Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information

Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	6PR501
Course Name	Manufacturing Processes
Desired Requisites:	Basic Knowledge of Manufacturing Processes

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial		30	20	50	100
		Credits: 3			

Course Objectives

1	To impart the fundamentals knowledge of metal forming and metal cutting processes such as casting, forging, rolling, extrusion, wire drawing, deep drawing, turning milling, etc.
2	To make the students familiar with the recent developments in metal forming and cutting processes.
3	To prepare the student to select the appropriate forming and cutting process with equipment and tooling.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Distinguish various metal forming and cutting processes with desired quality and maximum yield.	II	Understanding
CO2	Use appropriate modern equipment's, process parameters, and techniques in metal forming and cutting processes.	III	Applying
CO3	Design of dies, mold's, tooling etc. required for metal forming and cutting processes.	VI	Creating

Module	**Module Contents**	**Hours**
I	Study of various forming and metal cutting processes, their special features with respect to other manufacturing processes. Hot, cold and worm working. Recrystallization, strain hardening and Bauschinger effect in metal working. Parameters affecting the formability. Foundry infrastructure, its merits and limitations. Advantages of casting. Types of pattern materials, sand, binder, resins, fluxes and their properties.	7
II	Sand preparation and reclamation. High pressure and flaskless molding. Furnaces used and their selection criteria. Pattern mould, feeder, gating design and analysis. Casting defects and remedial measures. Salvaging of casting. Costing of castings.	7
III	Forging: classification, equipment's, process variable in forging, Forgability of metals, , forging defects ; Rolling: Classification, rolling equipment, hot and cold rolling, rolling of bars and shapes, camber in rolling defects, variables in rolling. Applications, limitations, defects and their remedies.	7
IV	Extrusion: Classification, extrusion equipment, load displacement, characteristics, process variables and their optimization, different extrusion dies extrusion defects, tube extrusion; Wire drawing: Study of wire drawing processes and process variables, applications, limitations, defects and their remedies.	7

V	Sheet metal forming: Formability of sheets, formability tests, principles of deep drawing, redrawing ironing and sinking, stretch forming, hydro-forming, spinning, bending, sheet metal forming defects. Forming Limit Diagram (FLD) diagrams. Recent developments in metal forming.	7
VI	Metal Cutting Technology: Introduction to metal cutting - tool nomenclature and cutting forces -thermal aspects of machining - tool materials - tool life and tool wear - traditional and non-traditional machining – high speed machining, machining of difficult to cut materials.	7

Textbooks	
1	Dharmendra Kumar, S.K. Jain, "Foundry Technology", CBS Publishers and Distributors, New Delhi, First Edition 1994, Reprint 2007, ISBN – 81 – 239 – 0290 – 5.
2	B. L. Juneja, "Fundamentals of Metal Forming Processes", New Age International Pvt. Ltd. Publisher, 2nd Edition, 2010, ISBN : 9122430899.
3	Amitabha Ghosh, Ashok Kumar Mallik, "Manufacturing Science", East-West Press (Pvt.) Ltd, 2nd Edition, 2010, ISBN : 9788176710633.
4	Bhattacharya "Metal Cutting Theory and Practice", New Central Book Agency (p) Ltd., Calcutta1984.
5	Boothroyd .D.G. and Knight. W.A "Fundamentals of Machining and Machine tools", Marcel Dekker, New York, 1989.
References	
1	E. Paul DeGarmo, J.T. Black, Ronald A. Kosher, "Materials and Processes in Manufacturing" PHI Publication, 8th Edition 1997, ISBN – 81–203–1243–0.
2	P. N. Rao, "Manufacturing Technology- Foundry, Forming and Welding", Tata McGraw-Hill, New Delhi, Third edition, 2009, ISBN– 13–978– 0 – 07 – 008798 – 9.
3	P.L. Jain, "Principles of Foundry Technology", Tata McGraw-Hill, New Delhi, 2nd Edition, ISBN – 0–07– 451698–1.
4	Metals Handbook. Vol. 16, Machining. Materials Park; OH: ASM International, 1995.
5	Kalpakjian, S "Manufacturing Process for Engineering Materials", MA:Addison-Wesley, 1997.
Useful Links	
1	https://nptel.ac.in/courses/112/107/112107144/
2	https://nptel.ac.in/courses/112/105/112105127/
3	https://onlinecourses.nptel.ac.in/noc21_me30/preview

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1		2	3			
CO2			2	3		
CO3				2	3	
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information	
Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	6PR502
Course Name	Advanced Joining Technology
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial		30	20	50	100
		Credits: 3			

Course Objectives	
1	To impart knowledge of permanent joining processes and their applications.
2	To develop the student to select the proper welding process.
3	To develop problem-solving skills through the use of weld design and welding quality.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Distinguish conventional and modern welding processes.	II	Understanding
CO2	Exploit the methodology for optimized choice of material, consumables, welding process and parameters for weld quality	III	Applying
CO3	Investigate physics, chemistry and metallurgy of welding for weld quality/ defects reduction.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	Introduction, Importance and application of welding, classification of welding process. Selection of welding process. Welding vs. other Joining processes, Weld joints, weld symbols, Joint design.	6
II	Brief review of conventional welding process, Gas welding, Arc welding, MIG, TIG welding. Resistance welding. Electro slag welding, Friction welding, Friction Stir Welding-Metal flow phenomena, tools, process variables and applications, Friction Stir Processing- Process, Application, Heat affected zone.	7
III	Advanced welding Techniques, Principles, working and applications of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding, Diffusion bonding, Atomic hydrogen welding, Explosive welding, Underwater welding, Spray-welding, High Temperature Solid-State Welding.	7

IV	Physics and Metallurgy of Welding, General considerations, structure of the weld metal, weld composition, HAZ, Weldability, Fracture behaviour, Weldability tests, Welding residual stresses - causes, occurrence, effects and measurements - thermal and mechanical relieving; types of distortion - factors affecting distortion - distortion control methods. Soldering: Techniques of soldering, solders, phase diagram, composition, applications Brazing: Wetting and spreading characteristics, surface tension and contact angle concepts, brazing fillers, role of flux and characteristics, atmospheres for brazing, adhesive bonding Cladding, Surfacing and Cutting.	8
V	Welding of Specific Alloys, Welding of Cast Iron, Copper alloys, Al alloys, Stainless steels, Dissimilar metals, Welding of heat resistant alloys.	6
VI	Joint Evaluation and Quality Control, Overview of Weld Discontinuities, Inspection of Welded Joints, Acceptance standards, quality assurance and quality control, Reliability.	6

Textbooks	
1	N.K.Srinivasan, Welding Technology, Khanna Publishers, Fourth Edition, 2005.
2	Parmer, Welding Processes and Technology, Khanna Publishers, second edition, 2003.
3	Little R L,Welding and Welding Technology, Tata McGraw Hill Education Private Limited, 1stst Edition, 2005.
4	Mishra. R.S and Mahoney. M.W, Friction Stir Welding and Processing, ASM, 200.

References	
1	Howard B. Cary, Modern Welding Technology, Prentice Hall NJ, Fourth Edition, 1998.
2	Robert W. Messler Jr., Principles of Welding: Processes, Physics, Chemistry and Metallurgy, WILEY-VCH, Verlag GmbH & Co. KGaA, 2004.
3	Thomas Lienert, ASM Handbook, Volume 6a: Welding Fundamentals and Processes, ASM International, 2012.

Useful Links	
1	https://nptel.ac.in/courses/112/103/112103244/
2	https://nptel.ac.in/courses/112/107/112107213/
3	https://onlinecourses.nptel.ac.in/noc20_me65/preview

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2			3		
CO2			2		3	
CO3				2	2	

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	6PR551
Course Name	Research Methodology
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture		**LA1**	**LA2**	**ESE**	**Total**
Tutorial		30	30	40	100
Interaction	2 Hrs/week	**Credits: 2**			

Course Objectives

1	To develop a research orientation among the students and to acquaint them with fundamentals of research methods
2	To develop understanding of the basic framework of research process and techniques.
3	To identify various sources of information for literature review and data collection.
4	To develop an understanding of the ethical dimensions of conducting applied research.
5	To develop understanding about patent process.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	**Identify** various methods to solve research problem.	III	Applying
CO2	**Construct** a research problem in respective engineering domain	III	Applying
CO3	**Investigate** various data analysis techniques for a research problem.	IV	Analyzing
CO4	**Author** the survey paper based on literature review for research problem.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Research Fundamentals** What is research? Literature survey and review, types of research, the process of research. Formulation of a research problem, Experimental design, Classification. Theoretical research, Formulating a problem, verification methods, modeling and simulations, ethical aspects	4
II	**Research Methods** Steps in conducting research, Research Problem identification, Probable solutions, verification of the proposed methodology, conclusions. Meaning, Need and Types of research design, Research Design Process, Measurement and scaling techniques, Data Collection – concept, types and methods, Processing and analysis of data, Design of Experiment	5

III	**Analysis Techniques** Quantitative Techniques Sampling fundamentals, Testing of hypothesis using various tests like Multivariate analysis, Use of standard statistical software, Data processing, Preliminary data analysis and interpretation, Uni-variate and bi-variate analysis of data, testing of hypotheses, techniques such as ANOVA, Chi square test etc., Nonparametric tests. Correlation and regression analysis	5
IV	**Research Communication** Writing a conference paper, Journal Paper, Technical report, dissertation/thesis writing. Presentation techniques, software used for report writing such as WORD, Latex etc. Types of journal/conference papers	4
V	**Intellectual Property Rights** Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	5
VI	**Patents and Patenting Procedures** Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs	4

Textbooks	
1	C. R. Kothari, Research Methodology Methods and Techniques, New Age international, 2nd Edition, 2009
2	*Deepak Chopra and Neena Sondhi, Research Methodology* : Concepts and cases, Vikas Publishing House, New Delhi 2008
References	
1	E. Philip and Derek Pugh, How to get a Ph. D. – a handbook for students and their supervisors, Open university press,5th Edition,2010
2	Stuart Melville and Wayne Goddard, Research Methodology: An Introduction for Science & Engineering Students, Kenwyn, South Africa : Juta & Co. Ltd., 1996.
Useful Links	
1	https://youtu.be/rz30rRfManE
2	https://youtu.be/vKVFZfwIEDg
3	https://youtu.be/UZq_QStxsak
4	https://youtu.be/5fvpsqPWZac

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2		1			
CO2					2	2
CO3				2		
CO4		2				
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M. Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6PR545
Course Name	Production Engineering Laboratory 1
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	4 Hrs/Week	**LA1**	**LA2**	**ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 2			

Course Objectives

1	To provide advanced knowledge and expertise in order to produce creative and imaginative engineers with a strong scientific acumen.
2	To develop ability through hands-on experience for implementing modern methods, techniques and best practices in manufacturing.
3	To make aware about current scenario and facilitate with modern trends which are tending towards their own area of interest.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Demonstrate and illustrate various manufacturing and Joining technologies.	III	Applying
CO2	Investigate and justify various manufacturing and joining processes.	IV	Analyzing
CO3	Develop and recommend the optimum resources in manufacturing and joining area.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of Manufacturing process and Advanced Joining Technology.

