. Criteria for world class organizations in Manufacturing. Competing in World markets. Review of frameworks in World Class Manufacturing (WCM). Models for manufacturing excellence: Schonberger, Halls, Gunn & Maskell models and Business Excellence.	<b>06</b>
<b>02</b>	<b>Benchmark, Bottlenecks and Best Practices</b> Concepts of benchmarking, Bottleneck & best practices. Best performers, Gaining competitive edge through world class manufacturing, Value added manufacturing, Value Stream mapping, Eliminating different types of waste. Lean Thinking (Toyota Production System), Six Sigma, Theory of Constraints.	<b>06</b>
<b>03</b>	<b>System and Tools for World Class Manufacturing</b> Improving Product & Process Design: SQC, Statistical Process Control, Quality Function Deployment (QFD), Seven Basic Quality Tools, FMS, Poka Yoke, 5-S, Optimizing Procurement & stores practices, Total Productive maintenance and Visual Control.	<b>06</b>
<b>04</b>	<b>HR Dimensions in WCM – WCM Strategy Formulation</b> 4.1 Adding value to the organization: Organizational learning, techniques of removing Root cause of problems, People as problem solvers, New organizational structures. 4.2 Associates: Facilitators, Teams man ship, Motivation and reward in the age of continuous improvement.	<b>06</b>

<b>05</b>	<p><b>Characteristics of WCM Companies:</b> Performance indicators like POP, TOPP and AMBITE systems.</p> <p>Other features of WCM: Supply Chain Management &amp; key issues in SCM, Agile Manufacturing, Green Manufacturing, Role of Information system in WCM, Introduction to Knowledge management, Study of various performance measures in world class organization.</p>	<b>06</b>
<b>06</b>	<p>Evolution of TQM concepts and framework for TQM, Customer satisfaction, Employee involvement, Continuous process improvement, Supplier partnership, Performance measures.</p> <p><b>WCM - the Indian Scenario</b></p> <p>Case discussions on leading Indian companies' efforts towards world class manufacturing and the task ahead.</p>	<b>06</b>

### Term Work

Term work shall consist of at least one assignment from each module from syllabus and at least three (3) case studies and analysis based on the syllabus.

The distribution of marks for term work shall be as follows:

- Case studies with inferences: **10** marks
- Assignments: **10** marks
- Attendance (Theory and Practical): **05** marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

### Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

### Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## References

1. *World Class Manufacturing – Strategic Perspective*, Sahay B.S., Saxena K B C and Ashish Kumar, Mac Milan Publications, New Delhi.
2. *World Class Manufacturing - The Lesson of Simplicity*, Schonberger R. J, Free Press, 1986
3. *Management strategy: achieving sustained competitive advantage*, Marcus, A. A., New York: McGraw-Hill/Irwin, 2011.
4. *Manufacturing Strategy: Process and Content*, Voss C. A., Chapman & Hall, London, 1992.
5. *Lean production simplified*, Pascal. D., 2nd Edition, Productivity Press, 2007
6. *Total Quality Management*, Besterfield, D. H., Pearson Education, 1999.
7. *Advanced Operations Management*, Mohanty R. P., Deshmukh S. G., Pearson Education, 2003.
8. “*Managing Technology and Innovation for Competitive Advantage*”, Narayanan V.K, Prentice Hall, 2000.
9. “*Making Common Sense Common Practice – Models for manufacturing Excellence*”, Ron Moore, Butter worth Heinmann.
10. *The Toyota Way – 14 Management Principles*”, Jeffrey K.Liker, Mc-Graw Hill, 2003.
11. “*Operations Management for Competitive Advantage*”, Chase Richard B., Jacob Robert., 11th Edition , McGraw Hill Publications, 2005.



Course Code	Course/Subject Name	Credits
<b>PEE8016</b>	<b>Mechatronics</b>	<b>3+1</b>

### Objectives

1. To familiarise the students with the architecture of the mechatronics system.
2. To study various actuators applicable to a Mechatronics system.
3. To understand the interfacing of the electromechanical devices.

