Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

Course Contents (Syllabus) for

First Year M. Tech.
(Mechanical Production Engineering)
Sem - I to II

AY 2020-21

ODD Semester

Professional Core (Theory) Courses

Title of the Course: Research Methodology 4IC501	L	T	P	Cr
	2	-	-	2

Pre-Requisite Courses:

Textbooks:

1. C. R. Kothari, "Research Methodology", New Age international, 2nd edition, 2004.
2. Deepak Chopra and Neena Sondhi, "Research Methodology: Concepts and cases", Vikas Publishing House, New Delhi, 1998
3. Stuart Melville and Wayne Goddard, "Research Methodology: An Introduction for Science & Engineering Students", Tata MacGraw Hill, 2000

References:

1. E. Philip and Derek Pugh, "How to get a Ph. D. – a handbook for students and their supervisors", open university press, 2001
2. Kumar R., "Research Methodology- A step by step guide for beginners", SAGE, 3rd Edition, 2012.
3. G. Ramamurthy, "Research Methodology", Dream Tech Press, New Delhi, 2009.

Course Objectives:

1. To prepare the students to identify and formulate the research problems,
2. To impart the Knowledge of planning and execution of research project, IPRs, Patents etc
3. To develop the student to prepare and write papers for publications to Conferences and Journals.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Classify the research problem and research plan.	III	Apply
CO2	Analyze the research problem, literature and methodology.	IV	Analyze
CO3	Interpret the research papers, reports, case studies, patent information and database, etc	V	Evaluate

CO-PO Mapping:

	1	**2**	**3**	**4**	**5**	**6**
CO1	3			2	3	
CO2				1	3	
CO3				1	2	3

Assessments:

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10

ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first two modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last two modules) covered after MSE.

Course Contents:

Module 1:	**5 Hrs.**
Meaning of research problem, Sources of research problem, Criteria, Characteristics of a good research problem, and Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	
Module 2:	**4 Hrs.**
Effective literature studies approaches, analysis. Plagiarism, Research ethics.	
Module 3	**5 Hrs.**
Effective technical writing, how to write report, Paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	
Module 4:	**4 Hrs.**
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.	
Module 5:	**4 Hrs.**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	
Module 6:	**4 Hrs.**
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.	

Module wise Measurable Students Learning Outcomes:

Students will able to

1. Explain the research problem and research plan.
2. Propose methodology for their research topic and understand various analysis techniques.
3. Analyze and interpret the research data.
4. Prepare the conference papers, dissertation report and understand patent related aspects.
5. Handle issues related to IPR.
6. Process and interpret the research data.

Title of the Course: Manufacturing Processes, 4PR501	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

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. AmitabhaGhosh, 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.

Course Objectives :

1. To impart the fundamentals knowledge ofmetal 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 Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1		2	3			
CO2			2	3		
CO3				2	3	

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**7 Hrs.**
Study of various forming and metal cutting processes, their special features with respect to other manufacturing process. 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.	
Module 2	**7Hrs.**
Sand preparation and reclamation. High pressure and flask-less 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.	
Module 3	**7 Hrs.**
Forging: classification, equipment's, process variable in forging, Forgability of metals, , forging defects ; Rolling: Classification, rolling equipment's, hot and cold rolling, rolling of bars and shapes, camber in rolling defects, variables in rolling. Applications, limitations, defects and their remedies.	
Module 4	**7 Hrs.**
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.	
Module 5	**7 Hrs.**
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.	
Module 6	**7 Hrs.**
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 nontraditional machining – high speed machining, machining of difficult to cut materials.	

Module wise Measurable Students Learning Outcomes :
After the completion of the course the student should be able to:

1. Describeand summarize the metal forming and cutting processes, metallurgical aspects, hot, warm and cold working, recent developments and use of various tools and equipment's in metal casting.
2. Study the runner, riser, gating system design, casting finishing techniques, production of defect free castings and improvement in productivity.
3. Describe the forging, rolling operations, equipment's and tools used.
4. Explain the extrusion and wire drawing operations, equipment's and tool design.
5. Discuss the deep drawing process, FLD diagram, and recent developments in metal forming operations.
6. Use appropriate cutting process at optimized parameters to improve tool life and productivity etc.

