

SAVITRIBAI PHULE PUNE UNIVERSITY



FACULTY OF ENGINEERING

**SYLLABUS FOR
T. E.
(MECHANICAL ENGINEERING - SANDWICH)
(2015 Course)**

WITH EFFECT FROM YEAR 2017-2018

Savitribai Phule Pune University
T.E. Mechanical Sandwich Engineering 2015 – Course
(w. e. f. 2017-2018)

T. E. (Mechanical Sandwich) (2015 Course) Semester – I

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits	
		Lecture	Tut	Pract	In-Sem	ESE	TW	PR	OR		Th	TW / PR / OR
302047	Numerical Methods & Optimization*	4	--	2	30	70	--	50 [#]	--	150	4	1
302042	Heat Transfer*	4	-	2	30	70		50 [#]	-	150	4	1
302050	Mechatronics*	3	1	---	30	70	--	--	25	125	3	1
302061	Applied Computer Aided Engineering	3	--	2	30	70	50	--	--	150	3	1
302062	Machine Design	4	--	2	30**	70**	50	--	25	175	4	1
302054	Audit Course*	--	--	--	--	--	-	-	-	-	-	-
Total		18	1	08	150	350	100	100	50	750	18	5
23												

* Subject common with Mechanical Engineering (refer TE Mechanical Engineering 2015 course syllabus)

Evaluation should be on performance in practical examination and oral based on Term Work by one Internal Examiner and one External Examiner

** Total time allotted for In-Sem Theory examination (Machine Design) will be 1 hr 30 mins and end sem exam will be 3 hrs.

T. E. (Mechanical Sandwich) (2015 Course) Semester – II

Code	Subject	Teaching Scheme Hrs / week			Examination Scheme					Total Marks	Credits	
		Lecture	Tut	Pract	In-Sem	ESE	TW	PR	OR		Th	TW / PR / OR
302064	Industrial In-plant Training- I	One contact hour per student per week by College Guide [@]			-	-	100	--	100 [#]	200	6	4
302063	Industrial case study assignments				-	-	100	---	50 ⁺	150	4	1
302065	Seminar	-	-	2 ^{\$}	-	-	-	-	50 ⁺	50	-	2
302066	Materials and Manufacturing Engineering (Self Study-I)	3 ^{\$}	-	-	30*	70	--	-	-	100	3	0
302067	Industrial Engineering and Technology Management (Self-Study –II)	3 ^{\$}	-	-	30*	70	--	-	-	100	3	0
Total		-	-	-	60	140	200	--	200	600	16	7
23												

@ - The contact hours are provided for supervision of students under training and for giving guidance regarding the industrial in plant training, seminar during the training.

\$ - Contact hours with Industrial supervisor are to be certified by the concerned Industry

- Oral (Industrial in plant training – I and Industrial case study) will be based on Term Work, by one Internal Examiner and one External Examiner from Industry

+ Assessment by internal and external examiners.

*Assessment based on continuous done by conducting Assignments/ Quiz, **NO INSEM EXAMINATION**

**T.E. Mechanical (Sandwich) - 2015 Course
(302061) Applied Computer Aided Engineering**

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)						Credits	
		Lect	Tuto.	Pract	Theory		TW	PR	OR	Total	Th.	Pr.
					In sem	End sem						
302061	Applied Computer Aided Engineering	3	---	2	30	70	50	--	--	150	3	1
									Total		4	

Course Objectives: To teach students

1. Basics of modeling.
2. Discuss various geometries.
3. Discretization of the solid model.
4. Apply Boundary Conditions similar to real world.
5. Generate solution to ensure design can sustain the applied load conditions.
6. Discuss latest manufacturing methods.

Course Outcomes: After completion of the course students would be able to,

1. Analyze and design real world components
2. Suggest whether the given solid is safe for the load applied.
3. Select suitable manufacturing method for complex components.

Unit 1: Computer Graphics (8 hrs)

Computer Graphics Module, Transformations-Introduction, Formulation, Translation, Rotation, Scaling and Reflection. Homogenous Representation, Concatenated Transformation, Mapping of Geometric Models, Inverse Transformations. Projections: Orthographic and Isometric.

Unit 2: Modeling (8 hrs)

Curves-Introduction, Analytic Curves - Line, Circle, Ellipse, Parabola, Hyperbola. Synthetic Curves - Hermite Cubic Spline, Bezier Curve, B-Spline Curve. Numerical on Line, Circle, Ellipse and Hermite Cubic Spline.

Surfaces-Introduction, Surface Representation, Analytic Surfaces, Synthetic Surfaces, Hermite bicubic Surface, Bezier surfaces, B-spline Surfaces, Coons Surface [No analytical and numerical treatment.

Solids: Introduction, Geometry and Topology, Solid Representation, Boundary Representation, Euler's equation, Constructive Solid Geometry, Boolean operation for CSG, Hybrid Modeling, Feature Based Modeling, Parametric Modeling, Constraint Based Modeling, Mass, area, volume calculation.

Unit 3: Robotics & Automation (8 hrs)

Structure of Robotic System - Point to point & continuous path robotic systems, Joints, End Effectors, Grippers - Mechanical, Magnetic and Pneumatic. Drives, Controllers, Industrial Applications.

Types of Automation - Automation strategies, Group Technology & Coding Methods, Flexible Manufacturing System – Types, Advantages, Limitations. Computer Integrated Manufacturing and Computer Aided Process Planning.

Unit 4: Computer Aided Manufacturing (8 hrs)

Introduction and working of NC, CNC and DNC machines. Computer Aided Manufacturing. CNC Programming. Steps in developing CNC part program. CNC part programming for Lathe Machine – Threading & Grooving cycle (Canned cycle). CNC part programming for Milling Machine - Linear & circular interpolation, milling cutter, tool length compensation & cutter radius compensation. Pocketing, contouring & drilling, subroutine and Do loop using canned cycle.

