

# UNIVERSITY OF MUMBAI



## Bachelor of Engineering

in

## Production Engineering

Second Year with Effect from AY 2020-21

Third Year with Effect from AY 2021-22

Final Year with Effect from AY 2022-23

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

Under

## FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year  
2019–2020)

AC \_\_\_\_\_

Item No. \_\_\_\_\_

**UNIVERSITY OF MUMBAI****Syllabus for Approval**

<b>Sr. No.</b>	<b>Heading</b>	<b>Particulars</b>
1	Title of the Course	Final Year in Bachelor of Production Engineering
2	Eligibility for Admission	After passing First year Engineering as per Ordinance 0.6242
3	Passing Marks	40%
4	Ordinances / Regulations ( if any)	Ordinance 0.6242
5	No. of Years / Semesters	8 semester
6	Level	Under Graduation
7	Pattern	Semester
8	Status	New
9	To be implemented from Academic Year	With effect from Academic Year: 2022-23

**Dr. S. K. Ukarande**  
Associate Dean  
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**Dr. Anuradha Muzumdar**  
Dean  
Faculty of Science and Technology  
University of Mumbai

## 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 Science and Technology (in particular Engineering) of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are 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. Choice 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. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Third Year of Engineering from the academic year 2021-22. Subsequently this will be carried forward for Final Year Engineering in the academic year 2022-23.

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## **Incorporation and implementation of Online Contents from NPTEL/ Swayam Platform**

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of 'C' scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD's/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

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## Preface By BoS

Engineering education in India is changing fast and is set to face multiple challenges in the near future. Academic institutes are expected to prepare good quality engineers and Industries are expected to come good with the wealth generation activity. Manufacturing, among the industry sectors, is currently emerging as one of the high growth sectors in India. Government of India (GOI) has launched the 'Make in India' program to place India on the world map as a manufacturing hub. The GOI has set an ambitious target of increasing the contribution of manufacturing output to 25% of GDP by 2022, from the current 16%. In this context, the major challenge is to ensure high quality in all aspects related to education & industry practices. Accreditation of the program is one of the principal ways, by which the quality can be assured. The major emphasis of the 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. Keeping this in mind, the Faculty of Science and Technology of the University of Mumbai has taken the lead in ensuring that the outcome based education is stressed upon in the curriculum development.

At the Board of Studies (Adhoc) in Production Engineering of the University of Mumbai, we are happy to state that, the Program Educational Objectives (PEOs) of the UG Program in Production Engineering, were discussed in detail and finalized during the multiple brain storming sessions, attended by more than 20 members from different colleges affiliated to the University of Mumbai. Experts from the industry were also invited for their inputs and suggestions. Thus the PEOs were finalized as follows:

To prepare the Learner with sound foundation in STEM subjects, related to Manufacturing and its strategies.

To motivate the Learner for self-learning and to use modern tools for solving real life problems.

To inculcate a professional and ethical attitude, good leadership qualities and commitment to social responsibilities in the Learner's thought process.

To prepare the learner to face industrial challenges through practical exposure in an industrial environment. To prepare the Learner for a successful career in Indian and Multinational Organizations.

In addition to PEOs, for each course of the program, objectives and expected outcomes from a learner's point of view are also included in the curriculum to achieve the goal of outcome based education. We hope to achieve the desired goals in our efforts to prepare high quality Production Engineers. Thank you very much.

**Board of studies (Adhoc) in Production Engineering**

**Dr. Hari Vasudevan – Chairman**

**Dr. Arun Rane – Member**

**Dr. Yogesh Padia – Member**

**Dr. K. H. Inamdar**

## Semester VIII

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned					
		Theory	Pract./Tut.	Theory	Pract.	Total			
PEC801	Automation & Control Engineering.	3	--	3	--	3			
PEC802	Computer Aided Engineering.	3	--	3	--	3			
PEC804	Engineering Economics, Finance, Costing and Accounting.	3	--	3	--	3			
PEDO801 X	Department Optional Course – 3	3	--	3	--	3			
PEIO801 X	Institute Optional Course – 1/2	3	--	3	--	3			
PEL801	Automation & Control Engineering Lab.	--	2	--	1	1			
PEL802	Computer Aided Engineering. Lab.	--	2	--	1	1			
<b>Total</b>		<b>15</b>	<b>4</b>	<b>15</b>	<b>2</b>	<b>17</b>			
Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract./oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Prese- ntation stage 1	Prese- ntation stage 2	Avg					
PEC801	Automation & Control Engineering.	20	20	20	80	3	--	--	100
PEC802	Computer Aided Engineering.	20	20	20	80	3	--	--	100
PEC804	Engineering Economics, Finance, Costing and Accounting.	20	20	20	80	3	--	--	100
PEDO801 X	Department Optional Course – 3	20	20	20	80	3	--	--	100
PEIO801 X	Institute Optional Course – 1/2	20	20	20	80	3	--	--	100
PEL801	Automation & Control Engineering Lab.	--	--	--	--	--	25	25	50
PEL802	Computer Aided Engineering. Lab.	--	--	--	--	--	25	25	50
<b>Total</b>		<b>--</b>	<b>--</b>	<b>100</b>	<b>400</b>	<b>--</b>	<b>50</b>	<b>50</b>	<b>600</b>

<b>Course Code</b>	<b>Department Level Optional Course III</b>	<b>Course Code</b>	<b>Institute Level Elective Course II#</b>
PEDO8011	Advances in Automobile Engineering.	ILO8021	Project Management
PEDO8012	Product Design and Industrial Marketing.	ILO8022	Finance Management
PEDO8013	World Class Manufacturing.	ILO8023	Entrepreneurship Development and Management
PEDO8014	Plant Engineering.	ILO8024	Human Resource Management
PEDO8015	Energy Management & Audit.	ILO8025	Professional Ethics and CSR
		ILO8026	Research Methodology
		ILO8027	IPR and Patenting
		ILO8028	Digital Business Management
		ILO8029	Environmental Management

Course Code	Course Name	Credits
<b>PEC801</b>	<b>Automation and Control Engineering</b>	<b>03</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

### 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.
4. To learn the basics of Control Theory.

### Outcomes: Learner will be able to:

1. Illustrate the basic concept of Industrial automation in different manufacturing set-ups.
2. Design and develop pneumatic control circuits of medium complexity.
3. Design and develop hydraulic control circuits of medium complexity.
4. Illustrate the use of PLC in control systems.
5. Illustrate the basic application of Microprocessor and Microcontroller.
6. Model the system and check with stability of a mechanical system.