Title of the Course: Advanced Joining Technology- 4PR502	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

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.
5. Linnert G. E.,'Welding Metallurgy', Volume I and II, 4th Edition, AWS, 1994

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

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 Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
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

CO-PO Mapping :

PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2			3		
CO2			2		3	
CO3				2	2	

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**6Hrs.**
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	
Module 2	**7Hrs.**
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	
Module 3	**7 Hrs.**
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. .	
Module 4	**8 Hrs.**
Physics and Metallurgy of Welding, General considerations, structure of the weld metal, weld composition, HAZ, Weldability, Fracture behavior, 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	
Module 5	**6 Hrs.**
Welding of Specific Alloys, Welding of Cast Iron, Copper alloys, Al alloys, Stainless steels, Dissimilar metals, Welding of heat resistant alloys	
Module 6	**6 Hrs.**
Joint Evaluation and Quality Control, Overview of Weld Discontinuities, Inspection of Welded Joints, Acceptance standards, quality assurance and quality control, Reliability	

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

1. Describe the basic concepts of welding and its importance.
2. Classify welding process and their parameters.
3. Examine advanced welding techniques and processes.
4. Analyse physics and metallurgy of welding.
5. Employ the welding methods for specific materials.
6. Evaluate quality and strength of welded joints.

Professional Core (Lab) Courses

Title of the Course: **Production Engineering Lab 1- 4PR551**

L	T	P	Cr
0	0	4	2

Text Books:
As per the course details

References:
As per the course details

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 Learning Outcomes:

CO	**After the completion of the lab the student should be able to**	Bloom's Cognitive	
		level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2					1
CO2				2		1
CO3	2					2

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of 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.	
List of experiments for course Manufacturing Processes(Minimum eight experiments) 1. Testing of molding sand grain fineness number. 2. Testing of molding sand – Compressive strength, shear strength (green and dry). 3. Testing of molding sand – Tensile strength (green and dry), mold and core hardness. 4. Permeability test of molding sand. 5. Study and use of metal forming software's for various case studies on metal forming -I. 6. Study and use of metal forming software's for various case studies on metal forming -II. 7. Study and analysis of cutting force during machining operation. 8. Study and analysis of tool wear during machining of metals. 9. Visit to industry / R&D organization and report submission related to metal forming and machining processes.	20 Hrs.
List of experiments for course Advanced Joining Technology(Minimum Eight Experiments) 1. Demonstration and hands-on experiments on Gas welding process 2. Demonstration and hands-on experiments on Arc welding process 3. Demonstration and hands-on experiments on Manual Metal Arc welding process 4. Demonstration and hands-on experiments on spot welding process 5. Case study on any one of above welding process-I 6. Case study on any one of above welding process-II 7. Practice for preparation of welding procedure specification 8. Practice for preparation of procedure qualification record. 9. Microstructure observation of weldments of Carbon steel, Stainless steel and Aluminum alloy.	20 Hrs.

Professional Elective (Theory) Courses

Title of the Course: PE1:Finite Element Methods In Manufacturing - 4PR511	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

Textbooks:

1. S.S.Rao., *"IntroductiontoFiniteElementinEngineering"*,Elsevier, New Delhi, 4th Edition- 2006.
2. T.R.Chandrupatla. *"IntroductiontoFiniteElementinEngineering"*,Prentice Hall, New Delhi, 2nd Edition- 1997.
3. M. J. Fagan, "*Finite Element Analysis*", Pearson, 1992.

References:

1. J.N.Reddy. *"IntroductiontoFiniteElement"*, PHI, New Delhi, 1st Edition, 1st Reprint- 2009.
2. KlausJurgenBathe,*"FiniteElementProcedures"*, Prentice Hall, 1st Edition- 1995.
3. S. S. Bhavikatti, "*Finite Element Analysis*", New Age International Publishers, 2005.

Course Objectives :

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 Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Bloom's Cognitive Descriptor
CO1	Explain basic procedure of finite element analysis.	II	Understanding
CO2	Apply FEM procedure to solve different mechanical or production engineering problems.	III	Applying
CO2	Formulate different mathematical models for static- linear and non-linear analysis.	IV	Analyzing

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2					3
CO2				2		3
CO3					3	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 Introduction	**6 Hrs.**
Physical problem, Mathematical Modeling and Finite Element Solutions, FEM as integral part of Computer Aided Design	
Module 2 General ProcedureUsedInFEM	**7 Hrs.**
Discretization, Formulation, Solving and Post processing, Mesh refinement, combined load analysis.	
Module 3 MathematicalFormulation	**7 Hrs.**
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.	
Module 4 Static analysis and dynamic analysis	**6 Hrs.**
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.	
Module 5 Application of FEA in Manufacturing Processes	**7 Hrs.**
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	
Module 6 Computer implementation of FE procedure	**6 Hrs.**
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.	