Unit 5: Advanced Manufacturing Method – Rapid Prototyping (8 hrs)

Introduction to Rapid Prototyping, classification of RP Processes, Working principle, models & specification process, application, advantages & disadvantages & case study of

- Stereo Lithography Apparatus (SLA)
- Laminated Object Manufacturing (LOM)
- Selective Laser Sintering (SLS)
- 3D Printing.
- Fused Deposition Modeling [FDM]

Unit 6: Finite Element Analysis (10 hrs)

Introduction, Stress and Equilibrium, Boundary Condition, Strain – Displacement Relations, Stress-Strain Relation, Potential Energy and Equilibrium: - Rayleigh-Ritz Method, Galerkin's Method.

One Dimensional Problem: Finite Element Modelling, Coordinate and Shape function, Potential Energy Approach, Galerkin Approach, Assembly of Global Stiffness Matrix and Load Vector, Properties of Stiffness Matrix, Finite Element Equations, Quadratic Shape Function, Temperature Effects .

Trusses: Introduction, 2D Trusses, Assembly of Global Stiffness Matrix.

Term Work:

The term work shall consist of record of ten assignments based on the following topics, with two on CAD based, three on CAE based, three on CAM based and two on robot and R. P.

Following all assignment are compulsory.

1. Developing CAD model of mechanical sub assembly consisting 8- 10 components using CAD features of Hybrid Modeling, Feature Based Modeling, Parametric Modeling and Constraint Based Modeling.
2. Program on concatenated Transformation involving three steps.
3. Stress and Deflection Analysis of 2D truss.
4. Stress and Deflection Analysis of Beam.
5. Stress and deflection analysis of plate 2D/3D.[Mechanical Component]
6. Tool path generation for Turning – Grooving and Threading.
7. Tool path generation for Milling – Facing, Pocketing, Contouring and Drilling.
8. Tool path generation of Turn Mill.
9. Robot simulation/Robot Gripper Design. [Compulsory Site visit and Report]
10. Case study on R.P.

Reference Books:

1. Ibrahim Zeid and R. Sivasubramanian - CAD/CAM - Theory and Practice Tata McGraw Hill Publishing Co. 2009
2. Ibrahim Zeid, —Mastering CAD/CAM – Tata McGraw Hill Publishing Co. 2000
3. Chandrupatla T.R. and Belegunda A.D. -Introduction to Finite Elements in Engineering - Prentice Hall India.
4. Segerling L.J. - Applied Finite Elements Analysis - John Wiley and Sons.
5. Rao P.N., Introduction to CAD/CAM Tata McGraw Hill Publishing Co.
6. Groover M.P.-Automation, production systems and computer integrated manufacturing - Prentice Hall of India
7. Yoram Koren - Robotics McGraw Hill Publishing Co.
8. James G. Keramas, Robot Technology Fundamentals, Delmar Publishers.
9. S. R. Deb, Robotics Technology and Flexible Automation, Tata McGraw Hill.

10. Lakshiminarayana H. V. Finite Element Analysis (Procedures in Engineering), University Press, 2004.
11. Chandrupatla T. R., Finite Element Analysis for Engineering and Technology, University Press, 2009.
12. Seshu P. Text book of Finite Element Analysis, PHI Learning Private Ltd. New Delhi, 2010.
13. Ian Gibson, David W. Rosen, and Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer.

**T.E. Mechanical (Sandwich) - 2015 Course
(302062) Machine design**

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)						Credit	
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total	Th	Pr
					Insem	Endsem						
302062	Machine Design	4	--	2	30 (90 Min.)	70 (3hrs.)	50	--	25	175	4	1
									Total		5	

Course Objective:-

1. The student shall gain appreciation and understanding of the design function in Mechanical Engineering, the steps involved in designing and the relation of design activity with manufacturing activity.
2. Shall be able to choose proper materials for different machine elements depending on their physical and mechanical properties. Thus he shall be able to apply the knowledge of material science in real life usage.
3. Student shall gain a thorough understanding of the different types of failure modes and failure criteria. Will be conversant with various failure theories and be able to judge which criterion is to be applied in which situation.
4. Student shall be able to design different machine elements e.g. shafts, couplings, springs, gears etc. by applying basic design process.

Course Outcomes:-

1. Ability to analyze the stress and strain of mechanical components and understand, identify and quantify failure modes for Machine components.
2. Ability to select standard machine components from Manufacturer's catalogue.
3. Enhancement in proficiency of CAD software for designing Mechanical systems and to generate production drawing.
4. Ability to design different machine elements.

Unit 1: Design Process and design of Simple Machine elements (8 hrs)

Machine Design, Design Process, Design considerations, Introduction to standards and codes, Use of preferred series, Factor of safety, Service factor. Design of Cotter joint, Knuckle joint.

Design for Fluctuating Loads :-

Stress concentration-causes & remedies, fluctuating stresses, fatigue failures, S-N curve, endurance limit, notch sensitivity, endurance strength modifying factors, design for finite and infinite life, cumulative damage in fatigue failure, Soderberg, Gerber, Goodman, Modified Goodman diagrams.

Unit 2: Power Screws, Threaded and Welded Joints (8 hrs)

Power Screws: Forms of threads, multiple start screws, Torque analysis and Design of power screws with square and trapezoidal threads, Self-locking screw, Collar friction torque, Stresses in power screws, design of a C- Clamp.

Threaded joint: (Theoretical treatment only)

Threaded joint, bolt of uniform strength, terminology of screw threads and ISO metric screw threads.

Welded Joints:-

Welding symbols, Stresses in butt and fillet welds, Axially loaded unsymmetrical welded joints, Eccentric load in plane of welds, Welded joints subjected to bending and torsional

moments.

Unit 3: Design of Shafts, Keys, Couplings and Springs (8 hrs)

Shaft design on the basis of strength, torsional rigidity and lateral rigidity, A.S.M.E. code for shaft design, Design of Rectangular keys and splines, Design of Flange Coupling.

Mechanical Springs:

Types, applications and materials for springs, Design of helical compression and helical tension springs, Style of ends, Multi-leaf spring.

Unit 4: Spur, Helical, Bevel and Worm Gears (8 hrs)

Spur Gears: Number of teeth and face width, Constructional details of gear wheel, Force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by velocity factor and Buckingham's equation, Design of spur gears.