### Outcomes: Learner should be able to...

1. Identify the suitable sensor and actuator for a mechatronics system
2. Develop the skill required for interfacing the electromechanical system.
3. Illustrate basic aspects of design and development of a mechatronic system

Modules	Details	Hrs.
01	<b>1.1 Introduction to Mechatronics.</b> Key element of mechatronics. mechatronics systems in a factory, home and business applications. Basic Components of mechatronics systems. Advantages of mechatronics.	04
02	<b>Electrical Actuating systems</b> DC motors : Principles of operation of DC motor, Modelling of DC motor behaviour, Heat dissipation in DC motor, Servo Amplifier, DC motor service drive. Stepper Motors: Characteristics of a Stepper motor, Classification of a Stepper motor, Principle of Operation, Stepper motor performance, AC Induction motors: Three phase motor.	06
03	<b>Pneumatic and Hydraulic actuating systems</b> Components of pneumatic and hydraulic systems, pumps, compressor, filter, control valves, pressure regulation, relief valves, accumulator. <b>Piezoelectric drives.</b> <b>Selection of actuator</b>	06
04	<b>Development of circuits for industrial automation.</b> Electro-pneumatic systems, Electro-hydraulic system, hydro-pneumatic system, Development of circuits for Industrial automation. <b>Programmable Logic Controller (PLC) in automation:</b> Basic structure, I/O processing. Ladder logic diagram, PLC for industrial process control, Selection of PLC.	08
05	<b>System Interfacing and Data Acquisition</b> Data Acquisition systems (DAQs), data loggers, supervisory control and data acquisition, interfacing requirements, buffers, handshaking, polling and interrupt, digital communication, parallel communication, serial communication interface, universal asynchronous receiver and transmitter (UART)	06
06	<b>Mechatronics case studies:</b> Autonomous Mobile Robot, Wireless Surveillance Balloon, Fire Fighting robots, Cantilever beam vibration control using piezo sensors and actuators, Car engine management.	06

### Course Project

There will be a course project, which students shall integrate based on the knowledge gained during the course. The projects shall be developed by team of maximum four students. Further, course project shall demonstrate design, setup, and implementation of a simple mechatronics system.

## Term Work

Term work shall consist of minimum 6 experiments, one assignment on first three modules, one each on module 4 and module 5 respectively and a report on course project

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiments) : **10 marks**
- Assignments : **05 marks**
- Course project: **05 marks**
- Attendance (Theory and Practical) : **05 marks**

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

## Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

## Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## References

1. Mechatronics, Kenji Uchino and Jayne R. Giniewicz, publication: Marcel Dekker, Inc.
2. Applied Mechatronics- A. Smaili and F. Mrad, *OXFORD university press*.
3. Mechatronics System Design , Shetty and Kolk *CENGAGE Learning, India Edition*
4. Introduction to Mechatronics and Measurement Systems , Alciatore and Histan *Tata McGraw-Hill*
5. Mechatronics, Necsulescu, *Pearson education*.
6. Mechatronics - Electromechanics and Control Mechanics , Mill *Springer-Verlag*
7. Mechatronics - Electronic Control Systems in Mechanical Engineering , Bolton *Pearson education*
8. Mechatronics - Electronics in products and processes , Bradley, et al. *Chapman and Hall*
9. Mechatronics - Mechanical System Interfacing , Auslander and Kempf, *Prentice Hall*
10. Introduction to Mechatronics, Appu Kuttan K.K., *OXFORD Higher Education*
11. The Art of Electronics, Horowitz and Hill *Cambridge, University Press*
12. Electromechanical Design Handbook , Walsh, *McGraw-Hill*
13. Electro-mechanical Engineering - An Integrated Approach , Fraser and Milne
14. Handbook of Electromechanical Product Design , Hurricks Longman, John Wiley, *Addison Wesley*
15. Principles and Applications of Electrical Engineering , Rizzoni *Irwin Publishing*