Textbooks

1	As per the course details

References

1	As per the course details

Useful Links

1	https://nptel.ac.in/courses/112/105/112105126/
2	https://nptel.ac.in/courses/112/104/112104162/
3	https://nptel.ac.in/course.html
4	https://nptel.ac.in/courses/112/107/112107213/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1			1		2
CO2	1		1		2	1
CO3		2				1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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Course Information	
Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	6PR511
Course Name	Finite Element Methods In Manufacturing
Desired Requisites:	Basic Knowledge of Matrix Transformation

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	# Hrs/week	30	20	50	100
		Credits: 3			

Course Objectives	
1	The objective of the course is to teach the fundamentals of finite element method with emphasize on the underlying theory, assumption, and modeling issues as well as providing hands on experience using finite element software to model, analyze and design systems of mechanical and production engineers

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain basic procedure of finite element analysis.	II	Understanding
CO2	Apply FEM procedure to solve different mechanical or production engineering problems.	III	Applying
CO3	Formulate different mathematical models for static- linear and non-linear analysis.	IV	Analyzing
CO4			

Module	**Module Contents**	**Hours**
I	**Introduction** Physical problem, Mathematical Modeling and Finite Element Solutions, FEM as integral part of Computer Aided Design.	6
II	**General Procedure Used In FEM** Discretization, Formulation, Solving and Post processing, Mesh refinement, combined load analysis.	7
III	**Mathematical Formulation** Types of 2D and 3D Elements and their properties, types of shape functions (Langragian and Hermite), Principal of virtual work and principle of minimum potential energy, concentrated mass and lumped mass formulation, principle of minimization–weighted residual and variational methods, imposing of boundary conditions, formulation for isoperimetric elements, cylindrical coordinate system, spherical coordinate system.	7
IV	**Static analysis and dynamic analysis** Direct stiffness method, Plain stress and strain elements, axisymmetric elements, non-linear analysis, composite materials, time dependent loads, determination of temperature distribution and thermal stresses, introduction to dynamic analysis of structure.	6

V	**Application of FEA in Manufacturing Processes** Application of FEA in metal casting, cutting, metal forming and welding, moulds and dies. Finite Element Solution in forming processes. Sheet Forming Analysis and Sheet-Metal Formability Tests.	7
VI	**Computer implementation of FE procedure** Various interactive methods used in static and dynamic analysis, inter-elemental continuity, convergence rate, refinement of FE solution, Validation of FE solutions, review of software in FEM, coupled field analysis.	6

Textbooks	
1	S.S. Rao., "Introduction to Finite Element in Engineering", Elsevier, New Delhi, 4th Edition-2006.
2	T.R. Chandrupatla. "Introduction to Finite Element in Engineering", Prentice Hall, New Delhi, 2nd Edition1997.
3	M. J. Fagan, "Finite Element Analysis", Pearson, 1992.

References	
1	J.N. Reddy. "Introduction to Finite Element", PHI, New Delhi, 1st Edition, 1st Reprint- 2009.
2	Klaus Jurgen Bathe," Finite Element Procedures", Prentice Hall, 1st Edition- 1995.
3	S. S. Bhavikatti, "Finite Element Analysis", New Age International Publishers, 2005.

Useful Links	
1	https://nptel.ac.in/courses/112/104/112104193/
2	https://nptel.ac.in/courses/112/103/112103295/
3	https://ocw.mit.edu/resources/res-2-002-finite-element-procedures-for-solids-and-structures-spring-2010/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2					3
CO2				2		3
CO3					3	2

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	6PR512
Course Name	Industrial Hydraulics and Pneumatics
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial		30	20	50	100
		Credits: 3			

Course Objectives

1	To impart the basic knowledge of principles and working of various hydraulic and pneumatic systems.
2	To make the student aware of recent developments in hydraulics and pneumatics.
3	To enable the student to design the hydraulic and pneumatic system for various applications.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Demonstrate the applications of hydraulic and pneumatic systems.	III	Applying
CO2	Identify the different components for hydraulic and pneumatic circuits.	IV	Analyzing
CO3	Design and build circuits for industrial applications.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Introduction to fluid power** Introduction to hydraulic- pneumatics system, ISO / JIC Symbols used in fluid power, Hydraulic fluids and their properties, Selection of fluid for hydraulic systems, Effect of temperature on fluids, Criterion for selection of suitable fluid power system, Details of secondary component: Strainers, filters, heat exchanger, seal, Pipes , hoses and fittings, accumulator, intensifier, jack, power.	6
II	**Hydraulic systems** Actuators, Hydraulic motor, Hydraulic cylinders and their mountings, Hydraulic Pumps and its types with details.	7
III	**Hydraulic circuits with application** Details of pressure control valve with types, Details of direction control valve with types, Details of flow control valves with types, Pilot operated pressure relief valve with industrial application, Pressure reducing valve with industrial application, Sequence valves with industrial application, Meter-in + Meter-out circuits +bleed off circuit with application, Linear and regeneration circuits with accumulator and intensifier, Maintenance, troubleshooting and safety of hydraulic systems.	7

IV	**Pneumatic systems** Basic principles and requirements of pneumatic system, Details of secondary component: filters, regulators, lubricators (FRL unit), Mufflers, dyers, piping layout, fitting and connectors, Pneumatic actuators, Rotary and reciprocating, Cylinder – types and their mountings, Details of Air motor, Compare air motor and hydraulic motor.	6
V	**Pneumatic circuits** Maintenance, troubleshooting and safety of pneumatic systems, Servicing of compressed air, Basic pneumatic circuit, impulse operation, speed control, sequencing of motion, time delay circuit, System for linear and rotary motion.	7
VI	**Electro- Pneumatic systems** Study of simple logic gates, Turbulence, amplifiers, Pneumatic sensors, applications. Applications of hydro-pneumatic systems, Hydro electrical systems, Design of various hydraulic and pneumatic circuits required for manual, semi-automatic and automatic operations, Electro- Pneumatic system with applications.	7

Textbooks	
1	S.R. Majumdar, "Oil Hydraulic Systems-Principles and Maintenance", Tata McGraw-Hill, New-Delhi, 2006.
2	S.R. Majumdar, "Pneumatic Systems: Principles and Maintenance", Tata McGraw-Hill, New-Delhi, 2006.

References	
1	D.A. Pease, "Basic Fluid Power", Prentice Hall Ltd., 1988.
2	J .J. Pipenger, "Industrial Hydraulics". McGraw-Hill Publications, 1979.
3	Goodwin, "Power Hydraulics".
4	Esposito A.P., "Fluid Power", Pearson Education Asia, 7th edition, 2005

Useful Links	
1	https://www.lunchboxsessions.com/explore/hydraulics
2	https://nptel.ac.in/courses/112/105/112105047/
3	https://engineeringvideolectures.com/video/15820

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1		2	3			
CO2			2	3		
CO3				2	3	

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	6PR513
Course Name	Quality Engineering for Manufacturing
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial		30	20	50	100
		Credits: 3			

Course Objectives

1	To impart the knowledge to students on various concepts and philosophies of quality management and engineering.
2	To develop problem-solving and creative abilities of students by using Taguchi & ANOVA techniques.
3	To make student aware of quality achievements through exploration of management techniques and tools.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply the basic concepts of modern quality philosophies, methodologies, total quality management, Taguchi's quality engineering and loss function.	III	Applying
CO2	Investigate the dependent and independent variables for a process, and use the variables to design the experiments.	IV	Analyzing
CO3	Select the statistical techniques like AOM, ANOVA, etc. for analyzing the experimental data,	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction** Need for TQM, evolution of quality, Definition of quality, TQM philosophy – Contributions of quality gurus like Deming, Juran, Crosby and Ishikawa, Different TQM models.	6
II	**TQM Principles** Customer focus, Leadership and Top management commitment, Employee involvement – Empowerment and Team work, Supplier Quality Management, Continuous process improvement, Training, Performance measurement and customer satisfaction.	6
III	**TQM Tools and Techniques** PDSA, The seven tools of quality, New seven management tools, Concept of six sigma, FMEA, Bench Marking, JIT, POKA YOKE, 5S, KAIZEN, Quality circles.	7
IV	**Quality Engineering** Perception of quality, Taguchi's definition of quality – quality loss function, Tolerance using loss function, Quality and process capability, Planning of experiments, Design principles, Terminology. Causes of variation, Classification of parameters, Parameter design strategy.	7

V	**Robust Design** Variability due to noise factors, Product and process design, Principles of robust design, Objective functions in robust design, Noise factors and testing conditions, Planning and conducting the experiment, S/N ratios , Optimization using S/N ratios, Fraction defective analysis, ANOVA, case studies	6
VI	**Optimization Techniques** Response surface methods and designs – Introduction to SRM, design and analysis of first and second order designs. Grey relations analysis - Introduction, basic concept, steps in GRA, Case study with applications	7

Textbooks	
1	Dale H. Besterfiled, "Total Quality Management", Pearson Education Asia, (Indian reprint), 2002.
2	Phadke Madhav, "Quality Engineering using Robust Design", Prentice Hall, 1989.
3	Ross, Phillip J., "Taguchi Techniques for Quality Engineering", McGraw Hill, 2nd Edition, 1996.

References	
1	Narayana V. and Sreenivasan, N. S., "Quality Management – Concepts and Tasks", New Age International, 1996.
2	Montgomery, Douglas C., "Design and Analysis of Experiments: Response surface method and designs" New Jersey: John Wiley and Sons, Inc. 2006.
3	Juran J. M. and Frank M. Gryna Jr., "Quality Planning and Analysis", TMH, India, 1982.