Helical, Bevel and Worm gear: (Theoretical treatment only)

Comparison in between design of helical and spur gear, force analysis of helical gear. Introduction to Bevel and Worm gear.

Unit 5: Rolling and Sliding Contact Bearings (8 hrs)

Rolling Contact Bearings:

Types of rolling contact Bearings, Static and dynamic load carrying capacities, Stribeck's Equation, Equivalent bearing load, Load-life relationship, Selection of bearing life, Selection of rolling contact bearings from manufacturer's catalogue, Design for cyclic loads, bearing with probability of survival other than 90% Lubrication and mounting of bearings, Preloading of rolling contact bearings, Types of failure in rolling contact bearings - causes and remedies. Selection of Taper roller bearings.

Sliding contact bearing: (Theoretical treatment only)

Introduction to sliding contact bearing, Petroff's equations, Sommerfeld number

Unit 6: Belt, Rope and Chain Drives (8 hrs)

Belt Drive

Materials and construction of flat and V belts, geometric relationships for length of belt, power rating of belts, concept of slip & creep, initial tension, effect of centrifugal force, maximum power condition, selection of flat and V belts from manufacturer's catalogue, belt tensioning methods, relative advantages and limitations of flat and V belts, construction and applications of timing belts.

Wire Ropes

Construction of wire ropes, lay of wire ropes, stresses in wire rope, selection of wire ropes.

Chain Drives

Types of power transmission chains, Geometry of Chain, Polygon effect of chain, Modes of failure for chains, Lubrication of chains, Selection of roller chain from manufacturers catalogue

Term Work

Term work shall consist of:

1. One design project based on Design of a Two Stage Gear Box
(The design project shall consist of two full imperial (A1) size sheets involving assembly drawing with a part list and overall dimensions and drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified wherever required. A design report giving all necessary calculations of the design of components)

and assembly should be submitted in a separate file. Design data book shall be used wherever necessary to achieve selection of standard components. Drawing Sheets should be plotted using any CAD software.)

2. Three assignments should be based on following topics: (first assignment is mandatory)
 - i) Selection of Belt / Chain / Rope drive from manufacturer's catalogue. (Manufacturers catalogue is essential)
 - ii) Design of Flexible bush pin coupling
 - iii) Design of screw jack.
 - iv) Design of Knuckle joint

Text Books:-

- 1) Bhandari V.B., Design of Machine Elements, Tata McGraw Hill Publication Co. Ltd.
- 2) Shigley J.E. and Mischke C.R., Mechanical Engineering Design, McGraw Hill Publication Co. Ltd.
- 3) Spotts M.F. and Shoup T.E., Design of Machine Elements, Prentice Hall International.
- 4) Juvinal R.C., Fundamentals of Machine Components Design, John Wiley and Sons

Reference books :

- 1) Black P.H. and O. Eugene Adams, Machine Design, McGraw Hill Book Co. Inc.
- 2) William C. Orthwein, Machine Components Design, West Publishing Co. and Jaico Publications House.
- 3) Hall A.S., Holowenko A.R. and Laughlin H.G, Theory and Problems of Machine Design, Schaum"s Outline Series.
- 4) C.S.Sharma and Kamlesh Purohit, Design of Machine Elements, PHI Learning Pvt. Ltd.
- 5) D.K.Aggarwal & P.C.Sharma, Machine Design, S.K Kataria and Sons
- 6) P. C. Gope, Machine Design: Fundamentals and Applications, PHI Learning Pvt. Ltd.
- 7) Design Data - P.S.G. College of Technology, Coimbatore.
- 8) Bhandari, V. B. Machine Design data book, Tata McGraw Hill Publication Co. Ltd.

**T.E. Mechanical (Sandwich) - 2015 Course
(302054) Audit Course I - Fire & Safety Technology**

Code	Subject	Teaching Scheme			Examination Scheme (Marks)						Credit	
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total	Th	Pr
					Insem	Endsem						
302054	Fire & Safety Technology	-	-	-	-	-	-	-	-	-	-	-
								Total				

Description:

To generate, develop and sustain a voluntary movement on Fire & Safety Engineering at the National Level aimed at educating and influencing society to adopt appropriate policies, practices and procedures that prevent and mitigate human suffering and economic loss arising from all types of accidents.

Course Objective:

On completion of this Basic Fire Safety Course, participants will be able to:-

- Describe the chemistry of fire
- Identify fire hazards in the workplace
- Follow evacuation procedures
- Select and use appropriate firefighting equipment

Course Outcome:

• Students will be able

1. To create and sustain a community of learning in which students acquire knowledge in fire, safety and hazard management and learn to apply it professionally with due consideration for ethical, human life & property safety issues.
2. To pursue research and development in fire safety engineering, hazard management and disseminate its findings.
3. To meet the challenges of today and tomorrow in the most effective, efficient and contemporary educational manner.
4. To help in building national capabilities in fire safety engineering, disaster management, hazard management, industrial safety education through practical training to ensure a fire safe nation.

Course Contents:

1. Fire & Safety Overview

Fire & safety legislation, Safety Personnel Supplier for construction sites/commissioning of plants. Understanding the physics and chemistry of fire. Development and spread of fire. Action in the event of fire

2. Fire Fighting Techniques

Means of raising alarm, means of summoning the fire brigade, action on hearing the fire alarm Evacuation procedures Practical demonstration in the use of foam and CO₂ fire extinguishers using our state of the art gas fired training system.

3. Fundamentals of Fire Engineering Science

Fire Tech & Design, Fire Risk Assessment, Fire Control Technology, Fire Fighting Drills, Fire Tender with Crew on Hire. Fire & Safety Audit. Fire & Safety Consultancy Services.

4. Industrial Aspects of Fire & Safety

Industrial Training on Fire & Safety and Disaster Management. Repair of all kinds of Fire Equipment including Flooding System. Repair of Fire Tender including Pump and power take-off systems.

5. Maintenance of Fire Safety Equipments

AMC of Fire System. Refilling of Fire Extinguishers. Ultrasonic Thickness Test of Extinguishers, Vessels and Pipe lines. Hydro Testing of Fire Extinguishers, Vessels and Pipe Lines. Supply of Fire & Safety Equipment and Spares.