16. Understanding Electro-Mechanical Engineering - An Introduction to Mechatronics , Kamm *IEEE*
17. Modeling and control of Dynamic Systems, Macia and Thaler, *CENGAGE Learning, India Edition*
18. Mechatronics, A. Smaili, F. Mrad, *OXFORD Higher Education.*
19. Pneumatic and Hydraulic Control Systems: Aizerman. M.A.
20. Industrial Hydraulics: Pippenger
21. Vickers Manual on Hydraulics
22. Computer Numerical Control of Machine Tools: Thyer. G.R.
23. Pneumatic Applications: Deppert Warner & Stoll Kurt
24. Mechanization by Pneumatic Control: Vol. 1 & 2 Deppert Warner & Stoll kurt
25. Hydraulics and Pneumatics for Production: Stewart
26. Hydraulic Valves and Controls: Pippenger
27. Fundamentals of pneumatics: Festo series
28. Automatic Control Engineering: Francis. H. Raven.
29. Mechatronics, Nitaigour Mahalik, *Tata McGraw-Hill*
30. Mechatronics, *HMT*
31. *System Identification: Theory for the User* (2nd Edition) , Lennart Ljung
32. Design with Microprocessors for Mechanical Engineers, Stiffler *McGraw-Hill*

Course Code	Course/Subject Name	Credits
<b>PEE8017</b>	<b>Industrial Robotics</b>	<b>3+1</b>

### Objectives

1. To acquaint with significance of robotic system in agile and automated manufacturing processes.
2. To make conversant with robotic elements/ peripherals, their selection and interface with manufacturing equipments.
3. To study the basics of robot kinematics.

### Outcomes: Learner will be able to...

1. Acquire skills in understanding robot language and programming.
2. Acquire skill in robot task planning for problem solving.
3. Develop skills in understanding various sensors, robot peripherals and their use & deployment in manufacturing system.
4. Develop skills in identifying areas in manufacturing where robotics can be deployed for enhancing productivity.

Module	Details	Hrs.
<b>01</b>	<b>Introduction</b> Automation, robotics, Robotic system & Anatomy, Classification and Future Prospects.	<b>02</b>
<b>02</b>	<b>Drives</b> Control Loops, Basic Control System Concepts & Models, Control System Analysis, Robot Activation & Feedback Components, Position & Velocity Sensors, Actuators and Power Transmission system. <b>Robot &amp; its Peripherals</b> <b>End Effecters:</b> Type mechanical and other grippers, Tool as end effector. <b>Sensors:</b> Sensors in Robotics, Tactile Sensors, Proximity & Range Sensors, Sensor Based Systems, Vision systems and Equipment.	<b>07</b>
<b>03</b>	<b>Machine vision</b> Introduction, Low level & High level Vision, Sensing & Digitizing, Image Processing & analysis, Segmentation, Edge detection, Object Description & recognition, interpretation and Applications. <b>Programming for Robots</b> Method, Robot Programme as a path in space, Motion interpolation, motion & task level Languages, Robot languages, Programming in suitable languages and characteristics of robot.	<b>09</b>
<b>04</b>	<b>Robot Kinematics</b> Forward, reverse & Homogeneous Transformations, Manipulator Path control and Robot Dynamics.	<b>06</b>
<b>05</b>	<b>Root Intelligence &amp; Task Planning</b> Introduction, State space search, Problem reduction, use of predictive logic, Means. Ends Analysis, Problem solving, Robot learning and Robot task planning.	<b>06</b>
<b>06</b>	<b>Robot application in manufacturing</b> Material transfer, machine loading & un loading, processing operation, Assembly & inspectors, robotic Cell design & control, Social issues & Economics of Robotics.	<b>06</b>

## Term Work

Term work shall consist of at least one assignment from each module from syllabus, minimum six (6) practical's/exercises including programming of robots based on syllabus.

The distribution of marks for term work shall be as follows:

- Practicals/exercises: **10** marks
- Assignments: **10** marks
- Attendance (Theory and Practical): **05** marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

## Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

## Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## References

1. *Industrial Robotics, Technology, Programming & Applications*, Grover, Weiss, Nagel, Ordey, Mc Graw Hill.
2. *Robotics: Control, Sensing, Vision & Intelligence*, Fu, Gonzalez, Lee, Mc Graw Hill.
3. *Robotic technology & Flexible Automation*, S R Deb. TMH.
4. *Robotics for Engineers*, Yoram Koren , Mc Graw hill.
5. *Fundamentals of Robotics*, Larry Health.
6. *Robot Analysis & Control*, H Asada, JJE Slotine.
7. *Robot Technology*, Ed. A Pugh, Peter Peregrinus Ltd. IEE, UK.
8. *Handbook of Industrial Robotics*, Ed. Shimon. John Wiley.