Useful Links	
1	https://nptel.ac.in/courses/112/107/112107259/
2	https://nptel.ac.in/courses/112/106/112106249/
3	https://onlinecourses.nptel.ac.in/noc20_me27/preview

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3			2		
CO2	2				2	
CO3	2		3			

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	Second Year M. Tech., Sem - IV
Course Code	6PR514
Course Name	Manufacturing of Non-Metallic Products
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial		30	20	50	100
		Credits: 3			

Course Objectives	
1	To impart the knowledge of non-metals and determine their applications. .
2	To prepare the student for selecting manufacturing methods for non-metallic products.
3	To develop the student for the use of common processing methods for the plastics.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Classify different types of non-metals and their processing.	III	Applying
CO2	Study the effects of various processing techniques on the properties of Non-Metals.	IV	Analyzing
CO3	Discuss the processing of ceramic materials, plastic materials, synthesis techniques for thermoset, thermoplastic, crystalline, amorphous materials, and additive manufacturing of non-metals.	V	Evaluating

Module	**Module Contents**	**Hours**
I	Introduction, Reinforcements, glass fibers, boron fibers, carbon fibers, organic fibers, ceramic fibers, non-oxide fibers.	7
II	Polymer matrix composites, processing, interfaces, structure, properties and applications of PMC'S, Recycling. Metal matrix composite, types, metallic matrices, processing, interfaces, structures, properties and application.	8
III	Ceramic matrix composites, processing, interfaces, structure, properties and applications. Carbon-carbon composites, processing, interfaces, structure, properties and applications.	8
IV	Processing of plastics, blow moulding, thermoforming, rotational moulding, injection moulding, multi material injection molding, calendaring process, and fabrication process.	7
V	Introduction to ceramics, processing of ceramics, pressing, blowing, drawing, tape casting, slip casting, extrusion, compaction.	5
VI	Additive manufacturing of non-metals, fused deposition modeling, stereolithography, binder jetting, ceramic printing.	7

Textbooks

1	Krishan K Chawla, "Composite Material: Science and Engineering", Publisher Springer/BSP Books, Second Edition, 2006.
2	Rees Rawlings, Frank Matthews, "Composite Materials" Springer, New edition, 1999.

3	Crawford, R. J. Crawford, "Plastics Engineering" Butterworth-Heinemann, Third Edition, 1998.
References	
1	John Wanberg, "Composite Materials: Fabrication Handbook", Wolfgang Publications, Third Edition, 2012.
2	Steven L. Donaldson, Daniel B. Miracle, Scott D. Henry, "ASM Handbook", Volume 21: Composites, Revised edition, 2001.
3	John Wanberg, "Composite Materials: Fabrication Handbook", Wolfgang Publications, Third Edition, 2012.
Useful Links	
1	https://nptel.ac.in/courses/112/107/112107086/
2	https://nptel.ac.in/courses/112/107/112107221/
3	https://nptel.ac.in/courses/112/104/112104221/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1						1
CO2					1	
CO3			2			
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information	
Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	6PR515
Course Name	Project Management
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	# Hrs/week	30	20	50	100
		Credits: 3			

Course Objectives	
1	To prepare the students to manage projects by exploring both technical and managerial challenges and preparing the budget. .
2	To make aware the students about leadership and ethical qualities in dealing with real life project.
3	To induce qualities for working in interdisciplinary and cross functional teams with effective communication skills, economical and managerial challenges and commercial management.
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Grasp and perceive the project activities with respect to resources required and the constraint for feasibility or completion within time	II	Understanding
CO2	Estimate and prepare budget for project completion, Understand commercial management.	IV	Analyzing
CO3	Figure out and schedule the project and assess for controlling critical path networks.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction to Project Management** Brief history of project management, Different types of projects, Project life cycles, Factors for success or failure during the project fulfillment (execution) period, Identifying and ranking the stakeholders, Checklists, Developing and documenting the project specification, Responsibilities of Project Manager	6
II	**Project Cost** Classification of costs as direct or indirect, Top Down and Bottom Up estimation, Estimating formats, Estimating manufacturing costs, Estimating project labour costs, Estimates for material and equipment costs, Managing Project Cost, Cost Control, Audits and fraud prevention measures. Budget uncertainty and risk management, Case studies.	8
III	**Planning, feasibility, risk** General introduction to project planning, Ideal project plan, Planning Process, Project elements (Breakdown), Project feasibility analysis, Pay back and cash flow, Project funding, Types of risks and risk management, Planning for a crisis, Managing Changes	6

IV	**Critical Path Networks** Critical path analysis, Various methods and approaches, network logic, Network analysis as a management tool, Line of balance chart, PERT and CPM, Terms used, Critical path and critical time, Gantt Chart	6
V	**Principles of Resource Scheduling, Executing and Controlling** Various resources, Role of network analysis in resource scheduling, Scheduling people and other resources, logical steps of project resource scheduling, Scheduling materials, Scheduling cash flow, Managing constraints and scarcities of resources, Estimating and Evaluation	6
VI	**Commercial Management and various regulations** Contracts, Purchase orders, Purchasing cycle, Supplier selection, Purchase requisition and order, Terms of trade used in business, Contract payment structures, Stores administration, Introduction to Factories Act, Various acts and regulations applicable to business.	7

Textbooks	
1	Dennis Lock , Project Management - Gower Publishing Limited, 2013
2	Samuel J. Mantel, Jr., Jack R. Meredith, Scott M. Shafer, Margaret M. Sutton , Project Management in Practice - JOHN WILEY & SONS, INC., 2011
3	B.C. Punmia and Khandelwal, Project Planning and Control with PERT and CPM, Lakshmi Publications Pvt. Ltd., 2001
4	HoraldKerzner, Project Management: A systems approach to planning, scheduling and controlling, John Wiley & Sons Inc., 2009
5	The factories act 1948 – Government of India

References	
1	K. Nagarajan, Project Management, New Age Int., 2nd ed. 2004.
2	B.M.Naik, Project Management-Scheduling and Monitoring by PERT/CPM, 1984.
3	William R Duncan, A guide to the project management body of knowledge, PMI Publications, 1996

Useful Links	
1	Swayam/ NPTEL Link: https://youtu.be/Wk607ruc8P0
2	Swayam/ NPTEL Link: https://youtu.be/RjOA7AxOVj8
3	Swayam/ NPTEL Link: https://youtu.be/OC-sypMsCxA
4	Swayam/ NPTEL Link: https://youtu.be/RQNZWCl6eXI

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2				2	
CO2			2			3
CO3					2	2
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	6PR516
Course Name	Design for Manufacture and Assembly
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial		30	20	50	100
		Credits: 3			

Course Objectives

1	To make student aware for various factors influencing manufacturing of components and the use of tolerances in manufacturing.
2	To introduce the concept and application for DFMA to practicing designers and manufacturing engineers.
3	To discuss various fundamentals of assembly and design recommendations for product development.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply a systematic understanding of knowledge in the field of metal casting and forging and other processes.	III	Apply
CO2	Integrate the knowledge of compliance analysis and interference analysis for assembly and also use viscoelastic and creep in plastics.	IV	Analyze
CO3	Outline the appropriate design for economical production and select the materials for various machining and metal joining processes..	V	Evaluate

Module	**Module Contents**	**Hours**
I	**Introduction** (A) Introduction to DFMA, Introduction to Manufacturing Process, Mechanical properties of material, Introduction to materials and material selection. (B) Sand casting, Investment casting, Die casting, Injection moulding, Design for powder metal processing	7
II	**Design Parameters** Design for: Machining, Tuning operation, Machining round holes, Broached parts. Parts produced by milling, Parts produced by planning, Shaping and slotting.	6
III	**Processes** Metal Extrusion, Metal stamping, Fine blanked parts, Rolled formed section, Impact or cold extrusion, Forward extrusion, Design for Forging, Metal injection moulded parts.	7

IV	**Advanced Processes** (A) Design for: Cleaning, Polishing and plating, Plated surface, Heat treatment. (B) Hot dip metallic coating, Thermal sprayed coating, Vacuum metalized surfaces.	6
V	**Welding** Introduction to welding process, Design for: Welding, Solder and brazed assembly, Adhesively bonded assemblies.	6
VI	**Assembly** (A) Introduction to Assembly, Design for Assembly and Fasteners. (B) Introduction to CAD, Extraction of part feature information from CAD Model, Extraction of assembly feature information from CAD Model, Examples of assembly feature extraction: Aircraft wing and automotive chassis assembly	7

Textbooks	
1	A. K. Chitale and R. C. Gupta, (1999) Product design and Manufacturing, Prentice Hall of India, New Delhi.
2	James G. Bralla (1998) Design for Manufacturability Handbook, Second Edition, McGraw-Hill companies, New York, USA
3	Geoffrey Boothroyd (2005) Assembly Automation and Product Design, Second Edition, CRC press, Taylor & Francis, Florida, USA
4	G. Q. Huang (1996) Design for X, Concurrent Engineering Imperatives, First Edition, Chapman & Hall, London, UK

References	
1	J. Lesko,(1999) Industrial Design, Materials and Manufacture Guide, John Willy and Sons, Inc
2	George E. Dieter and Linda C. Schmidt (2009),Engineering Design, Fourth edition, McGraw-Hill companies, New York, USA
3	Geoffrey Boothroyd, Peter Dewhurst and Winston Knight (2002) Product Design for Manufacture and Assembly, Second Edition, CRC press, Taylor & Francis, Florida, USA
4	O. Molloy, S. Tilley and E. A. Warman (1998) Design for Manufacturing and assembly, First Edition, Chapman & Hall, London, UK.