Modules	Details	Hrs.
1	<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.	06
2	<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.	08
3	<b>Hydraulic control systems</b>	07



	<p>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).</p> <p>Fundamental concepts of digital and servo hydraulic controls. Comparison between proportional, digital and servo hydraulic control systems.</p>	
4	<p><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></p> <p>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. Brief exposure to developer board like Arduino UNO or raspberry Pi.</p>	08
5	<p><b>Sensors and Transducers</b></p> <p>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.</p>	02
6	<p><b>Fundamentals of Control System</b></p> <p>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.</p>	08

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

1. First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40%, but excluding contents covered in Test I).
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
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 any module other than module 3).
4. Only **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. *Electro pneumatics 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.

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Course Code	Course Name	Credits
PEC802	Computer Aided Engineering.	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory				Term Work/Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.		Oral
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

#### Objectives:

1. To introduce the concepts of computer aided engineering for design & manufacture and familiarize them with mathematical basis of computer graphics.
2. To impart knowledge on computer graphics, which are used routinely in diverse areas like science, engineering, medicine etc.
3. The aim is to provide the students with knowledge of the finite element method that will be of use in different manufacturing areas and to provide a foundation for further study.
4. To introduce the concept of Computer integrated manufacturing, and familiarize them with various automated material handling techniques.

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

1. Understand software configuration of graphic packages.
2. Understand use of Computer graphics in design.
3. Identify proper modeling techniques for geometric modeling.
4. Solve physical and engineering problems with emphasis on Structural and Thermal Engineering applications.
5. Understand the concept of Computer Integrated Manufacturing.
6. Understand the concept of automated material handling and its methodologies.

Module	Details	Hrs.
01	<b>Computer Aided Design:</b> 1.1 <b>Introduction:</b> Need and Utility of CAD systems in industry, Product Cycle, Definition of CAD tools based on their Constituents and Implementation in a design environment. 1.2 <b>CAD Hardware:</b> Types of systems, system considerations, I/O devices, Hardware Integration & Networking.	04
02	<b>Computer Graphics:</b> Pixel plotting, Scan conversions of lines & circuits, 2D & 3D transformation, 2D Viewing and clipping. Parallel Projection. Elementary treatment of Hidden lines and surfaces. Cubic spines Bezier curves & B- spines, Animation and Color models.	08
03	<b>Solid Modeling:</b> Types of representation of solid models, interactive tools available with solid modeling software's. Introduction to surface modeling. <b>CAD DATA Exchange :</b> File Structure and format of IGES,STEP and DXF	05

<b>04</b>	<p><b>FEA:</b> Introduction, Stress and Equilibrium, Boundary Condition, Strain – Displacement Relations, Stress Strain Relation, Potential Energy. One Dimensional Problem: Finite Element Modelling, Coordinate Potential Energy Approach, Galerkin Approach, Assembly of Global Stiffness Matrix, Properties of Stiffness Matrix, Finite Element Equations.</p> <p>Trusses: Introduction, 2D Trusses, Assembly of Global Stiffness Matrix.</p>	<b>10</b>
<b>05</b>	<p><b>CIM:</b> Introduction, Evolution, Objectives, CIM Hardware and Software, CIM Benefits, Nature and role of the elements of CIM, Identifying CIM needs, Data base requirements of CIM, Role of CAD/CAM in CIM, Obstacles to Computer Integrated Manufacturing, Concept of the future CIM systems, Socio -techno- economic aspects of CIM. Introduction to various aspects of Industry 4.0.</p>	<b>04</b>
<b>06</b>	<p><b>Automated Material handling systems:</b> Flexible manufacturing system: Components, layouts, advantages Automated guided vehicles: advantages, types, guidance systems Group technology (GT): Part families, Parts Classification and Coding Automated storage/ Retrieval system (AS/RS) Concept of “Ghost” factory.</p>	<b>08</b>

#### Assessment:

##### Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

1. First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40%, but excluding contents covered in Test I).
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

##### End Semester Examination:

Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1 will be compulsory** and should **cover maximum contents of the curriculum.**
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 any module other than module 3).
4. Only **Four questions need to be solved.**

#### References:

1. CAD/CAM by Groover and Zimmers.
2. CAD Principles and Applications by Barr, Krimger and Lazaer.
3. CAD/CAM Handbook by Teicholz.
4. William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, Mc Graw Hill Book Co. Singapore, 1989.
5. Donald Hearn and M. Pauline Baker “Computer Graphics”, Prentice Hall, Inc., 1992.
6. Foley, Wan Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education – 2003.
7. Reddy, J.N, “An Introduction to the Finite element Method”, McGraw Hill, 1985.
8. Rao, “Finite Element Method in Engineering”, Pergammon Press, 1989.
9. CAD / CAM by P.N. Rao (Tata-Mcgraw Hill)
10. Mathematical and Procedural Elements for computer graphics by Roger and Adams.
11. Computer Graphics by Hearn and Baker (PHI).

12. Computer Graphics by Plastock and Gordon (Schaums outline series).
13. FEM by Fagan I
14. FEM by J. N. Reddy (McGraw Hill).
15. A first course in FEM by daryl L. Logon (Cengage).
16. Concepts and applications of FEA by Cook, Malkus (Jhon-wiley).
17. Mastering CAD – CAM by Ibarahim Zeid (Tata-Mcgraw-Hill).

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Course Code	Course Name	Credits
<b>PEC803</b>	<b>Engineering Economics, Finance, Costing and Accounting.</b>	<b>03</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

**Objectives:**

1. To acquaint with the concepts of Micro and Macro Economics.
2. To comprehend 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 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>03</b>
<b>02</b>	<b>Micro Economics</b> Consumer's Behavior: meaning of utility, marginal utility and law of Diminishing Marginal Utility. Producer's Behavior: law of supply, variation in supply, Types of elasticity of supply. Types of Market: perfect competition, pure competition, Monopoly. <b>Macro Economics</b> Different Methods of Measuring National Income, Economic Policy: Monetary Income and Fiscal Policies. 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>08</b>