Course Code	Course/Subject Name	Credits
<b>PEE8018</b>	<b>Product Design and Development</b>	<b>3+1</b>

### Objectives

1. To acquaint with various approaches in designing and developing new products.
2. To familiarize with various software solutions for designing and developing products.
3. To familiarize with modern approaches like concurrent engineering, product life cycle management, robust design, rapid prototyping / rapid tooling, etc.

### Outcomes: Learner will be able to...

1. Develop competency in designing and developing products right from the conceptual level incorporating cost effective solutions.
2. Get familiarized with the computer aided product design approach.

Module	Details	Hrs.
<b>01</b>	<p>1.1 Introduction: Definition of product design, Classification of products, Design by evolution, Design by innovation, various phases in product development and Design, Morphology of Design, Considerations in product design, Product specifications.</p> <p>1.2 Conceptual Design: Market research, Need based origin of product, Technology driven products, Analysis of ideas from various angles of design methodology and user needs, Function analysis and component process study, 2-D and 3-D representations in the form of concept drawing, Computer generated images, dummy and prototypes.</p> <p>1.3 Materials: Overview of materials including new generation materials, Tailor made material concepts, Material selection process.</p>	<b>05</b>
<b>02</b>	<p>2.1 Design for manufacturing (DFM): Producibility requirements, Accuracy and Precision requirements, Forging and casting design, Design for pressed, mechanical components, powder metallurgical components, Die cast and special cast components, expanded metals and wire forms.</p> <p>2.2 Design for Assembly (DFA): Analysis of assembly requirements, Standardization, Ease of Assembly and disassembly, Design for bolted, welded and riveted components, Design for hinge and snap fit assemblies, maintenance, consideration of handling and safety, Modular concepts.</p>	<b>05</b>
<b>03</b>	<p>3.1 Strength considerations in Design: Criteria and objectives, Designing for uniform strength, Designing for stiffness and rigidity, Practical ideas for material saving in design of ribs, corrugations, rim shapes, bosses, laminates, etc.</p> <p>3.2 Designing with plastics: Mechanical behavior, special characteristics and considerations, Design concepts for product features to be manufactured by various production process technologies, Special considerations for designing of components for load bearing applications, Designing for safety, Reliability and environmental considerations.</p>	<b>06</b>



<b>04</b>	Value Engineering: Product value and its importance, Value analysis job plan, Steps to problem solving and value analysis, Value analysis tests, Value Engineering idea generation check list, Material and process selection in value engineering, Cost reduction, case studies and exercises.	<b>04</b>
<b>05</b>	<p>5.1 Product Ergonomics: Anthropometry, Environmental conditions, thermal, noise, vibration, displays, illusions, Psycho and psychological aspects in design, Man-machine information exchange.</p> <p>5.2 Product Aesthetics: Visual awareness, Form elements in context of product design, Concepts of size, shape and texture, Introduction to colour and colour as an element in design, Colour classifications and dimensions of colour, Colour combinations and colour dynamics, Interaction / communication of colours, Psychological aspects of colours, generation of products forms with analogies from nature.</p> <p>5.3 Product Graphics: Graphics composition and layout, Use of grids in graphics composition, Study of product graphics and textures.</p> <p>5.4 Creativity: Role of creativity in problem solving, Vertical and lateral thinking, Brain storming, Synectics, Group working dynamics, Adaptation to changing scenarios in economics, social, cultural and technological fronts, Anticipation of new needs and aspirations.</p>	<b>10</b>
<b>06.</b>	<p>6.1 Software solutions: Software for drafting, modeling, assembly, detailing, CAM interfacing, Rapid tooling/rapid prototyping, etc.</p> <p>6.2 Modern Applications: Concurrent Engineering, QFD, Robust Design, Sustainable Design, Rapid Prototyping, Rapid Tooling, Product Life Cycle Management techniques and application areas.</p>	<b>06</b>

### List of Exercises

1. At least two presentations pertaining to topics selected from syllabus contains.
2. Redesign of an existing product with 3D modeling to solve identified lacuna present in the product.
3. One assignment on understating design procedure and documenting and interpreting data.
4. One 3-D modeling on colour balance and radii manipulation.
5. One assignment on product detailing of moulded component.