Useful Links	
1	NPTEL web contents: https: //nptel.ac.in/courses/107/103/107103012/
2	Swayam/ NPTEL Link: https://youtu.be/vEPpKjIdpt0
3	NPTEL web contents: https://nptel.ac.in/courses/112/101/112101005/
4	Swayam/ NPTEL Link: https://youtu.be/0TQCjgE4a6s

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1			2			1
CO2				1		
CO3				1		1

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information

Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	6PR517
Course Name	Precision Engineering
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial		30	20	50	100
		Credits: 3			

Course Objectives

1	To make student aware of the basic requirements of machine tools, fundamentals of precision machining and the recent developments in precision machining processes.
2	To prepare the student for selection of appropriate process considering the advantages, limitations, cost economy, etc.
3	To develop the skills for optimization of process parameters in precision engineering.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Choose the appropriate machining process for precision components.	III	Applying
CO2	Study the appropriate geometrical features and tolerances for precision components.	IV	Analyzing
CO3	Justify the use of modern equipment's, techniques, and tools in precision machining.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Precision Engineering** Definition, difference in precision and accuracy, need for high precision, Classes of achievable machining accuracy – normal, precision, high precision and ultra-precision machining; Concept of accuracy – part accuracy, errors of form, errors in flat surface and errors in relative location of surfaces, machining accuracies and the processes. Applications of Precision Manufacturing, Micro electro mechanical devices and applications, Future scope of precision manufacturing.	6
II	**Geometrical Dimensioning and Tolerance** Geometrical tolerances, tolerance zones – form, location and orientation of tolerance zones, Datum and precedence – primary, secondary and tertiary, Positional tolerances – zones, form; Combination of dimensional coordinate tolerance and positional tolerance, Defining substitute elements (best fit elements) from measured coordinates; Maximum Material Requirements and Minimum (Least) Material Requirements, their applications; Accumulation of tolerances (tolerance stacking)	7

III	**Machine Tools and Accuracy** General concept of accuracy of machine tool, spindle rotation accuracy, displacement accuracy, the philosophy of precision machine design, sources of error on a machine tool, factors affecting work piece accuracy from the point of view of machine design, Accuracy of CNC machines – errors due to input interpolation and servo system; Thermal errors- Sources and transmission of thermal errors in precision machining, error avoidance and compensation, environment control of precision machinery- machine enclosures, room and factory enclosures.	7
IV	**Tool Materials for Precision Machining** Classes of tool materials and their properties, coated carbides- laminated, CVD and PVD coated carbides, Cermets, Ceramics - hot pressed, Silicon Nitride and whisker reinforced ceramics, Diamonds – crystallographic planes, natural and synthetic diamonds, polycrystalline diamonds, diamond coated tools, Cubic boron nitrides (CBN), coated CBNs, Tool and work material compatibility and availability	6
V	**Processing and Accuracy** Dimensional wear of cutting tools and its influence on accuracy, clamping and setting errors, errors due to location; Surface roughness and microfininshing processes – Terminology, influence of machining parameters on surface roughness, Honing, lapping and super finishing, Process capability – mean, variance, skewness, process capability metrics, Cp, Cpk, Methods for improving accuracy and Surface finish.	7
VI	**Precision Machining Processes** Classification of material removal processes in terms of the energy source used and the tool-work piece reaction, influence of machining parameters, work material and tool geometry, Diamond turning and milling – machines, tool design and alignment, Fixed abrasive processes - Basic mechanics of grinding, finish grinding, precision cylindrical, internal and surface grinding bondless diamond grinding wheels, jig grinding, electrolytic in-process dressing, Ultra-precision grinding, nano-grinding; Loose abrasive processes – polishing, modes of material removal. Study of some precision measurement devices, their calibrations methods	7

Textbooks	
1	Murty, R. L. (2009), - Precision Engineering in Manufacturing, (New Age International Publishers) ISBN: 81224-0750-1.
2	Venkatesh, V.C. and Izman, S. (2007), - Precision Engineering, (TMH), ISBN: 0-07-062090-3.
3	G. Henzold, (2006), 2/e, - Geometric Dimensioning and Tolerancing for Design, Manufacturing and Inspection, (Butterworth Heinemann – Elsevier Ltd.), ISBN: 0-7506-6738-9.

References	
1	Murty, R. L. (2009), - Precision Engineering in Manufacturing, (New Age International Publishers) ISBN: 81224-0750-1.
2	Venkatesh, V.C. and Izman, S. (2007), - Precision Engineering, (TMH), ISBN: 0-07-062090-3.
3	G. Henzold, (2006), 2/e, - Geometric Dimensioning and Tolerancing for Design, Manufacturing and Inspection, (Butterworth Heinemann – Elsevier Ltd.), ISBN: 0-7506-6738-9.
4	Murty, R. L. (2009), - Precision Engineering in Manufacturing, (New Age International Publishers) ISBN: 81224-0750-1.

Useful Links	
1	https://nptel.ac.in/courses/112/104/112104028/
2	https://nptel.ac.in/courses/112/105/112105126/
3	https://nptel.ac.in/courses/112/107/112107144/
4	https://nptel.ac.in/courses/112/104/112104028/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1			2			3
CO2			1	1		1
CO3			3	1		3
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	6PR518
Course Name	Costing and Cost Control
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial		30	20	50	100
		Credits: 3			

Course Objectives

1	Calculation of cost of different parameters involved in product manufacturing.
2	To make student aware for the technical underpinning of engineering economic analysis.
3	To develop the skills for analytical techniques to a wide variety of real world problems and data sets.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Demonstrate how materials, labor and overhead costs are added to a product at each stage of the production cycle.	III	Applying
CO2	Analyze the basic cost flow model and be able to assign costs in a job cost system.	IV	Analyzing
CO3	Formulate overhead using predetermined rates and activity-based costing and use of software for cost optimization.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Introduction** (A) (i) Concept of cost, cost unit, cost center, classification of cost, different costs for different purposes. (ii) Definition of costing, cost-price-profit equation, desirable conditions for a costing system. (B) Cost Estimating: Definition, purpose and functions of estimation, role of estimator, constituents of estimates, estimating procedures.	6
II	**Estimation of Weight and Material Cost** (A) (i) Process of breaking down product drawing in to simpler elements or shapes, estimating the volume, weight and cost (ii) Review of purchasing procedure, recording of stock and consumption of material by LIFO, FIFO, Weighted average method	6
III	**Estimation of fabrication cost** (A) Constitutes, direct cost, indirect cost, Procedure of estimation of fabrication cost; (B) Estimation of foundry cost: Constitutes, direct cost, indirect cost, Procedure of estimation foundry cost (C) Estimation of forging cost: Constitutes, direct cost, indirect cost, Procedure of estimation of forging cost. (D) Estimation of machining cost: Constituents, direct cost, indirect cost, Procedure of estimation of machining cost.	7

IV	**Costing Parameters** (A) Machine hour rate: definition, constituents, direct cost, indirect cost, steps for estimation of machine hour rate for conventional machines, CNC lathe and machining center. (B) Labour Cost – Direct and indirect labour, Workmen classification, Definition of wages, Methods of remuneration. (C) Overheads: Elements of overheads, classification, general considerations for collection, analysis of overheads, different methods for allocation, apportionment, absorption of overheads.	7
V	**Methodologies** (A) Cost Accounting Methods: Job costing, Batch costing, Unit costing, Process costing, Contract costing, Activity based costing. (B) Cost Control: Use of cost data for policymaking and routine operation, control techniques such as budgetary control, standard cost, variance analysis, marginal cost and break even analysis.	7
VI	**Cost Reduction Areas** Procedures and systems in product, methods and layouts, administrative and marketing, rejection analysis, cost of poor quality, value analysis and value engineering, Zero Base Budgeting	6

Textbooks	
1	Principles and Practice of Cost Accounting – N. K. Prasad (Book Syndicate Pvt. Ltd.), 1979
2	Costing Simplified: Wheldom Series – Brown & Owier (ELBS), 1970
3	A Text Book of Estimating and Costing Mechanical – J.S. Charaya & G. S. Narang, Satya Prakashan, 1985
4	Mechanical Estimation and Costing, B.P. Sinha, Mc. Graw Hill, 1985
5	Theory & Problems of Management and Cost Accounting – M.Y. Khan, P. K. Jain , Tata McgrawHill Publishing Company Limited, 2001

References	
1	Gregory K. Mislick, "Cost Estimation: Methods and Tools", Wiley, 1st edition, 2009.
2	Phillip F. Ostwald, Timothy S. McLaren, Cost Analysis and Estimating for Engineering and Management, 1st edition, Pearson/Prentice Hall, 2004

Useful Links	
1	Swayam/ NPTEL Link: https://youtu.be/_z4-7xr6ur8
2	NPTEL web contents: https://nptel.ac.in/courses/110/101/110101004/
3	Swayam/ NPTEL Link: https://youtu.be/Paecdg2_fb4
4	Swayam/ NPTEL Link: https://youtu.be/eUMwwp5zDW0

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1						2
CO2					2	1
CO3	2			1		

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - I
Course Code	6PR546
Course Name	Production Engineering Laboratory 2
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	4 Hrs/Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction		30	30	40	100
		Credits: 2			

Course Objectives

1	To provide advanced knowledge and expertise in order to produce creative and imaginative engineers with a strong scientific acumen.
2	To develop ability through hands-on experience for implementing modern methods, techniques and best practices in manufacturing.
3	To make aware about current scenario and facilitate with modern trends which are tending towards their own area of interest.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Demonstrate and illustrate various manufacturing and Project Management activities.	III	Applying
CO2	Investigate and justify various manufacturing and Design for Manufacturing and Assembly activities.	IV	Analysing
CO3	Develop and recommend the optimum resources in manufacturing and Precision Engineering.	VI	Create

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of Finite Element method in Manufacturing/ Industrial Hydraulics and Pneumatics/ Quality Engineering for Manufacturing/ Manufacturing of non metallic products/ Project Management/ Design for Manufacturing and Assembly/ Precision Engineering/ Costing and Cost control.