Case Study & Group Work:

- Identification of fire & safety technology
- To study the Fire Fighting Properties of Foam Concentrate
- Case Studies of Salvage operations in different types of occupancy
- Design and drawing of parts contained in the syllabus
- Compilation of Results & Presentation
- Case Study on the projects (products or processes) carried out by your institution or an organization in your vicinity, for safety.

Books:**References:**

1. Accident Prevention manual for Industrial Operations, NSC, Chicago 1982.
2. The manual of fire ship – 6 – A by HMSO
3. Electricity Fire Risks – G.S. Hodges
4. Fire Pumps and Hydraulics: I.E. Ditts and T. M. Harris.
5. Fire Service Manual (Volume 2) Fire Service Operations – Petrochemical Incidents
6. The Principles and Practice of Fire Salvage Operation by Fire Salvage association.

**T.E. Mechanical (Sandwich) - 2015 Course
(302054) Audit Course II - Entrepreneurship Development**

Code	Subject	Teaching Scheme			Examination Scheme (Marks)						Credit	
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total	Th	Pr
					Insem	Endsem						
302054	Entrepreneurship Development	-	-	-	-	-	-	-	-	-	-	-
								Total				

Description:

EDP is a program meant to develop entrepreneurial abilities among the people. In other words, it refers to inculcation, development, and polishing of entrepreneurial skills into a person needed to establish and successfully run his enterprise. Thus, the concept of entrepreneurship development programme involves equipping a person with the required skills and knowledge needed for starting and running the enterprise.

This course will help in developing the awareness and interest in entrepreneurship and create employment for others. Students get familiar with the characteristics and motivation of successful entrepreneurs. Students learn how to identify and refine market opportunities, how to secure financing, how to develop and evaluate business plans and manage strategic partnerships. Students learn various concepts including the basics of management, leadership, motivation, decision-making, conflict management, human resource development, marketing and sustaining an organization. Students also get basic knowledge of accounting practices and finance. The core course in Entrepreneurship Development & Management equips students with skills and knowledge required to start and sustain their own business.

Course Objective:

- To impart basis managerial knowledge and understanding;
- Develop and strengthen entrepreneurial quality, i.e., motivation or need for achievement.
- To analyze environmental set up relating to small industry and promoting it.
- Collect and use the information to prepare project report for business venture.
- Understand the process and procedure involved in setting up small units.
- Develop awareness about enterprise management.

Course Outcome:**The students will be able to**

- Appreciate the concept of Entrepreneurship
- Identify entrepreneurship opportunity.
- Develop winning business plans

Course Contents:

Entrepreneurship- Definition; Growth of small scale industries in developing countries and their positions large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries Government policy for small scale industry; stages in starting a small scale industry, requirements to be an entrepreneur, SWOT Analysis.

Projects: Identification and Selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

Market Assessment and Product feasibility

Marketing -Concept and Importance Market Identification,

Customer needs assessment, Market Survey Product feasibility analysis

Business Finance & Accounts

Business Finance: Costing basics, Sources of Finance, Break Even Analysis,

Business Accounts: Preparation of balance sheets and assessment of economic viability, decision, making, expected costs, planning and production control, quality control, marketing, Book Keeping, Financial Statements, Financial Ratios and its importance, Concept of Audit.

Project Planning and control:

The financial functions cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital expenditure and operations. Control of financial flows, control and communication.

Institutional Support and Policies: institutional support towards the development of entrepreneurship in India, technical consultancy organizations, E-Commerce: Concept and process, government policies for small scale enterprises.

Case Study & Group Work:

- Assess yourself-are you an entrepreneur?
- Prepare a Project Report for starting a small scale business.
- An Interview with an Entrepreneur.

Books:**References:**

1. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
2. Saini, J. S., 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd.
3. Khanka, S. S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi
4. Badhai, B 'Entrepreneurship for Engineers', Dhanpat Rai & co. (p) Ltd.
5. Desai, Vasant, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.
6. Gupta and Srinivasan, 'Entrepreneurial Development', S. Chand & Sons, New Delhi.

**T.E. Mechanical (Sandwich) - 2015 Course
(302054) Audit Course III - Intellectual Property Right**

Code	Subject	Teaching Scheme			Examination Scheme (Marks)						Credit	
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total		
					Insem	Endsem					Th	Pr
302054	Intellectual Property Right	-	-	-	-	-	-	-	-	-	-	-
								Total				

Objective:

Intellectual property refers to the rights which are attached to the creation of the mind and which take the form of a property. Though intangible in nature, intellectual property has become the driving force of many companies today. Fortune 500+ companies undoubtedly are the best examples of what a company can achieve through the proper understanding and management of IPR.

Thus the study of intellectual property rights is inevitable for managers, considering the fact that India is fast emerging as an economy with considerable investment in cutting-edge research and development. India is also emerging as an economy where foreign companies propose to invest considerably, both technically and financially, provided proper protection is guaranteed to their intangible assets which form the cornerstone of their business.

Topics:

1. Introduction

- Concepts of IPR
- The history behind development of IPR
- Necessity of IPR and steps to create awareness of IPR

2. IP Management

- Concept of IP Management
- Intellectual Property and Marketing
- IP asset valuation

3. Patent Law

- Introduction to Patents
- Procedure for obtaining a Patent
- Licensing and Assignment of Patents
 - Software Licensing
 - General public Licensing
 - Compulsory Licensing
- Infringement of Patents
- Software patent US and Indian scenario

4. Copyrights

- Concept of Copyright Right
- Assignment of Copyrights
- Registration procedure of Copyrights
- Infringement (piracy) of Copyrights and Remedies
- Copyrights over software and hardware

5. Designs

- Concept of Industrial Designs
- Registration of Designs
- Piracy of registered designs and remedies

6. Trademark Law

- Concept of trademarks
- Importance of brands and the generation of “goodwill”
- Trademark registration procedure
- Infringement of trademarks and Remedies available
- Assignment and Licensing of Trademarks

Case Study & Group Work:

- Identify the projects (products or processes) carried out by your institution or an organization in your vicinity, which have been patented.
- A case study on significance of patents for a developing nation like India.
- Group discussion on creative / novel ideas and the feasibility of converting the idea into product or process.
- Discussion on Correlation between IPR and Entrepreneurship in the backdrop of Make in India Initiative.