<b>03</b>	<p><b>Financial Environment of Business:</b> Financial Management-Sources of finance-long term and short term finance</p> <p><b>Capital Markets:</b> 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.</p> <p>Money Markets: Basics of Money Market Mechanism, instruments, and institutions.</p> <p><b>An Overview of investment Appraisal Methods:</b> NPV method, Payback method, discounted payback period method, IRR, Annual worth method.</p>	<b>06</b>
<b>04</b>	<p><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 statement and analysis, Ratio Analysis.</p>	<b>08</b>
<b>05</b>	<p><b>Cost Accounting</b> Introduction to cost, Types of cost, Element of cost, Material and Labour cost accounting and control, Treatment of Overheads, Overhead allocation and absorption, Concept and Importance of Depreciation and Methods of Depreciation. Unit (cost sheet) and batch costing, activity based costing.</p>	<b>06</b>
<b>06</b>	<p><b>Management Accounting</b> Joint Product Costing, Process Costing, Marginal Costing, Cost Volume, Profit Analysis and Decision Making. Budgetary Controls, Standard Costing,</p>	<b>08</b>

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

1. First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40%, but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1 will be compulsory and should cover maximum contents of the curriculum.**
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 any module other than module 3).
4. Only **Four questions need to be solved.**

**References**

1. Managerial and Cost Accounting, Larry M. Walther , Christopher J. Skousen.
2. Corporate Finance Principles and Practices, Denzil Watson & Tong Heads, Financial Time Pitman Publisher.
3. Strategic Financial Management, Robert Alan Hill.
4. Basics of Accounting & Information Processing The Accounting Cycle, Larry M. Walther, Christopher J. Skousen.
5. Introduction to Managerial Accounting, Larry M. Walther , Christopher J. Skousen.
6. Managerial and Cost Accounting, Larry M. Walther, Christopher J. Skousen.
7. Essentials of Microeconomics, Krister Ahlersten.

8. Essentials of Macroeconomics, Peter Jochumzen.
9. Banking: An Introduction, Dr. AP Faure, Rhodes University.
10. Financial System: An Introduction, Dr AP Faure, Rhodes University.
11. Central Banking & Monetary Policy: An Introduction, Dr. AP Faure, Rhodes University.

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Course Code	Course Name	Credits
PEDO8011	Advances in Automobile Engineering	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

**Objectives:**

1. Study basic principles of actual automobile systems.
2. Study important systems in an automobile.
3. Study recent and modern trends in automobile sector.

**Outcomes:** Learner will be to:

1. Understand various systems in an automobile.
2. Understand the concept of transmission system and its components.
3. Understand the concepts of steering system and its application.
4. Understand the concepts of brakes, suspension, wheel and balancing etc.
5. Understand the electric system used in automobile.
6. Understand principle of operation, construction and applications of various sensors used in modern automobile along with recent trends.

Module	Details	Hrs.
01	<p><b>Vehicle Performance:</b> Types of Engines used in automobile, their characteristics and selection, resistance to motion of vehicle, air, rolling, and gradient resistance.</p> <p><b>Chassis types and structure types:</b> chassis layout, power plant location, Types, Open, Semi integral and integral bus structure.</p> <p><b>Body Engineering</b> Importance of Body design, Materials for body construction-Styling forms Coach and bus body style, layouts of passenger cars, Bus and truck bodies.</p> <p><b>Aerodynamic drag –</b> Aerodynamic lifts and pitching moments, Side force, Yawing moments and rolling moments.</p>	06
02	<p><b>Introduction Transmissions:</b> Necessity of gear box, Sliding mesh, Constant mesh, Synchromesh and epicyclic gear box, Overdrives and hydrodynamic torque converter, CVT, DSG, DCT, AMT, Trouble shooting and remedies.</p> <p><b>Drive line:</b> Propeller shaft and universal joints, types and construction, different types of universal joints and constant velocity joints.</p> <p><b>Live axle and differential:</b> Final drive, spiral, bevel, Hypoid and worm drives, Types of live axles, semi, three quarter and full floating axles. Necessity of differential, Conventional and non-slip differential, Trouble shooting and remedies.</p>	05

03	<p><b>Steering and Front axles</b> Steering geometry, Steering requirements, Steering linkages and steering gears, over steer and under steer, Cornering power, Reversibility of steering gears, wheel alignment, wheel balancing, Power steering mechanisms, components, types. Types of front axles and their constructions. Trouble shooting and remedies</p> <p><b>Brakes</b> Requirement of brake, Classification of brakes, Mechanical, Hydraulic, Pneumatic, Electro and vacuum brakes. Disc brakes, Braking of front wheel, Rear wheel and four wheel brakes, Brake trouble shooting. Introduction to antilock braking system (ABS).</p>	07
04	<p><b>Suspension</b> Objects of suspension, Basic requirements, Air suspension and its features, Independent suspension, Forces acting in independent suspension, Sprung and un-sprung mass, Pitching, rolling and bouncing, Shock absorbers.</p> <p><b>Wheels and Tyres</b> Requirements of wheels and tyres, Constructional features, Types of tyres, Inflation Pressure and its importance, Application to ride and stability, Trouble shooting and remedies</p>	06
05	<p><b>Electrical system Battery:</b> Types of battery, Lead-Acid, Alkaline, ZEBRA, Sodium Sulphur and Swing, Ratings, charging, Maintenance and testing of Lead-Acid battery.</p> <p><b>Starting system:</b> Requirements, Various torque terms used, Starter motor drives; Bendix, Follo through, Barrel, Rubber compression, Compression Spring, Friction Clutch, Overrunning Clutch, Dyer. Starter motor solenoids and switches, Glow plugs.</p> <p><b>Alternator:</b> Principle of operation, Construction, Working, Rectification from AC to DC.</p>	06
06	<p><b>Recent trends in Automobiles</b> Electronic Control module (ECM), operating modes of ECM ( closed loop and open loop) Inputs required and output signals from ECM, Electronic Spark control, Air Management system, Idle speed control. Construction, working &amp; application of temperature sensors, inductive sensors, Position sensors (rotary, linear). Hot wire and thin film air flow sensors, vortex flow/turbine fluid sensors, Optical sensor, Oxygen sensors, Light sensors, methanol sensors ,Rain sensor, New developments in the sensor technology</p>	09

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

1. First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40%, but excluding contents covered in Test I).
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
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 any module other than module 3).