Module wise Measurable Students Learning Outcomes :

Student will able to

1. Comprehend the mathematical methods, an exciting and thorough understanding of finite element procedures for engineering applications.
2. Apply procedures used to obtain finite element matrices for 1D, 2D and 3D problems.
3. Explainthe concepts of strong and weak forms of a system equations and the construction of shape functions for interpolation of field variables.
4. Perform structural and thermal static analysis
5. Apply FE procedure in various manufacturing processes.
6. Perform FE analysis using commercial software's.

Title of the Course: PE1:Industrial Hydraulics and Pneumatics 4PR512	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

Textbook:

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

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.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1		2	3			
CO2			2	3		
CO3				2	3	

Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment, oral, seminar, test (surprise/declared/quiz), and group discussion.[One assessment tool per ISE. The assessment tool used for ISE 1 shall not be used for ISE 2]
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 Introduction to fluid power	**6 Hrs.**

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	
Module 2 Hydraulic systems	**7 Hrs.**
Actuators, Hydraulic motor, Hydraulic cylinders and their mountings, Hydraulic Pumps and its types with details.	
Module 3 Hydraulic circuits with application	**7 Hrs.**
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 re-generation circuits with accumulator and intensifier, Maintenance, troubleshooting and safety of hydraulic systems	
Module 4 Pneumatic systems	**6 Hrs.**
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	
Module 5 Pneumatic circuits	**7 Hrs.**
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	
Module 6 Electro- Pneumatic systems	**7 Hrs.**
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.	

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

1. Summarize basic principles used in industrial hydraulic systems, hydraulic fluid properties; make their selection.
2. Identify and describe different components like cylinders, pumps, motors, their applications, capacity calculations, construction details etc.
3. Identify circuit components and build circuits for industrial applications with due consideration to safety.
4. Identify different elements of pneumatic circuits, their construction details, applications and limitations.
5. Identify circuit components and build circuits for industrial pneumatic applications with due consideration to safety.
6. Explain the basic concepts and applications of fluidics, will be able to build circuits for pneumatic systems

Title of the Course: PE1: Quality Engineering for Manufacturing 4PR513	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

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.

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 Learning Outcomes:

CO	**Upon completion of this course the student will be able to**	Bloom's Cognitive level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3			2		
CO2	2				2	
CO3	2		3			

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

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MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 Introduction	**6 Hrs.**
Need for TQM, evolution of quality, Definition of quality, TQM philosophy –Contributions of quality gurus like Deming, Juran, Crosby and Ishikawa, Different TQM models.	
Module 2 TQM Principles	**6 Hrs.**
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.	
Module 3 TQM Tools and Techniques	**7 Hrs.**
PDSA, The seven tools of quality, New seven management tools, Concept of six sigma, FMEA, Bench Marking, JIT, POKA YOKE, 5S, KAIZEN, Quality circles	
Module 4 Quality Engineering	**7 Hrs.**
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	
Module 5 Robust Design	**6 Hrs.**
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.	
Module 6 Optimization Techniques	**7 Hrs.**
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	

Module wise Measurable Students Learning Outcomes :

Student should be able to:

1. Discuss the underlying reasons for modern quality philosophies and methodologies.
2. Explain various concepts of total quality management and various related theories.
3. Identify, understand and use different TQM tools and techniques.
4. Note the concepts of Taguchi's quality engineering and loss function.
5. Analyze experimental data based on techniques like AOM, ANOVA, etc; evaluate the significance, effects and interactions of various parameters of experimentations.
6. Perceive the role of managerial, human and ethical issues in design, planning and improvement of quality.

Title of the Course: PE1: Manufacturing of Non-Metallic Products 4PR514	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

Textbooks:

1. 1. Krishan K Chawla, "Composite Material: Science and Engineering", Publisher Springer/BSP Books, Second Edition, 2006.
2. 2. Rees Rawlings, Frank Matthews, "Composite Materials" Springer, New edition, 1999.
3. 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.

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 Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						1
CO2					1	
CO3			2			

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10

MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**7 Hrs.**
Introduction, Reinforcements, glass fibers, boron fibers, carbon fibers, organic fibers, ceramic fibers, non-oxide fibers.	
Module 2	**8 Hrs.**
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.	
Module 3	**8 Hrs.**
Ceramic matrix composites, processing, interfaces, structure, properties and applications. Carbon-carbon composites, processing, interfaces, structure, properties and applications.	
Module 4	**7 Hrs.**
Processing of plastics, blow moulding, thermoforming, rotational moulding, injection moulding, multi material injection molding, calendaring process, fabricationprocess.	
Module 5	**5 Hrs.**
Introduction to ceramics, processing of ceramics, pressing, blowing, drawing, tape casting, slip casting, extrusion, compaction.	
Module 6	**7 Hrs.**
Additive manufacturing of non-metals, fused deposition modeling, stereolithography, binder jetting, ceramic printing.	