Textbooks

1	As per the course details

References

1	As per the course details

Useful Links

1	https://nptel.ac.in/courses/112/105/112105126/
2	https://nptel.ac.in/courses/112/104/112104162/

3	https://nptel.ac.in/course.html
4	https://nptel.ac.in/courses/112/107/112107213/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1			1		2
CO2	1		1		2	1
CO3		2				1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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Course Information

Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - II
Course Code	6PR521
Course Name	Advanced Manufacturing Processes
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial		30	20	50	100
		Credits: 3			

Course Objectives

1	To impart the knowledge of the fundamentals in machining processes, traditional and non-traditional machining processes, development of miniature components.
2	To prepare the student for the use of the recent developments in micro and non-traditional machining processes and measurement techniques in micromachining.
3	To develop the student for selection of appropriate process considering the advantages, limitations, cost economy, etc.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Distinguish the process parameters and operations in various traditional and non-traditional machining processes.	III	Understanding
CO2	Identify appropriate machining process for miniaturized components.	IV	Analyzing
CO3	Recommend modern equipment's, techniques, tools and methodology for micro features.	V	Evaluating

Module	**Module Contents**	**Hours**
I	Introduction of traditional and non-traditional machining processes, need for non-traditional machining processes. Introduction of micromachining technology. Advances in machining technology, characterization of micro-machining. Micro-machinability of materials.	7
II	Micro-Turning: tools, process results and applications, Micro-milling: tools, process results and Micro-milling Applications, Micro-drilling: tools, process results and applications. Forces of chip formation and surface generation in micro-cutting. Accuracy attainable in micro-cutting	7
III	Diamond micro-machining, abrasive micromachining and micro-grinding process, working principle, accuracy and dimensional control, industrial applications. Micro-machining by finishing techniques such as micro-lapping, micro-honing, Super finishing processes such as magneto abrasive micromachining and finishing (MAF).	7
IV	Ultrasonic micro-machining, working principle, effect of process variables on removal rate, accuracy and tolerances in USMM, Micro-EDM, Micro-WEDM, Micro-ECM, Electro chemical grinding (ECG), working principle and applications.	7

V	Laser micro-machining, principles of laser material removal, machining equipment and tools used, laser micro-drilling, laser micro-adjustment, laser surface structuring, laser micro-cutting. Water jet machining (WJM), Hybrid machining processes - Introduction, the machining system, Process parameters, Applications, Advantages and disadvantages.	7
VI	Measuring Techniques in micro-machining: on-line measurement by machine vision and integrated probe, stylus instruments, scanning tunneling microscopes, atomic force microscope, measurement of micromoles and slots using optical method, surface integrity and other related measurements.	7

Textbooks	
1	J. M. Geough, Micro-machining of Engineering Materials, Edited by Marcel Dekker, 2002.
2	R.W. Johnstone, M. Parameswaran, An introduction to surface-micromachining, Kluwer Academic Publishers, 2004.
3	V. K. Jain, Introduction to Micromachining, Alpha Science, 2010, ISBN 1842654853, 9781842654859

References	
1	N. P Mahalik. Micro-manufacturing and nano-technology, edited by, Springer Publication, 2006.
2	M. P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, 2003.
3	Amitabha Ghosh, Asok Kumar Mallik, "Manufacturing Science", East-West Press (Pvt.) Ltd, 2nd Edition, 2010, ISBN : 9788176710633.
4	El-Hofy, Hassan Abdel-Gawad, "Advanced Machining Processes:Nontraditional And Hybrid Machining Processes", McGraw-Hill, 2005.

Useful Links	
1	https://nptel.ac.in/courses/112/107/112107078/
2	https://nptel.ac.in/courses/112/107/112107077/
3	http://www.nptelvideos.in/2012/12/advanced-machining-processes.html

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2				
CO2		2	3			
CO3			2	2	2	

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - II
Course Code	6PR522
Course Name	Industrial Automation and Mechatronics
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial		30	20	50	100
		Credits: 3			

Course Objectives	
1	To train the students in the area of instrumentation, automation and control system.
2	To select suitable major control components required to automate a process or system.
3	To develop competent mechanical engineers with comprehensive knowledge of mechatronics to enable them to apply the relevant knowledge and technologies for the design and realization of innovative systems and products

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Outline potential areas of automation and justify need for automation.	II	Understanding
CO2	Translate and simulate a real time activity using modern tools and discuss the benefits of automation..	III	Applying
CO3	Appraise the importance of integration of Mechanical, Electronics and Control in the design of Mechatronics system.	IV	Analyzing

Module	**Module Contents**	**Hours**
I	**Introduction** Concept and need of automation, mechanization and automation , Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines. (SLE: Analysis of Transfer Lines).	6
II	**Hydraulic & Pneumatic system** Hydraulic & Pneumatic system Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatics system – Selection criteria. Hydraulic system components selection and specification characteristics – Linear actuator– construction. Reservoir capacity, heat dissipation, accumulators - standard circuit symbols, circuit (flow) analysis. Direction, flow and pressure control valves-operating characteristics-electro hydraulic servo valves-types, characteristics and performance.	7
III	**Control System** Industrial Control Systems, Process Industries Versus Discrete-Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms. Introduction to Mechatronics, Overview, Scope, Importance, Evolution, Interdisciplinary approach,	6

IV	**Sensors and Transducers** Definition and classification of transducers, Definition and classification of sensors, Various types, Principle of working of each, Applications Analog signal conditioning and processing, Operational amplifiers, Digital signal conditioning, Introduction to counters, timer, A/D converter, D/A converter Digital logic, Number systems, Logic gates, Boolean algebra, Application of logic gates, Sequential logic, Flip flop, D flip flop, JK flip flop, Master slave flip flop	7
V	**Microprocessors and Microcontrollers** General definitions of microprocessors and micro controllers, Similarities and Dissimilarities microprocessors and microcontrollers. Basic Architecture and characteristics of microprocessors, Interfacing of microprocessors with RAMs, ROMs. Introduction to peripheral-interfacing, INTEL 8085 Microprocessor: Pin Functions, Architecture, Addressing Modes, Instruction Set, Timing Diagrams, Interrupts, Programming Examples..	7
VI	**Programmable Logic Controllers** Programmable Logic Controllers (PLC) based control system, programming languages & instruction set, ladder logic, functional blocks, structured text, and applications. Human Machine Interface (HMI) & Supervisory Control and Data Acquisition System (SCADA); motion controller, applications of RFID technology and machine vision.	7

Textbooks	
1	M.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education, 1987
2	Andrew Parr, (HB), "Hydraulic and Pneumatics ", Jaico Publishing House, 1999.
3	A K Gupta & S K Sharma, "Industrial automation and robotics",Laxmi publication, 2013.
4	W. Bolton ,Mechatronics,Pearson Education , 4th Edition,
5	Mahalik ,Mechatronics ,TATA McGraw Hill, (2006) Reprint,
6	Gaokar ,Microprocessor 8085, Prentice Hall of India, 5th Edition ,
7	Hackworth, Programmable Logical Controller, Pearson Education, (2008).
8	Reis Webb ,Programmable Logical Controller ,Prentice Hall of India 5th Edition

References	
1	Krishna Kant ,Computer Based Industrial Control, EEE-PHI,2nd edition,2010.
2	Tiess Chiu Chang & Richard A. Wysk ,An Introduction to Automated Process Planning Systems
3	Viswanandham, PHI ,Performance Modeling of Automated Manufacturing Systems,-1st edition,2009.
4	Robert H. Bishop, "Mechatronics: An Introduction", CRC Press- Taylor Francis, 2006.
5	Godfrey C. Onwubolu, "Mechatronics: Principles and Applications", Elsevier, 2005.

Useful Links	
1	NPTEL web contents: https://nptel.ac.in/courses/112/103/112103174/
2	NPTEL web contents: https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod1.pdf
3	Swayam/ NPTEL link: https://youtu.be/v-3TmN4HhLc
4	Swayam/ NPTEL link: https://youtu.be/oxMdDsud5vg

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2				2	
CO2			3		2	
CO3	1				2	
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M. Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6PR571
Course Name	Production Engineering Laboratory 3
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	4 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction		30	30	40	100
		Credits: 2			

Course Objectives

1	To provide advanced knowledge and expertise in order to produce creative and imaginative engineers with a strong scientific acumen.
2	To develop ability through hands-on experience for implementing modern methods, techniques and best practices in manufacturing.
3	To make aware about current scenario and facilitate with modern trends which are tending towards their own area of interest.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Demonstrate and experiment on advanced manufacturing techniques.	III	Applying
CO2	Identify and criticize various parameters in manufacturing processes and systems.	IV	Analyzing
CO3	Design and develop various tools, equipment's using interdisciplinary skills in manufacturing area.	VI	Creating

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of Advanced Manufacturing Processes and Industrial Automation and Mechatronics.

Textbooks

1	As per the course details

References

1	As per the course details

Useful Links

1	https://nptel.ac.in/courses/112/104/112104265/
2	https://nptel.ac.in/courses/112/104/112104230/
3	https://nptel.ac.in/courses/112/104/112104162/
4	https://nptel.ac.in/courses/112/104/112104289/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2		1			
CO2					2	1
CO3	2					1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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Course Information	
Programme	M. Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem I
Course Code	6PR591
Course Name	Pre-dissertation Work and Seminar
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	4 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 2			

Course Objectives

1	To Review and increase students' understanding of the specific topics.
2	To induce Learning management of values.
3	To teach how research papers are written and read such papers critically and efficiently and to summarize and review them to gain an understanding of a new field, in the absence of a textbook.
4	To teach how to judge the value of different contributions and identify promising new directions in specified area.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply the existing knowledge on real life problems	III	Applying
CO2	Investigate the selected topic/ system.	IV	Analysing
CO3	Verify the outcomes of the work have solved the specified problems.	V	Evaluating

List of Experiments / Lab Activities/Topics

Contents:

The pre-dissertation work will start in semester II and should preferably be a problem with research potential and should involve scientific research review, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based preferably on the area in which the candidate is interested to undertake the dissertation work. The candidate has to be in regular contact with their guide and the topic of seminar/dissertation must be mutually decided. The examination shall consist of the preparation of report consisting literature review, detailed problem statement, case studies, etc, according to type of work carried out. The work has to be presented in front of the examiners panel formed by DPGC for evaluation.

Textbooks

1	Suitable books based on the contents of the dissertation/seminar topic selected.

References

1	Suitable books based on the contents of the dissertation/seminar topic selected and research papers from reputed national and international journals and conferences.