4. Only **Four** questions need to be solved.

**References:**

1. Automotive Mechanics, William Cruose & Donald L. Anglin, Tata McGraw Hill.
2. Automotive Mechanics, Joseph Heitner, East-West press pvt .Ltd.
3. The Automobile Engineering, T. R. Banga & Nathu Singh, Khanna Publishers.
4. The Automobile, Harbans Singh Reyat, S. Chand & Co.
5. Automobile Engineering, R. K. Rajput, Laxmi Publication.
6. Basic Automobile Engineering, C.P.Nakra, Dhanpat Rai Publishing CO.
7. Automobile Engineering, Kirpal Singh Vol I & II, Standard publishers Distributors, Delhi.
8. Automobile Engineering, K. K. Jain & R.B. Asthana, Tata McGraw Hill.
9. Automotive Mechanics, S. Srinivasan, Tata McGraw Hill.
10. Automobile Engineering, Vol I & II, R.K. Mohanty, Standard Book House.
11. Automobile Electrical and Electronics, Tom Denton.
12. Vehicle Body Engineering, J Pawlowski, Century publisher.
13. Computerised Engine Control, Dick King, Delmar publisher.
14. System Approach to Automobile Technology, Jack Erjavec, Cengage Learning.
15. Light & Heavy Vehical technology, M. J. Nunney, Elsevier.

Course Code	Course Name	Credits
PEDO8012	Product Design and Industrial Marketing	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory				Term Work/Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.		Oral
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

### 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.
4. To familiarize with characteristics of business markets, buying situations, trends in industrial marketing and relevant industrial strategies.

### Outcomes: Learner will be able to:

1. Design and develop products right from the conceptual level.
2. Demonstrate concept of computer aided product design approach.
3. Illustrate various modern approaches like concurrent engineering, product life cycle management, robust design, rapid prototyping / rapid tooling.
4. Analyze products based on ergonomics and aesthetic aspects.
5. Apply appropriate strategies in industrial marketing.
6. Demonstrate various aspects related to Industrial Marketing Communication, Advertising, Sales promotion, Publicity Media Plan.

Module	Contents	Hrs.
01	<p>1.1. <b>Introduction:</b> Definition of product design, Classification of products, Design by evolution, Design by innovation, Product Mix, Various phases in product development and Design, Morphology of Design, Considerations in product design, Product specifications.</p> <p>1.2. <b>Conceptual Design:</b> Market research, Generation, Selection and Embodiment of concept, Product Architecture, Customer centric product designing</p> <p>1.3. <b>Creativity:</b> 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> <p>1.4. <b>Materials:</b> Overview of materials including new generation materials, Tailor made material concepts, Material selection process.</p>	05
02	<p>2.1. <b>Design for manufacturing (DFM):</b> Guidelines and Methodology, Producibility requirements, Accuracy and Precision requirements, Strength considerations in Design: Criteria and objectives, Designing for uniform strength, Designing for stiffness and rigidity, Practical ideas for material saving in design - ribs, corrugations, rim shapes, bosses, laminates, etc.</p> <p>2.2. <b>Design for forged and Cast components,</b> Design for Sheet Metal processed</p>	09

	<p>components, powder metallurgical components, Expanded metals and wire forms</p> <p>2.3. <b>Designing with plastics:</b> 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,</p> <p>2.4. <b>Other DFX Principles:</b> Designs for Maintainability, Safety, Reliability, Sustainable Design</p> <p>2.5. <b>Design for Assembly (DFA):</b> DFA Index, 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>	
03	<p>3.1. <b>Product Ergonomics:</b> Anthropometry, Environmental conditions, thermal, noise, vibration, displays, illusions, Psycho and psychological aspects in design, Man-machine information exchange.</p> <p>3.2. <b>Product Aesthetics:</b> 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>3.3. <b>Product Graphics:</b> Graphics composition and layout, Use of grids in graphics composition, Study of product graphics and textures.</p>	05
04	<p>4.1. <b>Value Engineering:</b> 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.</p> <p>4.2. <b>Software solutions:</b> Software for drafting, modeling, assembly, detailing, CAM interfacing, Rapid tooling/rapid prototyping, etc.</p> <p>4.3. <b>Modern Applications:</b> Concurrent Engineering, Robust Design, Additive Manufacturing/Rapid Prototyping, Product Life Cycle Management techniques and application areas.</p>	06
05	<p>5.1 Introduction to Industrial Marketing, Understanding Industrial Markets, Nature of Industrial Buying, Industrial Market Segmentation, New Products and Established product strategies, Resource based and Value based strategy, Industrial Pricing: Price Determinants, Pricing Policies, Pricing Decisions, Pricing – Value based and Competition based.</p>	07
06	<p>6.1. <b>Industrial Marketing Channels:</b> Channel participants, Channel effectiveness, Marketing logistics, Physical Distribution and Marketing Strategy, Value added market channels</p> <p>6.2. Industrial Marketing Communication, Advertising, Sales promotion, Publicity Media Plan, Integrated Promotion Plan, Industrial Sales force Management, Technical Support for Marketing – customer technical services and feedback.</p>	07

#### Assessment:

##### Internal Assessment for 20 marks:

Consisting Two Compulsory Class Tests

1. First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40%, but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

##### End Semester Examination:

Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
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 any module other than module 3).
4. Only **Four questions need to be solved.**

#### References Books:

1. *Product Design & Development*, Karl Ulrich, Steven Eppinger,
2. *Design Fundamentals*, R. G. Scott.
3. *Design methods inter science*, Jones.
4. *Creative Engineering Design*, Buhl H. R.
5. *The Science of Engineering Design*, Holt, Hill Percy H.
6. *Ergonomics*, Marilyn Joyce, Ulrika Waller Steiner.
7. *Human Factors in Engineering & Design*, 4th edition
8. *Human Engineering Guide & Equipment Design*, Morgon C. T. & Others
9. *Barron D.ed, Creativity*, New York, Art Directors
10. *Design for Production*, Baldwin E. W. & Niebel B. W. Edwin, Homewood Illinois.
11. *Industrial design of plastic products*, Gordon, 2003
12. *Plastics Engineered Product Design*, Rosato, 2001
13. *Industrial Marketing Analysis, Planning and control*, Robert R Reeder, Edward G Brierty, Betty H Reeder, Prentice Hall India
14. *Industrial Marketing*, Havalder, Krishna K, Tata McGraw Hill, New Delhi.
15. *Industrial Marketing*, P. K. Ghosh, Oxford University Press, New Delhi.