Module wise Measurable Students Learning Outcomes
After the completion of the course the student should be able to:
Students will be able to
1. Summarize various types of reinforcements and its importance in manufacturing of composites.
2. Study the polymer matrix and metal matrix composites its processes, structures and their applications.
3. Discuss the Ceramic processing and Additive Manufacturing of non-metals.
4. Analyze importance of interfaces in Ceramic matrix composites.
5. Compare the various manufacturing processes for non-metals.
6. Select processing techniques additive manufacturing.

Title of the Course: PE 2 : Project Management 4PR515	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

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
6. Meri Williams , The Principles of Project Management By – SitepointPvt Ltd., 2008

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

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.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2				2	
CO2			2			3
CO3					2	2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 – Introduction to Project Management	**Hrs.**
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**
Module 2 – Project Cost	**Hrs.**
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**
Module 3 – Planning, feasibility, risk	**Hrs.**
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**
Module 4 - Critical Path Networks	**Hrs.**
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**
Module 5 - Principles of Resource Scheduling, Executing and Controlling	**Hrs.**
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**
Module 6 – Commercial Management and various regulations	**Hrs.**
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**

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

1.Perceive what is project management and corresponding documentation.
2. Arriving at the total project cost by considering various factors and understanding importance of audit.
3. Planning for the execution of project, keeping in mind the change and risk management.
4. Applying and interpreting various networking techniques for project management.
5.Scheduling, executing, controlling and estimating at various stages of project completion.
6. Note variousdetails of commercial management and know the various rules and regulations applicable to any industry / business.

Title of the Course: PE2: Design for Manufacture and Assembly 4PR516

L	T	P	Cr
3	0	0	3

Text Books:

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

Reference Books:

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.
5. D. E. Whitney, (2004) Mechanical Assemblies: Their Design, Manufacture, and Role in Product Development, Oxford University Press, New York

Course Objectives:

1. To make student aware forvarious 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 Learning Outcomes:

CO	After the completion of the course the student should be able to	Blooms Cognitive	
		Level	Descriptor
CO1	Apply a systematic understanding of knowledge in the field of metal casting and forging and other processes.	III	Applying
CO2	Integrate the knowledge of compliance analysis and interference analysis for assembly and also use viscoelastic and creep in plastics.	IV	Analysing
CO3	Outline the appropriate design for economical production and select the materials for various machining and metal joining processes.	V	Evaluating

CO PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			2			1
CO2				1		
CO3				1		1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

1	**Module 1**: (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.	7hrs
2	**Module 2**: Design for: Machining, Tuning operation, Machining round holes, Broached parts. Parts produced by milling, Parts produced by planning, Shaping and slotting.	6hrs
3	**Module 3**: Metal Extrusion, Metal stamping, Fine blanked parts, Rolled formed section, Impact or cold extrusion, Forward extrusion, Design for Forging, Metal injection moulded parts.	7hrs
4	**Module 4**: (A) Design for: Cleaning, Polishing and plating, Plated surface, Heat treatment. (B) Hot dip metallic coating, Thermal sprayed coating, Vacuum metalized surfaces.	6hrs
5	**Module 5**: Introduction to welding process, Design for: Welding, Solder and brazed assembly, Adhesively bonded assemblies.	6hrs
6	**Module 6**: (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	7hrs

Module wise Measurable Students Learning Outcomes :
After the completion of the course the student should be able to:
(1) Select various types of materials, its classification, suitable materials for product design and various methods of material selection, various mechanical properties of material.
(2)Create various casting design, machining design, designing of formed components.
(3) Preparevarious design recommendations for cleaning, design for polishing, plating and coating, and Heat treatment and various design recommendations.
(4) Prepare various design recommendation for permanent joining such as welding, soldering and brazing.
(5)Prepare various design recommendation for riveting, screw fastening etc.
(6) LearnCAD, various types of geometric model, different types of features, procedure for feature extraction from part and assembly model.