References:

1. Ganguli Prabuddha, ‘Intellectual Property Rights: Unleashing the knowledge economy’, Tata McGraw Hill, New Delhi
2. Wadehra R. L., ‘Law Relating to patents, trademarks, copyrights, designs and geographical indicators – 2nd’, Universal Law Publishing.
3. Narayan P. S. ‘Intellectual Property Law in India’, Asia Law House Hyderabad.

**T.E. Mechanical (Sandwich) - 2015 Course
(302054) Audit Course IV - Lean Management**

Code	Subject	Teaching Scheme			Examination Scheme (Marks)						Credit	
		Lec	Tut	Pract.	Theory		TW	PR	OR	Total	Th	Pr
					Insem	Endsem						
302054	Lean Management	-	-	-	-	-	-	-	-	-	-	-
								Total				

Course Objective:

- To learn Lean Thinking and its applications
- To get knowledge of Tools & Techniques used in Lean Management
- To understand Business Impact of Lean Management

Course Outcome: Students

- Will be able to do practice Lean Management at the workplace
- Will be able to contribute in Continuous Improvement program of the Organization

Course Contents:

- Brief History of Lean Thinking
- Toyota Production System
- Five Steps to Lean
- Seven Types of MUDA – Waste in Manufacturing
- MURA – Unevenness / Fluctuation
- MURI – Overburden, Physical Strain
- Lean Tools & Techniques
- Value Stream Mapping
- Five ‘S’
- Visual Management
- Plan-Do-Check-Act (PDCA)
- Kanban
- Lean Distribution
- Various Lean Management Systems
- Just In Time Production
- Total Quality Management (TQM)
- Total Productive Maintenance (TPM)
- Problem Solving Techniques
- A3 Reporting Technique

Books:

References:

1. Lean Thinking: Banish Waste and Create Wealth in Your Corporation, Second Edition James P. Womack and Daniel T. Jones, Free Press, June 2003, ISBN: 0743249275
2. Learning to See: Value Stream Mapping to Create Value and Eliminate Muda Mike Rother and John Shook, Lean Enterprise Institute, June 2003, ISBN: 0966784308
3. Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System, Second Edition Pascal Dennis, Productivity Press Inc, September 2007, ISBN: 9781563273568
4. Gemba Kaizen: A Commonsense, Low-Cost Approach to Management Masaaki Imai, McGraw-Hill, March 1997, ISBN: 0070314462
5. World of Kaizen : By Shyam Talawadekar Paperback Publisher: Kaizen Publisher; 4 th edition (2016) ISBN-10: 819326780X ISBN-13: 978-8193267806

**T.E. Mechanical (Sandwich) - 2015 Course
(302054) Audit Course V - Smart Manufacturing**

Code	Subject	Teaching Scheme			Examination Scheme (Marks)						Credit	
		Lec	Tut	Pract.	Theory		TW	PR	OR	Total	Th	Pr
					Insem	Endsem						
302054	Smart Manufacturing	-	-	-	-	-	-	-	-	-	-	-
								Total				

Description:

Smart Manufacturing is an amalgamation of Information Technology, Cloud Computing & traditional Mechanical, Production Engineering towards achieving excellence in manufacturing. Maximum results with minimum resources being used. The course will introduce the concepts of Smart Manufacturing, how various technologies can be leveraged to achieve minimum breakdowns, First Time Right Production, 100% Delivery on Time with minimum turnaround time. Nine Pillars of Smart Manufacturing will be explained to the Students.

The course will make the students aware of developments in Technology those are going to alter the Traditional Manufacturing scenario. The following topics may be broadly covered in the classroom. The practical will be in the form of Group Discussion based on Case Study.

Course Objective:

- To know more about Smart Manufacturing & Industry 4.0
- To get knowledge of various converging Technologies
- To prepare ourselves for the ever changing Manufacturing Techniques

Course Outcome: The students will be

- Comfortable with terminology and practices in Smart Manufacturing
- Able to face the challenges in Industry & also contribute towards advancement.
- Active part of Industry 4.0 (Fourth Industrial Revolution)

Course Contents:

- Introduction to Industry 4.0
- Historical Background
- Nine Pillars of Smart Manufacturing
- Big Data & analytics
- Autonomous Robots
- Simulation
- Universal System Integration
- IIOT – Industrial Internet of Things
- 3 D Printing – Additive Manufacturing
- Cloud Computing

- Augmented Reality
- Convergence of Nine Pillars
- Business Propositions delivered with Smart Manufacturing
- Adding Smartness to Manufacturing – Adoption & Scaling
- Economic Aspects
- Ecosystem Required for Smart Manufacturing
- Skill set Required for Smart Manufacturing
- Effects on 4 M- Man, Machine, Materials & Methods in Smart Manufacturing

References:

1. Smart Manufacturing by Shoukat Ali; Publisher: LAP LAMBERT Academic Publishing (10 August 2016)Language: EnglishISBN-10: 3659933554ISBN-13: 978-3659933554

2. Industry 4.0: The Industrial Internet of Things 2016by Alasdair Gilchrist (Author)
Publisher: Apress; 1st ed. edition (30 July 2016)
Language: English
ISBN-10: 1484220463
ISBN-13: 978-1484220467

3. Industry 4.0 Data Analytics31 July 2016 by Rajesh Agnihotri and Samuel New
Publisher: CreateSpace Independent Publishing Platform (31 July 2016)
Language: English
ISBN-10: 1534778284
ISBN-13: 978-1534778283

4. 3D Printing: The Next Industrial Revolution4 May 2013by Christopher Barnatt
Publisher: Createspace Independent Publishing Platform (4 May 2013)
Language: English
ISBN-10: 148418176X
ISBN-13: 978-1484181768