Course Code	Course Name	Credits
<b>PEDO8013</b>	<b>World Class Manufacturing</b>	<b>03</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

### 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	Content	Hrs.
<b>01</b>	<b>Philosophy of WCM</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 & SPC Tools. Statistical Process Control, Quality Function Deployment (QFD), Poka Yoke, 5-S, Optimizing Procurement & stores practices, JIT, KANBAN, Total Productive maintenance and Visual Control.	<b>07</b>

<b>04</b>	<p><b>HR Dimensions in WCM – WCM Strategy Formulation</b></p> <p>Adding value to the organization: Organizational learning, techniques of removing Root cause of problems, People as problem solvers, New organizational structures. Associates: Facilitators, Teams man ship, Motivation and reward in the age of continuous improvement.</p>	<b>06</b>
<b>05</b>	<p><b>Characteristics of WCM Companies:</b></p> <p>Performance indicators like Performance Objectives-Production (POP), TOPP and Advance Manufacturing Business Implementation Tool for Europe (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>07</b>
<b>06</b>	<p><b>Framework for TQM:</b> Customer Top Management Commitment, Employee involvement, Continuous process improvement, Supplier partnership, Performance measures.</p> <p><b>WCM - the Indian Scenario</b></p> <p>Case study discussions on leading Indian companies' efforts towards world class manufacturing and the task ahead.</p>	<b>07</b>

#### Assessment:

##### Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

1. First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40%, but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

##### End Semester Examination:

Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
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 any module other than module 3).
4. Only **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.

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Course Code	Course Name	Credits
<b>PEDO8014</b>	<b>Plant Engineering</b>	<b>03</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

### Objectives

1. To acquaint with concepts of plant engineering and various plant organizing functions.
2. To familiarize with various types of maintenance work and systems in plant.
3. To acquaint with various methods of pollution, noise and vibration control.
4. To acquaint with concept and significance of sustainable approaches in plants.
5. To get conversant with approaches in material handling and plant safety.

### Outcomes: Learner will be able to:

1. Design and plan plant layouts and organization for plant engineering.
2. Demonstrate selection and use of material handling systems in plant engineering.
3. Demonstrate various operational and safety practices including fire safety.
4. Illustrate concepts of pollution, noise and vibration control.
5. Apply sustainable approaches and practices.

Module	Contents	Hrs.
1.	<b>INTRODUCTION:</b> Plant Engineering functions, Organization for Plant Engineering, Plant layout – considerations and significance, plant utilities, utility structure, ventilation, heating, air-conditioning, exhaust systems, sanitation and house-keeping, communication and IT network,	06
2.	<b>POLLUTION CONTROL:</b> Types of industrial pollutants and pollutions – Solid, liquid, gaseous and noise pollutions, Regulatory standards and requirements, detection measurements and instrumentation, emission safety, emission controls, collection, storage and disposal of industrial waste, liquid waste, effluents–treatments and disposal, Managing poisonous vapors & gases-systems for handling and disposal, Operational noise and control of plant noise, Human response and noise, vibration and vibration control.	07
3.	<b>MATERIAL HANDLING AND PLANNING:</b> Material handling Equipment – Trolleys, Conveyers, fork lifts and cranes, Addressing material handling problems, Material Handling containerization – Automatic storage and Retrieval system. Use of AGU and Robots in material handling, Handling of powder and liquids – chutes and piping systems, vacuum conveying, Designing material handling projects.	07
4.	<b>PLANT SAFETY:</b> Significance of safety, organization for safety – Man, Machine and tool safety, Importance of house-keeping in safety. Safety tools and gadgets, Safety norms and safety practices. Safety monitoring and implementation of safe practices- use of safety posters and	06

	colors, plant fire hazard- Causes and prevention, Design and planning for fire safety, fire detectors and alarm system, special suppression systems, Firefighting- Accessibility for fire engines, firefighting gadgets – their use and maintenance. Training of employees on plant safety and fire hazards.	
5.	<b>PLANT MAINTENANCE:</b> Organization for maintenance, Classification of maintenance – Brake down maintenance, Preventive Maintenance and Total Productive Maintenance, Maintenance Planning and condition monitoring. Lubrication and Lubricants, types of Lubricants and selection, Lubricant systems, Basics of Corrosion and Corrosion prevention.	07
6.	<b>SUSTAINABILITY:</b> Introduction to sustainability and Sustainable approaches in plants, Approaches for carbon emission reduction carbon foot prints and carbon credits, Energy storage and energy conservation technologies, Enhancing energy efficiency through energy saving processes and design. Energy management and energy audits.	06

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

1. First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40%, but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1 will be compulsory and should cover maximum contents of the curriculum.**
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 any module other than module 3).
4. **Only Four questions need to be solved.**

**Reference Books:**

1. *Lindley and Higgins, "Maintenance Engineer's Hand Book", 7<sup>th</sup> Edition, McGraw Hill Professional, 2008.*
2. *Rosaler, R. C. "Standard Hand Book of Plant Engineering, 3<sup>rd</sup> Edition, McFraw Hill, 2002.*

Course Code	Course Name	Credits
<b>PEDO8015</b>	<b>Energy Management and Audit</b>	<b>03</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

**Objectives:**

1. To get conversant with basic concepts of energy, energy resources and significance of optimal use of energy.
2. To get acquainted with energy efficient technologies and energy storage technologies.
3. To enable the students to understand the concepts of energy management and energy management opportunities.
4. To get exposed to Energy laws, standards and energy auditing procedures.

**Outcomes:** The learner will be able to:

1. Practice energy efficient approaches in various fronts especially in manufacturing.
2. Develop competency in designing and developing energy efficient products and processes.
3. Will acquire knowledge in formulating energy policies and energy management.
4. Understand audit procedures and perform energy audit.

Module	Contents	Hours
1	<b>Introduction:</b> Basic concepts of energy, Types of energy – renewable and non-renewable, Sources of energy, importance of energy conservation –ongoing and futuristic trends, indigenous and global concerns and measures undertaken on energy front, types of industrial loads, optimal load scheduling, peak demand controls.	06
2	<b>Energy Conservation Technologies:</b> Energy storage technologies, Energy efficient approaches in appliances, instruments, manufacturing processes like machining, forging, metal casting, polymer moulding, Biomass conversion technologies and waste disposal.	06
3	<b>Energy Efficiency:</b> Energy efficient approaches in sectors like – transportation, air conditioning, power sectors, electrical utilities- lighting, drives, blowers & exhausts, heating & cooling systems. Energy efficient design, choice of energy efficient materials.	08
4	<b>Energy Management:</b> Objectives, energy policies -- purpose, formulation & ratification, managerial functions, role & responsibilities of energy managers, information system, energy instrumentation & information analysis, energy performance assessment, energy action planning, computer aided energy management.	07

<b>5</b>	<b>Energy Laws &amp; Standards:</b> Provisions of Energy Conservation Act 2001, Nodal agencies – Bureau of Energy Efficiency (BEE) & State Designated Agencies (SDA), energy conservation schemes of BEE, promoting energy efficiency in SMEs, certification of energy managers & auditors, standards & Labelling.	<b>07</b>
<b>6</b>	<b>Energy Audit:</b> Definition, need, types of energy audit, energy audit instruments, ways to reduce energy consumption, benefits of energy audit, and ISO standards for energy auditing, areas covered under audit.	<b>05</b>

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

1. First test based on approximately 40% of curriculum contents and second test based on remaining contents (approximately 40%, but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the two tests will be considered for final grading.