### Term Work

Term work shall consist of exercises listed in the above list

The distribution of marks for term work shall be as follows:

- Laboratory work (Experiment/ programs and journal): **10** marks
- Assignments: **10** marks
- Attendance (Theory and Practical): **05** marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

## Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

## Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## References

1. *Design Fundamentals*, R. G. Scott.
2. *Design methods inter science*, Jones.
3. *Creative Engineering Design*, Buhl H. R.
4. *The Science of Engineering Design*, Holt, Hill Percy H.
5. *Ergonomics*, Merilyn Joyce, Ulrika Waller Steiner.
6. *Human Factors in Engineering & Design*, 4<sup>th</sup> edition
7. *Human Engineering Guide & Equipment Design*, Morgon C. T. & Others
8. *Barron D.ed, Creativity*, New York, Art Directors
9. *Design for Production*, Baldwin E. W. & Niebel B. W. Edwin, Homewood Illinois.

Course Code	Course/Subject Name	Credits
<b>PEE8019</b>	<b>Sustainable Engineering</b>	<b>3+1</b>

### Objectives

1. To provide depth of knowledge and exposure to environmental related issues.
2. To appraise the significance of sustainable development for future survival.
3. To appraise about the ongoing global issues in sustainable engineering front.

### Outcomes: Learner will be able to...

1. Illustrate appropriate business responses to environmental problems.
2. Provide technical inputs for energy saves and energy recycling measures.
3. Develop a knowledge base in selecting and incorporating appropriate conversion technology in management of waste and pollutants.
4. Acquire skills to work as responsible partners in the ongoing efforts for sustainable development.

Module	Details	Hrs.
<b>01</b>	<b>Sustainability Concepts</b> Concepts related to Sustainability and sustainable development, Environmental problems,- pollution, land degradation, Ecosystem, biodiversity, energy availability, global warming and other natural disasters.	<b>04</b>
<b>02</b>	<b>Management of waste and pollutants</b> Nature and hazards of pollutants, types and sources of solid and hazardous wastes, Need for solid and hazardous waste management, waste segregation and processing, processing technologies, biological and chemical conversion technologies, energy recovery. Management of effluents.	<b>07</b>
<b>03</b>	<b>Implications of conversion technology</b> Innovations for reuse and recycling, concept of ecoefficiency, sustainable loading on ecosystem, energy audits, product life cycle assessment, environmental analysis, materials for sustainable design, Industrial case studies and discussion.	<b>07</b>
<b>04</b>	<b>Sustainability Integration</b> Materials for sustainability, Materials for future, selection of energy saving and effective materials, Recycling of materials, Toxicity and related health hazards, control on non –renewable material use.	<b>07</b>
<b>05</b>	<b>Measures for environmental preservation</b> Impact of culture, political and economical changes in environment and environmental management. Alternative product and process change, Environmental standards like ISO-14000. Environmental legislations- carbon footprint, anti-pollution boards, global warming, Kyoto protocol. Global sustainability agenda and green manufacturing.	<b>06</b>
<b>06</b>	<b>Strategies and decision making</b> Marketing and operating strategies based on environmental issues. Sustainability awareness, Role of I.T, sustainable innovations and promotions, sustainable rating schemes, Eco-labeling programmers, disaster management, Human values and professional ethics, case studies.	<b>05</b>

## Term Work

Term work shall consist of;

1. One report pertaining to any one of the environmental related issues.
2. At least one presentation from the topics selected from the syllabus.
3. Preparation of an exhaustive write up on creating sustainable manufacturing units.
4. At least four assignments selected from the topics of the syllabus.