Useful Links

1	As per the need of the dissertation/seminar topic.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	2	1			
CO2	3				1	
CO3		3			2	
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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Course Information

Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - II
Course Code	6PR531
Course Name	CAD/CAM/CNC
Desired Requisites:	Basic Knowledge of Computer

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	# Hrs/week	30	20	50	100
		Credits: 3			

Course Objectives

1	To impart fundamental knowledge to students in the latest technological topics on Computer Aided Design, Computer Aided Manufacturing and Computer Aided Engineering Analysis and to prepare them for taking up further research in the areas.
2	To explain the students about use of GD&T techniques in computer based drawing.
3	To discuss capabilities of advanced CNC machine tools for manufacturing of components.
4	To prepare the students for use of CAD/CAM tools with integration of database.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Discuss various functions, capabilities and limitations of modern CNC machining centres.	II	Understanding
CO2	Use geometric dimensioning and tolerancing based on the ASME Y14.5M – 1994 standard in design and to generate proper engineering drawings.	III	Applying
CO3	Design parts in a modern parametric CAD system for manufacture on a rapid prototyping machine and/or a CNC machining system	VI	Creating

Module	**Module Contents**	**Hours**
I	-CAD/CAM Hardware: Basic structure, System configuration, software -Computer Graphics: Graphic primitives, plotting of points lines ellipse etc., 2D transformation, combination transformation, 3D transformation, co-ordinate system.	4
II	-CAD Standards: Standardisation, Graphical Kernel system, other systems -Drafting Systems: Facilities, Commands, Editing	5
III	-Geometric Modelling Techniques: Solid modelling, various features, utilities, Entities, 3D drawing, Surface modelling, Designing curved shapes	5
IV	-Conceptual Shape Design: Design process, sketching the geometry, Curve and Surface design, features for conceptual design, data transfer to other software -Analysis tools like FEM: Introduction, modelling, software details	4
V	-Introduction to CNC: NC modes, NC elements -CNC Hardware basic: Structure, Spindle design, Drives, Actuation system, feedback -CNC tooling: Material, Geometry, ATC, Process parameters	4

VI	-CNC and control system: Machining centres, Turning centres, High speed machining tools, Control unit, Support system, Touch trigger probes -CNC programming: Fundamentals, Manual part programming, Preparatory functions, Miscellaneous functions	4

Textbooks	
1	Mikell Groover, "CAD/CAM: Computer-Aided Design and Manufacturing", Pearson Education, 2008
2	Ebrahim Zeid, "CAD/CAM Theory and Practice", Tata Mc.Graw Hills, 2009
3	P. Radhakrishnan, S. Subramanyan, V. Raju, "CAD/CAM/CIM", New Age International, 2014.
References	
1	Kunwoo Lee, "Principles of CAD/CAM/CAE systems", Addison Wesley, 1999
2	Carl Machover, "The C4 handbook: CAD, CAM, CAE, CIM", Tab Professional and Reference Books
3	Khalil Taraman, "CAD-CAM: Meeting Today's Productivity Challenge", University of Michigan
Useful Links	
1	https://nptel.ac.in/courses/112/102/112102101/
2	https://nptel.ac.in/courses/112/102/112102102/
3	https://web.iitd.ac.in/~hegde/cad/lecture/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1			2			2
CO2		3				
CO3				3		2

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - II
Course Code	6PR532
Course Name	Additive Manufacturing
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To impart knowledge to the students on various processes used in additive manufacturing.
2	To develop the students to apply the knowledge of additive manufacturing to reduce the new product development life cycle.
3	To make students aware of industrial economic sectors by innovative use of additive manufacturing tools and techniques.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Choose various processes used in additive manufacturing with their advantages and limitations.	III	Applying
CO2	Identify proper material and process commonly used for additive manufacturing.	II	Understanding
CO3	Justify application of additive manufacturing in various domains.	V	Evaluating

Module	**Module Contents**	**Hours**
I	**Introduction** Overview, History, Need, Classification -Additive Manufacturing Technology in product development, Materials for Additive Manufacturing Technology, Tooling, Applications.	4
II	**CAD and Reverse Engineering** Basic Concept, Digitization techniques, Model Reconstruction, Data Processing for Additive Manufacturing Technology: CAD model preparation, Part Orientation and support generation, Model Slicing, Tool path Generation, Software for Additive Manufacturing Technology: MIMICS, MAGICS.	5
III	**Liquid Based And Solid Based Additive Manufacturing Systems** Classification – Liquid based system – Stereolithography Apparatus (SLA)-Principle, process, advantages and applications – Solid based system –Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing	5
IV	**Powder Based Additive Manufacturing Systems** Selective Laser Sintering, Principles of SLS process, Process, advantages and applications, Three Dimensional Printing, Principle, process, advantages and applications, Laser Engineered Net Shaping (LENS), Electron Beam Melting.	4

V	**Medical and Bio-Additive Manufacturing** Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing, Computer Aided Tissue Engineering (CATE), Case studies	4
VI	**Applications** Design, Concept Models, Form & fit checking, Ergonomic Studies, Functional testing, CAD data verification, Aerospace industry, Construction industry, Retail industry.	4

Textbooks	
1	LiouW.Liou, Frank W.Liou, "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
2	Ali K. Kamrani, EmadAbouel Nasr, "Rapid Prototyping: Theory and practice", Springer, 2006.
3	Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.
References	
1	T. A. Grimm & Associates, "Users Guide to Rapid Prototyping", Society of Manufacturing Engineers (SME) ISBN 0872636976, 2014.
2	J. A. McDonalds, C. J. Ryall, "Rapid Prototyping- case book", Wiley Eastern, 2013.
3	C. E. Bocking, AEW Rennie, "Rapid & Virtual Prototyping & applications", Wiley Eastern, 2011.
Useful Links	
1	Swayam/ NPTEL link: https://youtu.be/sM67ict7TVM
2	Swayam/ NPTEL link: https://youtu.be/q5c30uW96-Y
3	Swayam/ NPTEL link: https://youtu.be/_TEBKq9i9a4
4	NPTEL web contents: http://home.iitk.ac.in/~nsinha/Additive_Manufacturing%20I.pdf

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1				1		
CO2						2
CO3	2					1

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information	
Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - II
Course Code	6PR533
Course Name	Micro Electro Mechanical Systems
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To illustrate the knowledge to students on various concepts of micro electro mechanical systems.
2	To evolve towards interdisciplinary approach, to incorporate electronics, communication, information technologies and micro/nano manufacturing.
3	To develop skills, those allow students to adopt an interdisciplinary and integrated approach to engineering design

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Illustrate the concepts of micro electro mechanical system.	III	Applying
CO2	Figure out interdisciplinary approach, to incorporate electronics, communication, information technologies and micro/nano engineering.	V	Evaluating
CO3	Combine the knowledge of various disciplines to adopt an interdisciplinary approach to engineering design.	VI	Creating
CO4			

Module	**Module Contents**	**Hours**
I	Introduction to MEMS, Surface micromachining, Oxide anchored Cantilever beam, poly anchored beams.	4
II	LPCVD poly silicon deposition, doping, oxidation, Transport in PolySi, 2 and 3 terminal beams. Bulk micromachining; Wet etching –isotropic and anisotropic; Etch stop – Electrochemical etching; Dry etching; Bonding. Comparison of bulk and Surface micromachining: LIGA; SU-8; Moulding processes.	5
III	Stiction: process, in-use, Measuring stiction, Pull-in parallel plate capacitor, Pressure Sensor: piezo-resisitivity, Diffused Si, Poly porous Si, Bonding techniques, Micro to macro interfacing.	4
IV	Beams: Structure; force, moments, equation, spring constant; Stress, pull-in, pull-out; resonance freq, etc, Accelerometer. Quasistatic, capacitive, equivalent circuit; Analog; Tunnel; Thermal accelerometer, Rate Gyroscope.	5
V	Biosensor and BioMEMS; Microfluidics; Digital Microfluidics; Ink jet printer,Optical MEMS: Displays -DMDs, LGVs, active and passive components.	4

VI	RF MEMS: switches, active and passive components, Packaging; Reliability, Scaling, Other materials/ actuators, MEMS software training: COMSOL & Intellisuite, Some process technology (Litho, oxidation, etc).Applications of mems in different domain.	4

Textbooks	
1	Senturia, "Microsystems design", published by Springer Science & Business Media, 08-May-2007
2	Madou, "Microfabrication" published byTaylor & Francis, 26-Sep-1997.
References	
1	Ted Kamins, "Polycrystalline Si for integrated circuits and display", publisher: springer science and business media, 1998.
2	Gurtin, "M. An Introduction to Continuum Mechanics", Academic Press, 1982
Useful Links	
1	https://nptel.ac.in/courses/117/105/117105082/
2	https://nptel.ac.in/courses/108/106/108106165/
3	https://nptel.ac.in/courses/108/108/108108113/
4	https://nptel.ac.in/courses/112/104/112104029/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1			1			
CO2					3	
CO3					3	1

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information	
Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	Second Year M. Tech., Sem - II
Course Code	6PR534
Course Name	Modeling and Simulation in Manufacturing
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To provide the knowledge of different modeling systems employed in manufacturing and engineering enterprises.
2	To impart the recent knowledge in the broader field of simulation techniques.
3	To provide information over aspects of discrete event system simulation with particular emphasis on applications in manufacturing, services and computing.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Apply the knowledge of different modeling techniques.	III	Applying
CO2	Evaluate the alternative models for the different types of events and encounter the suitable model for the particular event.	V	Evaluating
CO3	Propose/create innovative applications/solutions by the application of modeling and simulation techniques in the arena of manufacturing engineering.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Introduction** Introduction to Simulation, Concept of system, model and simulation, Components of discrete event simulation Advantages and disadvantages of simulation.	6
II	**Concepts of Simulation** Statistical models in simulation, Probability distribution functions, Estimation of statistical parameters.	7
III	**Queueing System Simulation** Characteristic of a queueing system, Simulation of single server queueing system Internet, Generation of Random number and Random number Varieties, Testing of random numbers	6
IV	**Input Modeling** Input modeling: Estimation of parameters, Fit tests of distributions.	7
V	**Output Data Analysis** Output data analysis for single system: Statistical analysis for terminating and nonterminating simulations, Comparing alternative system configurations.	6

VI	**Validation of models** Verification, validation and credibility of simulation models, Simulation of manufacturing and material handling systems, Monte Carlo simulation, Case studies.	7

Textbooks	
1	Banks, J. and Carson, J. S., "Discrete Event System Simulation", Prentice Hall, 2009.
2	Averill, M. L., and Kelton, W.D., "Simulation, Modeling and Analysis", McGraw Hill, 2006.
3	Jerry Banks, "Handbook of Simulation: Principles, Methodology, Advances, Applications, and Practices", EMP, 1998.
References	
1	B. K. Choi, D. H. Kang, "Modeling and Simulation of Discrete Event Systems", Wiley, 2013.
2	Sanjay K. Bose, "An Introduction to Queueing Systems", Springer Science & Business Media, Dec 2013.
3	Ding Geng Chen, John Dean Chen, "Monte-Carlo Simulation-Based Statistical Modeling", ICSA Book Series in Statistics, 2017.
Useful Links	
1	https://nptel.ac.in/courses/112/107/112107220/
2	https://onlinecourses.nptel.ac.in/noc20_me37/preview
3	https://nptel.ac.in/courses/103/107/103107096/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1			3		
CO2					2	
CO3						3
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information	
Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - II
Course Code	6PR535
Course Name	Product Lifecycle Management
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	# Hrs/week	30	20	50	100
		Credits:3			