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to the number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks.**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum.**
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 any module other than module 3).
4. Only **Four questions need to be solved.**

**References:**

1. Albert Thumann, William J. Younger, Handbook of Energy Audits, CRC Press, 2003.
2. Craig B. Smith, Energy management principles, Pergamon Press. 4. D.
3. Yogi Goswami, Frank Kreith, Energy Management and Conservation Handbook, CRC Press, 2007
4. G.G. Rajan, Optimizing energy efficiencies in industry --, Tata McGraw Hill, Pub. Co., 2001.
5. M Jayaraju and Premlet, Introduction to Energy Conservation And Management, Phasor Books, 2008
6. Paul O'Callaghan, Energy management, McGraw Hill Book Co.
7. Wayne C. Turner, Energy management Hand Book The Fairmount Press, Inc., 1997.
8. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 196.
9. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
10. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmount Press, Inc., 2006

Course Code	Course Name	Credits
<b>PEL801</b>	<b>Automation and Control Engineering Lab.</b>	<b>01</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	02	--	--	01	--	1

Theory				Term Work/Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.		Oral
Test-I	Test-II	Average						
--	--	--	--	--	25	25	--	50

**Objectives:**

1. To familiarize with software based pneumatics, electro-pneumatics and PLC circuits' simulation.
2. To familiarize with setup and execution of pneumatics, electro-pneumatics and PLC circuits on an experimental kit.

**Outcomes:** The learner will be able to:

1. Design & Simulate Pneumatic, Electro-Pneumatic and PLC based circuits on any compatible software.
2. Setup and execute Pneumatic, Electro-Pneumatic and PLC based circuits on an experimental kit.
3. Design & Simulate PLC based circuits (Ladder Diagram) on any compatible software.
4. Set up and execute Pneumatic circuits on an experimental kit.
5. Set up and execute electro-pneumatic circuits on an experimental kit.
6. Set up and execute PLC based circuit on an experimental kit.

Sr. No	Circuit Design / Assignment
1	Designing of the basic Pneumatic circuit – minimum 3 circuits
2	Designing of the basic Pneumatic circuit including flow control valves - minimum 3 circuits
3	Multiple cylinder pneumatic circuits with Simulation in any software- minimum 3 circuits
4	Designing of the basic Electro-Pneumatic circuit- minimum 3 circuits
5	Designing of the basic Electro-Pneumatic circuit including timer and counters- minimum 3 circuits
6	PLC based Circuit design - minimum 2 circuits

**Term Work:**

Term work shall consist of exercises listed in the above list

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

Circuit Simulation: **10 marks**

Circuit Setup and Execution: **10 marks**

Attendance: **05 marks**

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

**Practical/Oral Exam:**

The practical/Oral exam shall consist of the following;

Circuit Simulation: one problem: **15 marks**

Circuit Setup and Execution: one problem: **10 marks**

Course Code	Course Name	Credits
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<b>PEL802</b>	<b>Computer Aided Engineering Lab.</b>	<b>01</b>
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Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
--	02	--	--	01	--	1

Theory				Term Work/Practical/Oral			Total	
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.		Oral
Test-I	Test-II	Average						
--	--	--	--	--	25	25	--	50

**Objectives:**

1. To introduce the concepts of computer aided engineering for design & manufacture and familiarize them with mathematical basis of computer graphics.
2. To impart knowledge on computer graphics, which are used routinely in diverse areas like science, engineering, medicine etc.
3. The aim is to provide the students with knowledge of the finite element method that will be of use in different manufacturing areas and to provide a foundation for further study

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

1. Understand software configuration of graphic packages.
2. Understand use of Computer graphics in design.
3. Identify proper modeling techniques for geometric modeling
4. Solve physical and engineering problems with emphasis on Structural and Thermal Engineering applications.

**List of Experiment:**

1. Solid modeling using any 3D modeling software
2. Assembly of solid modelling using 3D modelling software.
3. Shape optimization using FEA software.
4. Structural analysis using FEA software.

**Term Work:**

Term work shall consist of

1. Assignments: On topics drawn from syllabus [At least 1 assignment per module].
2. Practical: Minimum six experiments are to be conducted based on the list of experiments.

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

Laboratory work (Experiment/ programs and journal):	<b>10 marks</b>
Assignments:	<b>10 marks</b>
Attendance (Theory and Practical):	<b>05 marks</b>
<b>TOTAL:</b>	<b>25 marks</b>

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

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Course Code	Course Name	Credits
ILO8021	Project Management	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

#### Objectives:

- To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
- To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

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

- Apply selection criteria and select an appropriate project from different options.
- Write work break down structure for a project and develop a schedule based on it.
- Identify opportunities and threats to the project and decide an approach to deal with them strategically.
- Use Earned value technique and determine & predict status of the project.
- Capture lessons learned during project phases and document them for future reference

Module	Details	Hrs.
01	<b>Project Management Foundation:</b> Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager, Negotiations and resolving conflicts, Project management in various organization structures, PM knowledge areas as per Project Management Institute (PMI)	5
02	<b>Initiating Projects:</b> How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6
03	<b>Project Planning and Scheduling:</b> Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart, Introduction to Project Management Information System (PMIS).	8

<b>04</b>	<p><b>Planning Projects:</b> Crashing project time, Resource loading and levelling, Goldratt's critical chain, Project Stakeholders and Communication plan</p> <p>Risk Management in projects: Risk management planning, Risk identification and risk register, Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks</p>	6
<b>05</b>	<p><b>5.1 Executing Projects:</b> Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings</p> <p><b>5.2 Monitoring and Controlling Projects:</b> Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep, Project audit</p> <p><b>5.3 Project Contracting</b> Project procurement management, contracting and outsourcing,</p>	8

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and **should cover maximum contents of the curriculum**
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 any module other than module 3)
4. **Only Four questions need to be solved**