5. Augmented Reality: Principles and Practice by Dieter Schmalstieg and Tobias Hollerer
Publisher: Pearson Education; First edition (5 October 2016)
Language: English
ISBN-10: 9332578494
ISBN-13: 978-9332578494

LIST OF EXPERIMENTS / CASE STUDIES

Case Study & Group Work:

- Identification of areas where Smart Manufacturing can flourish
- Business Goals achieved through Smart Manufacturing
- Compilation of Results & Presentation

**T.E. Mechanical (Sandwich) - 2015 Course
(302064) Industrial In-plant Training –I**

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme					Total Marks	Credits	
		Lect.	Tut	Pract	In Sem	End Sem	TW	PR	OR		Th	Pr
302064	Industrial In-plant Training- I	One contact hour per student per week by college guide @			-	-	100	--	100	200	6	4
									Total	10		

Students are expected to learn followings during their Industrial In-Plant Training. He or She shall be given training in Large or Medium size manufacturing unit (Core mechanical industry) in various departments.

1. Orientation: Types of Industry, Industrial Environment, Industrial Psychology, Industrial Management, Industrial Relations, Government Policies, Associated organizations and their role. Company profile, Organizational structure of the company, Organizational behavior, Scale and type of production, Types of products.

2. Departments in Manufacturing Industries: R & D (research and development), quality control, shipping, distribution, production, purchasing, recruiting or human resources, operations, finance, accounting, accounts payable, accounts receivable, billing, sales, marketing, advertising, maintenance, etc., There could be additional departments within other departments depending on the size and type of business.

3. Industrial Design and Drawing Practice: Design and Drawing Standards, Study of mechanical components and component design such as gears, gear boxes, chain and belt drives, couplings, shaft, keys, bearings, brackets, bolted and welded connections. Sub-assembly and assembly drawings. Simple assignments based on the above items.

4. Manufacturing processes:

To understand manufacturing concepts applied in industry. Study of material requirements, material standards. Heat treatments applied to products.

5. Machine Tools:

Machine tool classifications, types of machines tool, special machine tools, machine tool design, CNC controls, Programming languages and codes, Machine tool maintenance.

6. Manufacturing Automation:

Automation level, types of automation, application of hydraulics and pneumatics, mechatronics control, use of sensors and feedback in control, robotic control over the process.

7. Material Handling:

Unit load concept, types of material handling equipment, selection of Material handling equipment, design requirement of material handling system.

8. Measurement and Quality Control:

Precision measurement, Control chart, Statistical process control, Process capability, TQM

9. Processes and Operation Planning:

Production planning and control, Order preparation, Material planning, Process planning, Route sheets, documents in process planning, production control- dispatching, follow-up.

10. Machines, Personal and Plant safety.

Safety rules in organization, posters exhibits and publicity, fire prevention and protection, Health and sanitation, Protective wearing apparel, Safety signs, Industrial safety standards.

Operational Guidelines:

- Institute and Industry will prepare detail training program at the beginning of the training, covering as much as possible from above mentioned topics.
- It is expected that students get exposure to all departments in industry.
- The student shall be asked to do simple assignments in various departments where he or she is undergoing training.
- Institute will assign a supervisor faculty to each student.
- Supervisor will guide and monitor student's training by visiting the industry once a month.
- Student will maintain logbook during the training.

Term Work:

Term Work shall consist of a comprehensive report based on his or her observations, his or her contributions during six months of training.

The implant training report* shall include, all the points mentioned below in the same sequence:

1. Industry History, Product/Service details, List of customers, Organizational Structure, Plant layout for small enterprise, detailed layout of shop floor, Safe working practices followed in the industry.
2. The department details where the student has undergone training in the first semester. Training details (Classroom training) if given shall be included. If training certificate is provided can be included.
3. The activities done during the training with technical details should be included in the report. Technical details in the form of drawings, figures, process sheets, machine specifications etc.
4. The assignments (if any) other than Mini Project completed in the Semester during training should be included in the report. Mini project work should not be included in implant training report to avoid duplication.
5. Any other relevant details if required.
6. Conclusion- (Major Learnings from the training)
7. The report should include a certificate of successful completion of training and attendance from concerned industry.

* If a number of students are working in the same industry, point 1 will be same but 2 to 7 shall be different.

Examination:

Oral will be based on Term Work completed during training. Oral Examination shall be conducted by appointing one Internal Examiner and one External Examiner from industry.

Instructions for in-plant training report writing

It is important that the procedures listed below be carefully followed by all the students.

Prepare 3 COPIES of your In-Plant Training report.

1. Limit your In-Plant Training report to preferably 40-50 pages
2. Header For e.g. University of Pune
3. The footer for e.g. Mechanical Engineering
Institute Name, Mechanical Engineering Times New Roman 10 pt. and centrally aligned.
4. Page number as second line of footer, Times New Roman 10 pt, centrally aligned
5. Print the report using
 - a) Letter quality computer printing.
 - b) The main part of report should be Times New Roman 12 pt. and justified.
 - c) Use 1.5 line spacing.
 - d) Entire report shall be one chapter. No chapters for In-Plant Training report.
6. Use the paper size 8.5" × 11" or A4 (210 × 197 mm). Please follow the margins given below.
Margin Location Paper 8.5" × 11", Paper A4 (210 × 197 mm)
 - Top 1", 25.4 mm
 - Left 1.5", 37 mm
 - Bottom 1.25", 32 mm
 - Right 1", 25.4 mm
7. All paragraphs will be 1.5 line spaced with a one blank line between each paragraph. Each paragraph will begin with without any indentation.
8. Section titles should be bold with 14 pt typed in all capital letters and should be left aligned.
9. Sub-Section headings should be aligning at the left with 12 pt, bold and Title Case (the first letter of each word is to be capitalized).

10. Illustrations (charts, drawings, photographs, figures) are to be in the text. Use only illustrations really pertinent to the text. Illustrations must be sharp, clear, black and white. Illustrations downloaded from internet are not acceptable.