The distribution of marks for term work shall be as follows:

- Laboratory work (report/presentation): **10** marks
- Assignments: **10** marks
- Attendance (Theory and Practical): **05** marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

## Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

## Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## References

1. *Sustainable development*, N.k.Ghosh Roy, Ane Books PVT LTD.
2. *Design for Environment: A Guide to sustainable product development*, Joseph Fiksel Tata McGraw Hill.
3. *Green Management*, M. Karpagam, Geetha Jaikumar, Ane Books PVT LTD.
4. *Essential Environment Studies*, S.P.Mishra , S.N. Pandey, Sheth Publishers.
5. *Environmental Studies*, E Bharucha.
6. *Plastics and sustainability: Towards a peaceful Co-existence between Bio-based and fossil fuel based plastics*, Tolinski.

Course Code	Course/Subject Name	Credits
<b>PEE8010</b>	<b>Maintenance Engineering</b>	<b>3+1</b>

### Objectives

1. To acquaint with various principles, functions and practices adopted in industry for the successful management of maintenance activities.
2. To appraise with the importance of maintenance in the cost reduction.
3. To make conversant with preventive maintenance and breakdown maintenance functions.
4. To appraise with modern approaches in the field of maintenance.

### Outcomes: Learner will be able to...

1. Acquire awareness and interest about the significance of maintenance function.
2. Develop skills to diagnose and trace the faults.
3. Get an exposure to the ongoing trends in the field of science.

Module	Details	Hrs.
<b>01</b>	<b>Principles of Maintenance Planning</b> Introduction to maintenance, Types of maintenance, Basic Principles of maintenance planning, Objectives of planned maintenance activity, Importance and benefits of sound Maintenance systems, Reliability and machine availability trade off, concepts of MTBF, MTTR and MWT and factors of availability.	<b>06</b>
<b>02</b>	<b>Preventive Maintenance</b> Significance of Preventive maintenance, maintenance schedules, repair cycle, Principles and methods of lubrication.	<b>06</b>
<b>03</b>	<b>Breakdown Maintenance</b> Logical fault location methods, Sequential fault location, repair methods for beds, sideways, shafts, spindles, gears, keys, lead screws, bearings and similar drive elements.	<b>06</b>
<b>04</b>	<b>Condition Monitoring</b> Condition Monitoring, Cost comparison with and without CM, On-load testing and offload testing, Methods and instruments for CM, Temperature sensitive tapes, Pistol thermometers and wear-debris analysis	<b>06</b>
<b>05</b>	<b>Maintenance of Material Handling Equipment</b> Maintenance of Material handling equipment like crane, fork lift and conveyors.	<b>04</b>
<b>06</b>	<b>Maintenance Management</b> Maintenance strategies, Types and techniques, planned and unplanned maintenance, Computer aided maintenance, maintenance scheduling, spare part management, inventory control, maintenance records and documentation. Concepts of Total Productive Maintenance (TPM). Predictive maintenance techniques.	<b>08</b>

## Term Work

Term work shall consist of at least two assignments from each module from syllabus and minimum two presentations on case study/various aspects related to maintenance.

The distribution of marks for term work shall be as follows:

- Assignments: **10** marks
- Presentation: **10** marks
- Attendance (Theory and Practical): **05** marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

## Internal Assessment

Assessment consists of two tests out of which; one should be compulsory class test (on minimum 40% of curriculum) and the other is either a class test (on minimum 70% of curriculum) or assignment on live problems or course project.

## Theory Examination

**In question paper, weightage of each module will be proportional to number of respective lecture hours as mention in the syllabus.**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Question number 1 will be compulsory and based on maximum contents of the syllabus
3. Remaining questions will be mixed in nature (for example, if Q.2 has part (a) from module 3 then part (b) will be from other than module 3)
4. Total four questions need to be solved.

## References

1. *Industrial Maintenance Management*, Srivastava S.K., S. Chand and Co.
2. *Installation, Servicing and Maintenance*, Bhattacharya S.N., S. Chand and Co.
3. *Maintenance Planning*, White E.N., I Documentation, Gower Press.
4. *Industrial Maintenance*, Garg M.R., S. Chand & Co.
5. *Maintenance Engineering Hand book*, Higgins L.R., McGraw Hill.
6. *Condition Monitoring*, Armstrong, BSIRSA.
7. *Handbook of Condition Monitoring*, Davies, Chapman &Hall.
8. *Advances in Plant Engineering and Management*, Seminar Proceedings – IPE.