**REFERENCES:**

1. Project Management: A managerial approach, Jack Meredith & Samuel Mantel, 7<sup>th</sup> Edition, Wiley India
2. A Guide to the Project Management Body of Knowledge (PMBOK<sup>®</sup> Guide), 5<sup>th</sup> Ed, Project Management Institute PA, USA
3. Project Management, Gido Clements, Cengage Learning
4. Project Management, Gopalan, Wiley India
5. Project Management, Dennis Lock, 9<sup>th</sup> Edition, Gower Publishing England

Course Code	Course Name	Credits
ILO8022	Finance Management	03

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

**Objectives:**

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

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

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Details	Hrs
01	<p><b>Overview of Indian Financial System:</b> Characteristics, Components and Functions of Financial System.</p> <p><b>Financial Instruments:</b> Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills.</p> <p><b>Financial Markets:</b> Meaning, Characteristics and Classification of Financial Markets —Capital Market, Money Market and Foreign Currency Market</p> <p><b>Financial Institutions:</b> Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges</p>	06
02	<p><b>Concepts of Returns and Risks:</b> Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.</p> <p><b>Time Value of Money:</b> Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.</p>	06
03	<p><b>Overview of Corporate Finance:</b> Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. <b>Financial Ratio Analysis:</b> Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.</p>	09

<b>04</b>	<p><b>Capital Budgeting:</b> Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value (NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR)</p> <p><b>Working Capital Management:</b> Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.</p>	<b>10</b>
<b>05</b>	<p><b>Sources of Finance:</b> Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance.</p> <p><b>Capital Structure:</b> Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure</p>	<b>05</b>
<b>06</b>	<p><b>Dividend Policy:</b> Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches— Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach</p>	<b>03</b>

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1 will be compulsory and should cover maximum contents of the curriculum**
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 any module other than module 3)
4. **Only Four questions need to be solved.**

**REFERENCES:**

1. Fundamentals of Financial Management, 13<sup>th</sup> Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10<sup>th</sup> Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9<sup>th</sup> Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4. Financial Management, 11<sup>th</sup> Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Course Code	Course Name	Credits
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<b>ILO8023</b>	<b>Entrepreneurship Development and Management</b>	<b>03</b>
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Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

**Objectives:**

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

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

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Modules	Details	Hrs.
01	<b>Overview Of Entrepreneurship:</b> Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	<b>Business Plans And Importance Of Capital To Entrepreneurship:</b> Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur <b>Entrepreneurship And Business Development:</b> Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	<b>Indian Environment for Entrepreneurship:</b> key regulations and legal aspects, MSME Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08

<b>05</b>	<b>Effective Management of Business:</b> Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
<b>06</b>	<b>Achieving Success In The Small Business:</b> Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
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 any module other than module 3)
4. Only **Four questions need to be solved.**

**REFERENCES:**

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. [www.msme.gov.in](http://www.msme.gov.in)
12. [www.dcmesme.gov.in](http://www.dcmesme.gov.in)
13. [www.msmetraining.gov.in](http://www.msmetraining.gov.in)

Course Code	Course Name	Credits
<b>ILO8024</b>	<b>Human Resource Management</b>	<b>03</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

**Objectives:**

1. To introduce the students with basic concepts, techniques and practices of the human resource management
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations
3. To familiarize the students about the latest developments, trends & different aspects of HRM
4. To acquaint the student with the importance of inter-personal & inter-group behavioural skills in an organizational setting required for future stable engineers, leaders and managers

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

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioural skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Details	Hrs
<b>01</b>	<p><b>Introduction to HR</b></p> <ul style="list-style-type: none"> <li>• Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions</li> <li>• Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.</li> </ul>	<b>5</b>

02	<p><b>Organizational Behaviour (OB)</b></p> <ul style="list-style-type: none"> <li>• Introduction to OB Origin, Nature and Scope of Organizational Behaviour, Relevanceto Organizational Effectiveness and Contemporary issues</li> <li>• Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness</li> <li>• Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behaviour</li> <li>• Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor);</li> <li>• Group Behaviour and Group Dynamics: Work groups formal and informal groups and stages of group development, Team Effectiveness: High performing teams, TeamRoles, cross functional and self-directed team.</li> <li>• Case study</li> </ul>	7
03	<p><b>Organizational Structure &amp; Design</b></p> <ul style="list-style-type: none"> <li>• Structure, size, technology, Environment of organization; Organizational Roles &amp; conflicts: Concept of roles; role dynamics; role conflicts and stress.</li> <li>• Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership.</li> <li>• Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.</li> </ul>	6
04	<p><b>Human resource Planning</b></p> <ul style="list-style-type: none"> <li>• Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale</li> <li>• Performance Appraisal Systems: Traditional &amp; modern methods, Performance Counselling, Career Planning</li> <li>• Training &amp; Development: Identification of Training Needs, Training Methods</li> </ul>	5
05	<p><b>Emerging Trends in HR</b></p> <ul style="list-style-type: none"> <li>• Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes &amp; transformation in HR. Organizational Change, Culture, Environment</li> <li>• Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation</li> </ul>	6
06	<p><b>HR &amp; MIS:</b> Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&amp;D, Public Transport, Hospitals, Hotels and service industries)</p> <p><b>Strategic HRM:</b> Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals</p> <p><b>Labor Laws &amp; Industrial Relations:</b> Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act</p>	10

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**



2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
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 any module other than module 3)
4. Only **Four questions need to be solved.**

**REFERENCES:**

1. Stephen Robbins, Organizational Behavior, 16<sup>th</sup> Ed, 2013
2. V S P Rao, Human Resource Management, 3<sup>rd</sup> Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6<sup>th</sup> edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15<sup>th</sup> Ed, 2015, Himalaya Publishing, 15<sup>th</sup> edition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5<sup>th</sup> Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications

Course Code	Course Name	Credits
<b>ILO8025</b>	<b>Professional Ethics and Corporate Social Responsibility (CSR)</b>	<b>03</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

**Objectives:**

1. To understand professional ethics in business
2. To recognized corporate social responsibility

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

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Modules	Details	Hrs.
01	<b>Professional Ethics and Business:</b> The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	<b>Professional Ethics in the Marketplace:</b> Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy <b>Professional Ethics and the Environment:</b> Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	<b>Professional Ethics of Consumer Protection:</b> Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy <b>Professional Ethics of Job Discrimination:</b> Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	<b>Introduction to Corporate Social Responsibility:</b> Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	<b>Corporate Social Responsibility:</b> Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	<b>Corporate Social Responsibility in Globalizing India:</b> Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate	08

	Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	
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**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
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 any module other than module 3)
4. Only **Four questions need to be solved.**

**References:**

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Course Code	Course Name	Credits
<b>ILO8026</b>	<b>Research Methodology</b>	<b>03</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

**Objectives:**

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

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

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Details	Hrs
<b>01</b>	<b>Introduction and Basic Research Concepts</b> <b>1.1</b> Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology <b>1.2</b> Need of Research in Business and Social Sciences <b>1.3</b> Objectives of Research <b>1.4</b> Issues and Problems in Research <b>1.5</b> Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	<b>09</b>
<b>02</b>	<b>Types of Research</b> <b>2.1.</b> Basic Research <b>2.2.</b> Applied Research <b>2.3.</b> Descriptive Research <b>2.4.</b> Analytical Research <b>2.5.</b> Empirical Research <b>2.6</b> Qualitative and Quantitative Approaches	<b>07</b>
<b>03</b>	<b>Research Design and Sample Design</b> <b>3.1</b> Research Design – Meaning, Types and Significance <b>3.2</b> Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	<b>07</b>

<b>04</b>	<b>Research Methodology</b> <b>4.1</b> Meaning of Research Methodology <b>4.2.</b> Stages in Scientific Research Process: <b>a.</b> Identification and Selection of Research Problem <b>b.</b> Formulation of Research Problem <b>c.</b> Review of Literature <b>d.</b> Formulation of Hypothesis <b>e.</b> Formulation of research Design <b>f.</b> Sample Design <b>g.</b> Data Collection <b>h.</b> Data Analysis <b>i.</b> Hypothesis testing and Interpretation of Data <b>j.</b> Preparation of Research Report	<b>08</b>
<b>05</b>	<b>Formulating Research Problem</b> <b>5.1</b> Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	<b>04</b>
<b>06</b>	<b>Outcome of Research</b> <b>6.1</b> Preparation of the report on conclusion reached <b>6.2</b> Validity Testing & Ethical Issues <b>6.3</b> Suggestions and Recommendation.	<b>04</b>

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
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 any module other than module 3)
4. **Only Four questions need to be solved.**

**References:**

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2<sup>nd</sup>ed), Singapore, Pearson Education

Course Code	Course Name	Credits
<b>ILO8027</b>	<b>IPR and Patenting</b>	<b>03</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

#### Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

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

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Details	Hrs
<b>01</b>	<b>Introduction to Intellectual Property Rights (IPR):</b> Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plantvariety protection, Geographical indications, Transfer of technology etc. <b>Importance of IPR in Modern Global Economic Environment:</b> Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	<b>05</b>
<b>02</b>	<b>Enforcement of Intellectual Property Rights:</b> Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement <b>Indian Scenario of IPR:</b> Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	<b>07</b>
<b>03</b>	<b>Emerging Issues in IPR:</b> Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	<b>05</b>
<b>04</b>	<b>Basics of Patents:</b> Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	<b>07</b>

<b>05</b>	<b>Patent Rules:</b> Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	<b>08</b>
<b>06</b>	<b>Procedure for Filing a Patent (National and International):</b> Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement <b>Patent databases:</b> Important websites, Searching international databases	<b>07</b>

#### Assessment:

##### Internal Assessment for 20 marks:

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

##### End Semester Examination:

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
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 any module other than module 3)
4. Only **Four questions need to be solved.**

#### Reference Books:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7<sup>th</sup> Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellectual Property Rights: A Case Book, 3<sup>rd</sup> Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency

14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press.

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Course Code	Course Name	Credits
<b>ILO8028</b>	<b>Digital Business Management</b>	<b>03</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

**Objectives:**

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

**Outcomes:** The learner will be able to .....

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Details	Hrs
1	<p><b>Introduction to Digital Business-</b> Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts</p> <p>Difference between physical economy and digital economy,</p> <p><b>Drivers of digital business-</b> Big Data &amp; Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services)</p> <p>Opportunities and Challenges in Digital Business,</p>	09
2	<p><b>Overview of E-Commerce</b></p> <p><b>E-Commerce-</b> Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement</p> <p>B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals</p> <p>Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing</p> <p>EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC</p>	06
3	<p><b>Digital Business Support services:</b> ERP as e –business backbone, knowledgeTope Apps, Information and referral system</p> <p><b>Application Development:</b> Building Digital business Applications and Infrastructure</p>	06
	<p><b>Managing E-Business-</b>Managing Knowledge, Management skills for e-business, Managing Risks in e –business</p>	

4	Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	<b>E-Business Strategy</b> -E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	<b>Materializing e-business: From Idea to Realization</b> -Business plan preparation <b>Case Studies and presentations</b>	08

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
2. **Question 1** will be **compulsory** and should **cover maximum contents of the curriculum**
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 any module other than module 3)
4. Only **Four questions need to be solved.**

**References:**

1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6<sup>th</sup> Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2<sup>nd</sup> Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vincenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2<sup>nd</sup> International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective- DoI:10.1787/9789264221796-enOECD Publishing.

Course Code	Course Name	Credits
<b>ILO8029</b>	<b>Environmental Management</b>	<b>03</b>

Contact Hours			Credits Assigned			
Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
3	--	--	3	--	--	3

Theory					Term Work/Practical/Oral			Total
Internal Assessment			End Sem Exam	Duration of End Sem Exam	Term Work	Pract.	Oral	
Test-I	Test-II	Average						
20	20	20	80	03 Hrs.	--	--	--	100

**Objectives:**

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

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

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations.

Module	Details	Hrs
<b>01</b>	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities, Environmental issues relevant to India, Sustainable Development, the Energy scenario	<b>10</b>
<b>02</b>	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man-made disasters, Atomic/Biomedical hazards, etc.	<b>06</b>
<b>03</b>	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	<b>05</b>
<b>04</b>	Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility	<b>10</b>
<b>05</b>	Total Quality Environmental Management, ISO-14000, EMS certification.	<b>05</b>
<b>06</b>	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	<b>03</b>

**Assessment:**

**Internal Assessment for 20 marks:**

Consisting **Two Compulsory Class Tests**

First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)

**End Semester Examination:**

Weightage of each module in end semester examination will be proportional to number of respective lecture hours mentioned in the curriculum.

1. Question paper will comprise of total **six questions, each carrying 20 marks**
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4. Only **Four questions need to be solved.**

**REFERENCES:**

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G. Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3<sup>rd</sup> Ed. Access Publishing, 2015.