Course Objectives	
1	To prepare students to develop products by technical and managerial and software skill.
2	To make the students familiar with increased product complexity and to maintain product quality.
3	To develop skills to identify the gaps between current product development process.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Discuss the importance and the concept of Product Lifecycle Management & its need.	III	Apply
CO2	Exploit the methodology to Set the Product Lifecycle Management Vision & Develop Product Lifecycle Management strategy	IV	Analyze
CO3	Analyze the recent developments to perform product structure modelling with relationship	V	Evaluate

Module	**Module Contents**	**Hours**
I	Product life cycle – Introduction, growth, maturity & decline, Product Lifecycle, Management- Definition & Overview, Need of Product Lifecycle Management, Components/Elements of Product Lifecycle Management, Emergence of Product Lifecycle Management.	4
II	Product Lifecycle Management Life cycle model- plan, design, build, support & dispose. Threads of Product Lifecycle Management computer aided design (CAD), engineering data management (EDM), Product data management (PDM), computer integrated manufacturing (CIM). comparison of Product Lifecycle Management to Engineering resource planning (ERP). Product Lifecycle Management characteristics - singularity, cohesion, traceability, reflectiveness, Information Mirroring Model. External drivers- scale, complexity, cycle times, globalization & regulation. Internal drivers - productivity, innovation, collaboration & quality. Board room drivers – income, revenues & costs	5
III	Collaborative Product Development, Mapping Requirements to specifications. Part Numbering, Engineering Vaulting, Product reuse, Engineering Change Management, Bill of Material and Process Consistency. Virtual testing and collateral. Introduction to Digital Manufacturing	4
IV	Product life cycle management system- system architecture, Information models and product structure, Information model, the product information data model, the product model, functioning of the system.	4

V	Product Data issues – Access, applications, Archiving, Availability, Change, Confidentiality. Product Workflow, The Link between Product Data and Product Workflow, Key Management Issues around Product Data and Product Workflow, Company's Product Lifecycle Management vision, Principles for Product Lifecycle Management strategy.	5
VI	Different phases of product lifecycle and corresponding technologies, Foundation technologies and standards e.g. visualization, collaboration and enterprise application integration, Core functions e.g., data vaults, document and content management, workflow and program management, Human resources in product lifecycle.	4

Textbooks	
1	Grieves Michael, Product Lifecycle Management- Driving the Next Generation of Lean Thinking, McGraw-Hill, 2006. ISBN 0071452303
2	Antti Saaksvuori, AnselmiImmonen, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003)
3	Stark, John. Product Lifecycle Management: 21st Century Paradigm for Product Realization, SpringerVerlag, 2004. ISBN 1852338105
4	Kari Ulrich and Steven D. Eppinger, Product Design & Development, McGraw Hill International Edns, 1999.

References	
1	Product Design & Process Engineering, McGraw Hill – Kogalkusha Ltd., Tokyo, 1974.
2	Effective Product Design and Development – by Stephen Rosenthol, Business One Orwin, Homewood, 1992 ISBN 1-55623-603-4.
3	Clement, Jerry; Coldrick, Andy; & Sari, John. Manufacturing Data Structures, John Wiley & Sons, 1992. ISBN 0471132691.
4	Clements, Richard Barrett. Chapter 8 ("Design Control") and Chapter 9 ("Document Control") in Quality Manager's Complete Guide to ISO 9000, Prentice Hall, 1993. ISBN 013017534X.

Useful Links	
1	https://nptel.ac.in/courses/110/104/110104084/
2	https://nptel.ac.in/courses/112/107/112107217/
3	https://nptel.ac.in/courses/112/107/112107282/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1				1	
CO2			2	3		1
CO3			2	3		1

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information

Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - II
Course Code	6PR536
Course Name	Processing of Plastics and Composites
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To explain the mechanical and thermal properties of plastic and composite materials.
2	To introduce applications of polymers, composite materials.
3	To classify the plastic and composite materials manufacturing equipments and their industrial products.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Discuss various plastic manufacturing processes and their applications	II	Understand
CO2	Classify different polymers and their characteristics, types of composites	III	Apply
CO3	Detect the common moulding faults and remedies	IV	Analyze

Module	**Module Contents**	**Hours**
I	**Compression Moulding:** Moulding cycle, feeding, moulding temperature, breathing, curing and ejection. Pre-forming and methods of pre-heating. Bulk factor of material and melt flow properties. Effect of various factors on curing. Faults in moulded articles and remedies. Process limitations.	5
II	**Transfer Moulding:** Pot and plunger transfer, feeding, transfer temperatures pressures and clamping force. Melt flow, cull, sprue. Advantages and limitations of the process Temperatures and pressures for moulding.	4
III	**Laminate forming:** High and low pressure laminates, materials, reinforcements, Processing conditions and operation, industrial and decorative laminates and their applications.	4
IV	**Processing of Composites** Introduction to composite materials along with its basic requirements; Definition of composite material, Classification based on matrix and topology, Constituents of composites, Interfaces and Interphases, Distribution of constituents, Nano-composites.	4
V	Various models analyzing the design and performance of composite materials; studying the composite modulus, Composites in Electrical, Superconducting and Magnetic Applications, Nano-composite devices, Civil constructions of structures/pannels, Aerospace industries, Automobile and other surface transport industries.	5

VI	Fabrication of Metal Matrix Composites: Commonly used Matrices, Basic Requirements in Selection of constituents, solidification processing of composites - XD process, Spray processes - Osprey Process, Rapid solidification processing, Dispersion Processes - Stir-casting & Compo casting, Screw extrusion.	4

Textbooks	
1	Plastic Engineering Handbook – by Joel Frados
2	Handbook of Engineering Plastics – by Brown/Derock
3	Compression and Transfer Moulding of plastics – by Butler J
4	Outline of Polymer Processing – by R. Sinha
5	Laminated plastics; including high pressure and low pressure types and reinforced plastics – by Duffin D J
6	Composite materials, K.K. Chawala, 2nd ed., (1987), Springer-Verlag, New York
7	Nanocomposite Science and Technology, P. M. Ajayan, L.S. Schadler, P. V. Braun, (2003), Wiley-VCH Verlag GmbH Co. KGaA, Weinheim.
References	
1	Handbook American Society of testing and Material (ASTM)
2	Plastic Product design Handbook – by Edward Miller
3	Mechanics and Analysis of Composite Materials, V.V.Vasiliev and E.V. Morozov, (2001), Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 lGB, UK.
4	Advances in composite materials, G. Piatti, (1978) Applied Science Publishers Ltd., London.
Useful Links	
1	https://nptel.ac.in/courses/112/107/112107221/
2	https://onlinecourses.nptel.ac.in/noc20_me29/preview
3	https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-me36/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1		2			
CO2					3	2
CO3			3	2		1

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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AY 2022-23

Course Information

Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - II
Course Code	6PR537
Course Name	Advanced Tool Design
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To develop ability in design of modern tooling systems of the machines and the basic fundamentals in tool design.
2	To design a tooling for given production system/ production machine.
3	To understand the principles related to tool economy and tool life.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Design a tooling for given machine tool.	IV	Analyzing
CO2	Know about the ways to minimize the tooling cost.	V	Evaluating
CO3	Design of jigs and fixture for a given job.	VI	Creating

Module	**Module Contents**	**Hours**
I	**Introduction to Tool Design** Introduction –Tool Engineering, Tool Classifications, Tool Design Objectives, Tool Design in manufacturing- Standards in tool design- Tooling Materials- Ferrous and Nonferrous Tooling Materials- Carbides, Ceramics and Diamond - Nonmetallic tool materials-Designing with relation to heat treatment.	4
II	**Theory of Metal Cutting** Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle, effect of geometrical parameters on tool force, power consumption and surface finish, orthogonal and oblique cutting , angle relationships, chip formation in milling and drilling, the force system in turning for orthogonal and oblique cutting, force and velocity relationships, frictional force and energy in cutting, cutting force in drilling and milling, fundamental of friction processes in metal cutting, tool wear, machinability and tool life Taylor's tool life equation, Tool life test, effect of variables on tool life, machinability criteria, stress-distribution at the chip-tool interface.	5
III	**Design of Cutting Tools** Design of single point turning, parting and boring tools, design of form tools, broach design, milling cutter, drill bit of milling cutters, design of Breach, Design of twist Drills. Design of gear and thread milling Cutters. Economics of Machining: Gilbert's model: Minimum cost, Maximum production and Maximum profit rate.	4

IV	**Design of Jigs and Fixtures** Introduction, Principles of location – Locating methods and devices, Principles of clamping, Drill Jigs, Chip formation in drilling. General considerations in the design of drill jigs , Drill bushings ,Methods of construction, Thrust and Turning Moments in drilling , Drill jigs and modern manufacturing, Types of Fixtures – Vise Fixtures, Milling Fixtures , Boring Fixtures , Broaching Fixtures, Lathe Fixtures – Grinding Fixtures – Modular Fixtures, Cutting Force Calculations.	5
V	**Design of Press Tool Dies** Types of Dies, Method of Die operation, Clearance and cutting force calculations, Blanking and Piercing die design ,Pilots, Strippers and pressure pads Presswork materials, Strip layout , Shortrun tooling for Piercing – Bending dies – Forming dies – Drawing dies-Design and drafting.	4
VI	**Tool Design for CNC Machine Tools** Introduction –Tooling requirements for Numerical control systems Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures Cutting tools– Tool holding methods– Automatic tool changers and tool positioners Tool Pre-setting– General explanation of the Brown and Sharp machine.	4

Textbooks	
1	Geofffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Kogakusha.
2	Bhattacharyya, "Metal Cutting, Theory and Practice", New Central Book Agency (P) Ltd.
3	Venkataraman K., "Design of Jigs, Fixtures and Presstools", TMH, 2005.
References	
1	Arshinov, "Metal Cutting Theory and Design", MIR Publishers.
2	Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd.
3	E.G.Hoffman, "Jig and Fixture Design", Thomson Asia Pvt. Ltd, Singapore, 2004.
Useful Links	
1	Swayam/ NPTEL Link: https://youtu.be/ljveGnQw2G0
2	Swayam/ NPTEL Link:https://youtu.be/oI3RIAvyVxc
3	Swayam/ NPTEL Link: https://youtu.be/A0dTvf_Q8BA
4	NPTEL web contents: https://nptel.ac.in/courses/112/105/112105127/

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2		1			
CO2						1
CO3	2		1			
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M. Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6PR538
Course Name	Sustainable Manufacturing
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives

1	To impart knowledge of three pillars of sustainability and their consideration in sustainable manufacturing.
2	To make the students familiar with economic, environmental, and social aspects into decision making processes.
3	To select suitable link between manufacturing process models and sustainable manufacturing metrics for product and process improvement
4	