- a) Illustrations should not be more than two per page, one per page is enough.
- b) Figure No. and Title at bottom with 12 pt
- c) Legends below the title in 10 pt
- d) Leave proper margin in all sides

**T.E. Mechanical (Sandwich) - 2015 Course
(302063) Industrial Case Study Assignments**

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme					Total Marks	Credits	
		Lect.	Tut	Pract	In Sem	End Sem	TW	PR	OR		Th	Pr
302063	Industrial Case Study Assignment	One contact hour per student per week by college guide [@]			--	--	100	---	50	150	4	1
								Total		5		

Case study / Mini project has to be completed during the training. It could be a requirement/need based task given to the student by the industry/industry guide. Any of the following shall be considered as Mini Project

1. Min. 2 Assignments given by the respective departments where the students will be reporting in first semester.
2. A physical model may be of a die, Jig or fixture, Dashboards, etc. can be considered as Mini Project
3. Kaizen implementation and results (quantification of results)
4. Industrial data based case study it may include, process improvement, work study, work measurement etc.
5. Any idea implementation in order to save time, efforts, money and waste etc. It must be in quantified form. (% saving compared to earlier)
6. Plant layout improvement case studies. (quantification of results)
7. Material handling/Material Flow case study. (quantification of results)
8. Energy audits and suggestions for improvement, results of implementation
9. Inventory management system case study.
10. Any safe working idea, 3 D (danger, difficult, dirt/dust) implementation.
11. Application of any one technique under LEAN manufacturing.
12. Or any other similar task as above.

Examination:

Oral will be based on Mini Project in front of external and internal guide at the end of the semester training term. Case study / Mini project report should be of 10-15 pages for each assignment written on journal pages in a file as term work.

1. Introduction, problem/ task identification
2. Objectives
3. Methodology, process to be followed/action plan
4. Observation and solution
5. Comparison with the earlier status, include graphs wherever necessary
6. Quantification (the results should be represented in terms of %)
7. Conclusion.

**T.E. Mechanical (Sandwich) - 2015 Course
(302065) Seminar**

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme					Total Marks	Credits	
		Lect.	Tut	Pract	Insem	Endsem	TW	PR	OR		Th	Pr
302065	Seminar	-	-	2	-	-	-	-	50	50	0	2
									Total		2	

Seminar topic should be strictly out of syllabus but should be related to,

1. Mechanical Engineering
2. Interdisciplinary subjects
3. Recent trends in Engineering

Note:

1. Also it should be different from industry assignments and mini project.
2. For recent trends students may refer to technical magazines, science magazines, journal paper.
3. Students are not advised to make report for the seminar.
4. The topic should be selected with the consent of institute allotted guide.

Examination:

Oral presentation will be there based on seminar in front of external from other colleges and internal College guide at the end of the semester training term.

**T.E. Mechanical (Sandwich) - 2015 Course
(302066) Materials and Manufacturing Engineering**

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)						Credit		
		Lect.	Tut	Pract.	Theory		TW	PR	OR	Total			
					Insem	Endsem					Th	Pr	
302066	Materials and Manufacturing Engineering (Self-Study -I)	3	--	---	30*	70	--	--	---	100	3	0	
										Total		03	

Course objective

1. The student shall understand different materials and their properties.
2. Student shall learn various advanced materials used in actual industrial practice.
3. The student will be able to carry out proper selection of Material in actual practice.
4. The student shall able to undergo with various advance machining process
5. Student shall be able to understand advanced manufacturing processes-Broaching, Gear & Thread Manufacturing.
6. Student must learn various jigs and fixtures for various different machining processes.
7. Student should understand various Machining processes.

Course outcomes

1. The student will understand advanced materials and manufacturing processes and its use in industry.
2. The student will display professional skills in selecting proper materials at work.
3. The student will develop a good product by using proper manufacturing process.

Unit 1: Study of Non-Metallic Materials (08 hrs.)

Introduction to Polymers, Polymerization, Polymer processing, Elastomers, properties and applications of engineering polymers. Composite materials, Classification & Types of composite, Properties & applications, Metal matrix composite, Ceramic matrix composite, Fiber Reinforced plastic, laminates surface coated materials, Numerical based on composite (isostress & isostrain conditions).

Unit 2: Introduction to Advanced Material (08 hrs.)

Classification of biomaterials - Comparison & properties of some common biomaterials, Metallic, Ceramic and Polymeric implant materials, Introduction to bio sensors. Basic concepts of Nano science and technology, Properties and technological advantages of Nano materials, Carbon Nanotubes and applications. Magnetic materials: Soft & Hard Ferrites, Dielectric materials: Piezo electric and ferro electric materials and their applications, superconductors. Modern Materials for high, low temperatures and Cryogenic applications Smart materials, Shape memory alloys.

Unit 3: Corrosion and Its Prevention (08 hrs.)

Mechanism of corrosion, Classification of corrosion: General, Pitting, Crevice, Intergranular, Stress corrosion & cracking. Velocity related corrosion: Erosion, Impingement, and Cavitations corrosion. Corrosion fatigue, Hydrogen Blistering. High temperature corrosion. Corrosion prevention methods: Inhibitors, Internal & External coating, Cathodic & Anodic protection, Use of special alloys, Control over temperature & velocity, Dehydration, Improvement in design/ changes in design to prevent or control corrosion.

Unit 4: Broaching, Gear & Thread Manufacturing (08 hrs.)

Broaching: Introduction to broaching, broach tool geometry, Types of broaching machines and operations. Numerical on broach design.

Gear Manufacturing: Different Gear manufacturing Methods: Gear hobbing, Gear shaping, Gear shaving.

Gear finishing processes: Gear grinding and lapping.

Thread Manufacturing: Thread cutting, chasing and dies, milling, rolling, Thread finishing processes: grinding and lapping.

Unit 5: Precision Machining Processes (08 hrs.)

Finishing processes- Grinding, types of grinding processes, designation of grinding wheel, lapping, honing, buffing and burnishing.

Super finishing Processes-Abrasive flow machining, magnetic abrasive finishing, magnetorheological finishing, Ion beam machining.

Unit 6: Jigs and fixtures (08 hrs.)