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Explain the design concepts, methods, tools, the key technologies and the operation of sustainable manufacturing	II	Understanding
CO2	Apply the principles, techniques and methods to customize the learned generic concepts to meet the needs of a particular industry/enterprise	III	Applying
CO3	Identify the strategies for the purpose of satisfying a set of given sustainable manufacturing requirements	IV	Analysing
CO4			

Module	**Module Contents**	**Hours**
I	Definition of sustainability – Environmental, Economical and Social dimensions of sustainability - Sustainable Development Models – Strong and Weak Sustainability – Defining Development- Millennium Development Goals – Mindsets for Sustainability : Earthly, Analytical, Precautionery,Action and Collaborative– Syndromes of Global Change: Utilisation Syndromes, Development Syndromes, and Sink Syndromes – Core problems and Cross Cutting Issues of the 21 Century -Global, Regional and Local environmental issues – Social insecurity - Resource Degradation –ClimateChange – Desertification	7
II	History and emergence of the concept of sustainable development - Our Common Future – Stockholmto Rio plus 20– Rio Principles of Sustainable Development – Precautionary Principle- Polluter PaysPrinciple – Role of Civil Society, Business and Government -Natural Step- Peoples Earth Charter – Business Charter for Sustainable Development –UN Global Compact – Agenda 21	6

III	The Unjust World and inequities - Quality of Life - Poverty, Population and Pollution – CombatingPoverty -Millennium Development Goals, Indicators, Targets, Status and intervention areas - Demographic dynamics of sustainability - Strategies to end Rural and Urban Poverty and Hunger – Sustainable Livelihood Framework- Health, Education and Empowerment of Women, Children, Youth,Indigenous People, Non-Governmental Organizations, Local Authorities and Industry for Prevention,Precaution , Preservation and Public participation	7
IV	Protecting and Promoting Human Health – Investing in Natural Capital- Agriculture, Forests, Fisheries- Food security and nutrition and sustainable agriculture- Water and sanitation – Biodiversityconservation and Ecosystem integrity –Ecotourism - Urbanization and Sustainable Cities –Sustainable Habitats- Green Buildings - Sustainable Transportation – Sustainable Consumption andProduction – Sustainable Mining - Sustainable Energy– Climate Change –Mitigation and Adaptation -Safeguarding Marine Resources - Financial Resources and Mechanisms	7
V	Sustainability in global, regional and national context – Rio Plus 20 - Measuring Sustainability – limitations of GDP- Ecological Footprint- Human Development Index- Human Development Report – National initiatives for Sustainable Development	6
VI	Hurdles to Sustainability - Operational guidelines –-Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Inclusive Green Growth and Green Economy – National Sustainable Development Strategy Planning – Governance - Science and Technology- Sustainability Education.	7
Textbooks		
1	Charles Wankel, "21st century management: A reference handbook", SAGE Publications, Inc, 2008.	
2	Christian N. Madu ,"Handbook of environmentally conscious manufacturing" London : Kluwer Academic Publishers, 2001.	
3	Joseph Sarkis "Greener manufacturing and operations: from design to delivery and back' Greenleaf Pub, 2001	
4	T.E. Graedel and B.R. Allenby "Industrial Ecology" Pearson Education, Inc. 2003.	
References		
1	Sayer, J. and Campbell . B., The Science of Sustainable Development: Local Livelihoods and the Global Environment (Biological Conservation, Restoration &Sustainability), Cambridge University Press, London, 2003.	
2	Kirkby.J. O, Keefe, P. and Timberlake, Sustainable Development, Earthscan Publication, London,1993.	
3	MoEF (2012), "Sustainable Development in India –stocktaking in the Run up to Rio plus 20", Ministryof environment and forests, Government of India, New Delhi	
4	4United Nations 2001, Indicators of Sustainable Development: Guidelines and Methodologies. New York: United Nations,.	
5	UNEP, 2011, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, www.unep.org/greeneconomy, ISBN: 978-92-807-3143-9	
Useful Links		
1	https://www.youtube.com/watch?v=VDz-SS6-P4s	
2	https://www.youtube.com/watch?v=LnGL6qv33Z0	
3	https://www.youtube.com/watch?v=Nhnzn0RKzvo	
4	https://www.youtube.com/watch?v=eKiepu2D-XQ	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1		1		2		
CO2					3	1
CO3		1		2	2	
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment
The assessment is based on MSE, ISE and ESE. MSE shall be typically on modules 1 to 3. ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO. ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6. For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2022-23

Course Information	
Programme	M. Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem II
Course Code	6PR572
Course Name	Production Engineering Laboratory 4
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Practical	4 Hrs/ Week	**LA1**	**LA2**	**Lab ESE**	**Total**
Interaction	-	30	30	40	100
		Credits: 2			

Course Objectives

1	To provide advanced knowledge and expertise in order to produce creative and imaginative engineers with a strong scientific acumen.
2	To develop ability through hands-on experience for implementing modern methods, techniques and best practices in manufacturing
3	To make aware about current scenario and facilitate with modern trends which are tending towards their own area of interest

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Validate technological solutions to defined problems.	III	Applying
CO2	Acquire knowledge developed by scholarly predecessors and critically assess the relevant technological issues.	IV	Analyzing
CO3	Create skills towards research oriented fields	VI	Creating

List of Experiments / Lab Activities/Topics

List of Topics(Applicable for Interaction mode):

Creation of prototype/ apparatus/ small equipment/experimental set up/ innovation of existing product/ analysis or simulation of a process/ experimental verification of principles in thrust areas of CAD / CAM / CNC/ Additive Manufacturing/ Micro-Electro-Mechanical Systems/ Modeling and simulation in manufacturing/ Product Lifecycle Management/ Processing of Plastics and Composites/ Advanced Tool Design/ Sustainable Manufacturing .

Textbooks

1	As per the course details

References

1	As per the course details

Useful Links

1	https://www.youtube.com/channel/UCiTvTUsvKuwvSlCHCvGiJVg
2	https://www.youtube.com/watch?v=kNz-TM4zPkE&list=PLbTLRuAivTCR0YVCNxSTPI9lgccanmZLG
3	https://www.youtube.com/watch?v=j9y0gfN9WMg&list=PL5873EDBDFB69BAD8
4	https://www.youtube.com/watch?v=VL_noGr8zUE&list=PLWCl4kZYUWbDNhExmBxA08ZdSylfRyW29

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1			1			2
CO2				2	1	
CO3	1					1
The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High Each CO of the course must map to at least one PO.						

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing.(min 40 %), LA1+LA2 should be min 40%				
Assessment	**Based on**	**Conducted by**	**Typical Schedule**	**Marks**
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40
Week 1 indicates starting week of a semester. Lab activities/Lab performance shall include performing experiments, mini-project, presentations, drawings, programming, and other suitable activities, as per the nature and requirement of the lab course. The experimental lab shall have typically 8-10 experiments and related activities if any.				

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AY 2022-23

Course Information	
Programme	M.Tech. (Mechanical Production Engineering)
Class, Semester	First Year M. Tech., Sem - II
Course Code	6OE505
Course Name	Advanced Production Systems
Desired Requisites:	

Teaching Scheme		**Examination Scheme (Marks)**			
Lecture	3 Hrs/week	**MSE**	**ISE**	**ESE**	**Total**
Tutorial	-	30	20	50	100
		Credits: 3			

Course Objectives	
1	To impart the knowledge of the fundamentals in advanced production systems.
2	To prepare the student for the use of the recent developments in production systems and techniques for manufacturing
3	To develop the student for selection of appropriate production systems and techniques considering the advantages, limitations, cost economy, etc.

Course Outcomes (CO) with Bloom's Taxonomy Level

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

CO	**Course Outcome Statement/s**	**Bloom's Taxonomy Level**	**Bloom's Taxonomy Description**
CO1	Distinguish the elements and techniques in conventional and advanced production systems	II	Understanding
CO2	Identify appropriate production systems for manufacturing implementation	IV	Analyzing
CO3	Recommend modern equipment's, techniques, tools and methodology for advanced production systems.	V	Evaluating

Module	**Module Contents**	**Hours**
I	Origin of CIM- the changing manufacturing and management scene - External communication - islands of automation and software-dedicated and open systems-manufacturing automation protocol - product related activities of a company- marketing engineering - production planning - plant operations - business and financial management	5
II	History of group technology- role of G.T. in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems-facility design using G.T. - benefits of G.T. - cellular manufacturing systems. Process planning - role of process planning in CAD/CAM integration - approaches to computer aided process planning – Types of CAPP	4
III	Shop floor control-phases -factory data collection system -automatic identification methods-Bar code technology-automated data collection system. FMS-components of FMS - types -FMS workstation -material handling and storage systems- Information flow in Shop floor control systems	5
IV	Designing database-Hierarchical Model-Network Approach-Relational Data Model-Concepts, Principles, Keys, Relational Operations-Functional Dependence-Normalization, Types - Query Languages.	5

V	CIM and company strategy - system modeling tools -IDEF models - activity cycle diagram CIM open system architecture (CIMOSA)- manufacturing enterprise wheel-CIM architecture- CIM implementation software. Communication fundamentals- local area networks -topology -LAN implementations – network management and installations	4
VI	Open systems - open system inter connection -manufacturing automations protocol and technical office protocol (MAP /TOP) Development of databases - Architecture of database systems - data modeling and data associations - relational data bases - database operators - advantages of data base and relational database.	4

Textbooks	
1	Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education 2008.
2	Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice-Hall of India Pvt Ltd., New Delhi, 2010
3	Kalpakjain, "Manufacturing Engineering and Technology", Addision-Wesley Publishing Co.1995.
References	
1	Ranky, Paul G., "Computer Integrated Manufacturing", Prentice Hall International, 2010.
2	David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc 2008.
3	Date.C.J, "An Introduction to Database Systems", Narosa Publishing House, 2004..
4	Kerr.R, "Knowledge Based Manufacturing Management", Addison Wesley, 2003
Useful Links	
1	https://nptel.ac.in/courses/112/107/112107078/
2	https://nptel.ac.in/courses/112/107/112107077/
3	https://nptel.ac.in/courses/110/106/110106044/

CO-PO Mapping

	Programme Outcomes (PO)					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2				
CO2		2	3			
CO3			2	2	2	

The strength of mapping is to be written as 1,2,3; Where, 1:Low, 2:Medium, 3:High
Each CO of the course must map to at least one PO.

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
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