Concept of degree of freedom, 3-2-1 principle of location, General guidelines to design Jigs, fixtures and Indexing, advantages of jig and fixtures

Jigs: Definition. Elements of jig with the types, Location guidelines, Principles of clamping, Principles of guiding element, Channel jig, Template jig, Plate jig, Angle plate jig, turn over jig, Box jig, latch type jig.

Fixtures: Definition. Elements of fixtures, Location guidelines, Principles of clamping, Principles of setting element, Turning fixture, Welding fixture, Milling fixture, Assembly and Inspection fixtures.

Text Books

1. V.D. Kodgire and S.V. Kodgire, Material Science and Metallurgy for Engineers, Everest Publishing House, Pune, 24th edition, 2008.
2. P. C. Sharma, Production Engineering, Khanna Publishers.

Reference Books

1. W.D. Callister, Jr., Materials Science and Engineering: An Introduction, John Wiley and Sons, 5th edition, 2001
2. Mechanical Metallurgy, Dieter, G.E., McGraw-Hill, 1988.
3. P. N. Rao, Manufacturing Technology Vol I & II Tata McGraw Hill Publishers
4. V. K. Jain, Advanced Machining processes, Allied Publication, New Delhi
5. M. H. A Kempster, An Introduction to Jig and Tool Design, ELBS
6. P. H. Joshi, Jigs and fixtures , Tata McGraw Hill

**T.E. Mechanical (Sandwich) - 2015 Course
(302067) Industrial Engineering and Technology Management**

Code	Subject	Teaching Scheme (Weekly Load in hrs)			Examination Scheme (Marks)						Credits	
		Lect.	Tut	Pract	Theory		TW	PR	OR	Total	Th	Pr
					In Sem.	End Sem.						
302067	Industrial Engineering and Technology Management (Self Study - II)	3	--	—	30*	70	-	--	—	100	3	0
									Total	3		

COURSE OBJECTIVE

1. The student shall understand Concept of Industrial Engineering and its role in production management.
2. Student shall learn various Industrial Engineering techniques implemented in relation to production management in actual industrial practice.
3. The student shall able to undergo with various world class techniques in practice.
4. The student will be able to carry out proper selection of process for production in actual practice in industry.
5. To develop overall personality by exposing them to soft skills and professional ethics programs.
6. Student shall be able to understand industrial psychology.

COURSE OUTCOMES

1. The student will understand Concept of Industrial engineering and its role in production management.
2. The student will be good team member and project leaders to carry out projects in companies.
3. The student will display professional ethics while dealing with their colleagues at work.
4. The student will develop good inter personnel skills to deal with their superiors, peers as well as juniors.

Unit 1: Industrial engineering & organization (08 hrs.)

Industrial Engineering: History, development, definition, functions and applications of Industrial Engineering, contribution of F.W Taylor, Gilberth, Gantt and Maynard to industrial engineering, motivation and control, Maslow's hierarchy of needs,
Management concept: Basic concepts, Principles, levels, types and functions of management,
Organisation: Concept, organization Chart, principle of organisation, organization structure and types, authority and responsibility.

Unit 2: Plant layout & safety (08 hrs.)

Plant layout : Location- importance and factor affecting location, single and mutifacility location problems, Layout-Need ,importance, objectives and principles of good plant lay out, types of layouts and applications, Material Handling- Objectives , functions, principles of material handling, types of material handling equipment and selection.
Industrial safety: Safety organization, safety program and safety rules, factories act, industrial dispute act, workmen's compensation act.

Unit 3: PPC & Inventory (08 hrs.)

PPC and Inventory: Functions of PPC, work order preparation material planning, Bill of materials, Material requirement planning (MRP), Moving average method, Exponential smoothing, capacity planning, Inventory control and classification-objectives of inventory control, EOQ(Numerical), inventory models, ABC,FMS,VED analysis.

Unit 4: Work Study (08 hrs.)

Method Study: Introduction, steps, tools and techniques used in method study, Recording of facts, Process chart, symbols, flow diagrams, Two hand chart, Multiple activity chart, 5W&1H. use of motion pictures and analysis ,critical examination, selection of job, maintenance of proposed method, SIMO charts, importance of ergonomics in industry.

Work Measurement : Time Study: Aim and objectives, use of work measurement data, techniques of work measurement, Time study procedures, Time study forms, Performance rating, allowances and types, calculation of standard time. Work Sampling, Procedure.

Unit 5: Process Planning (08 hrs.)**Process Planning**

Introduction- Role of Product Engineering department, Phases of process planning, process planning concept and procedure, make or buy decision, process selection and procedure, process chart, Introduction to group technology

Network Analysis: Network technique, terminology, PERT, CPM, comparison and simple numerical.

Unit 6: Technology Management (08 hrs.)

Technology Management : Concept and meaning of technology, evolution and growth of technology, role and significance of management and technology, impact of technology on society and business, forms and technology, process technology and product technology. Competitive advantages through new technologies: product development, from scientific breakthrough to marketable product – role of government in technology development. Linkage between technology, development and competition, managing research and development (R& D) managing intellectual property.

Text Books

1. Prof L C Jhamb, "Production(Operations) Management, Everest Publishing house
2. Mukherjee & Kachwala, "Operations Management & Productivity Tech", Prentice Hall of India
3. M. Mahajan, "Industrial Engineering & Production Management", Dhanpat Rai and Company
4. P. Rama Murthy, "Production & Operation Management", New Age Internation (P) Ltd.
5. Banga ans Sharma,"Industrial Organisation and Engineering Economics", Khanna Publishers.
6. Adam EE & RJ Ebert, "Production and operation management:, Prentice Hall
7. Riggs. J. L., "Production system, planning, analysis and control", John Weily and sons
8. James Dilworth, "Production and operation management", McGraw Hill Book Company, New York.
9. Martand Telsang, "Industrial Engineering and Production Management", S Chand & Co, New Delhi
10. Janat Shah, Supply Chain Management - Text and Cases, Pearson Education, 5th edition, 2012.
11. Sunil Chopra and Peter Meindl, Supply Chain Management-Strategy Planning and Operation,PHI Learning / Pearson Education, 5th edition.