Title of the Course: PE2:Precision Engineering 4PR517	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

Textbooks:

1. Murty, R. L. (2009), - Precision Engineering in Manufacturing, (New Age International Publishers) ISBN: 81-224-0750-1.
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. Dornfeld, David and Lee, Dae-Eun, (2008), - Precision Manufacturing, (Springer Science + Business Media, LLC), ISBN: 978-0-387-32467-8.
2. Meadows, James D., (1995), Geometric Dimensioning and Tolerancing, (Marcel Dekker Inc.).
3. Drake, Paul J. Jr. (1999), - Dimensioning and Tolerancing Handbook, (McGraw Hill), ISBN: 0-07-018131-4.
4. Seyfried, P., Kunzmann, H., McKeown, P., Weck, M.Proceedings of the 6th International Precision Engineering Seminar (IPES 6)/2nd International Conference on Ultraprecision in Manufacturing Engineering (UME 2), May, 1991 Braunschweig, Germany

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 Learning Outcomes:

CO	Upon completion of this course the student will be able to	Bloom's Cognitive	
		level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			2			3
CO2			1	1		1
CO3			3	1		3

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 Precision Engineering	**6 Hrs.**
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 scopeof precision manufacturing.	
Module 2 Geometrical Dimensioning and Tolerance	**7 Hrs.**
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)	
Module 3 Machine Tools and Accuracy	**7 Hrs.**
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.	
Module 4 Tool Materials for Precision Machining	**6 Hrs.**
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	
Module 5 Processing and Accuracy	**7 Hrs.**
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, C_p, $C_{pk,}$ Methods for improving accuracy and Surface finish.	
Module 6 Precision Machining Processes	**7 Hrs.**
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		

Module wise Measurable Students Learning Outcomes :

Students should be able to

1. Examine the basic concepts of precision engineering and its applications.
2. Assign the geometrical dimensioning and tolerances to the components in precision engineering.
3. Explain the role of machine tools accuracies / errors and its control in precision engineering.
4. Justify the tool materials used in precision engineering considering recent development such as CVD and PVD processes.
5. Assess the role of processing in precision engineering, errors in precision engineering, microfininshing, methods for improving surface finish and accuracy.
6. Discuss the precision machining processes their capabilities and applications.

Title of the Course: **PE 2: Costing and Cost Control 4PR518**

L	T	P	Cr
3	0	0	3

Text Books:

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 Mcgraw-Hill 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

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 Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1						2
CO2					2	1
CO3	2			1		

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE	
Module 1: (A) Introduction: (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 hrs
Module 2: Estimation of Weight and Material Cost: (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 hrs
Module 3: (A) Estimation of fabrication cost : 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 hrs
Module 4: (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 hrs
Module 5: (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 hrs
Module 6: 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 hrs
Module wise Measurable Students Learning Outcomes : **After the completion of the course the student should be able to:** 1. Study various important cost related aspects of casting and its estimation 2. Estimate weight of material and according to volume corresponding cost for production. 3. Calculate cost of fabrication, casting, forging, and machining cost. 4. Forecast for machining rate, labour cost and related overheads. 5. Learn about accounting methods and methodologies for controlling cost. 6. Find the areas related to cost reduction with budgeting.	

Professional Elective (Lab) Courses

Title of the Course: **Production Engineering Lab 2, 4PR552**

L	T	P	Cr
0	0	4	2

Text Books:
As per the course details

References:
As per the course details

Course Objectives :

1. To provide fundamental knowledge and expertise in order to produce competency in recent engineering fields.
2. To develop ability through the applications of the acquired knowledge, skills, and tools pertinent to production engineering.
3. To engage in continuous professional development in response to technological challenges in manufacturing

Course Learning Outcomes:

CO	**After the completion of the lab the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	Demonstrate clearly and effectively for the practical utilization in day-to-day life	III	Applying
CO2	Analyze results using significant modern scientific methods	IV	Analyzing
CO3	Build ability to understand advanced technologies and research in manufacturing engineering	VI	Creating

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			2			
CO2					2	1
CO3						1

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of 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.

Students should perform experiments based on electives selected from PE 1 and 2	
Professional Elective – 1 (Experiments from any one elective selected by student)	
List of Experiments for course Finite Element Analysis Using ANSYS 18.0 1. Finite element analysis of stepped bar. 2. Finite element analysis of composite wall. 3. FEA analysis of complex Truss. 4. Deflection due to self-weight. 5. Structural analysis of Complex truss. 6. Transient analysis of spanner, truss, bridge, etc. 7. Thermal analysis of composite materials 8. Modal analysis of different structures. 9. Variable load application 10. Application of FEA in manufacturing	**20 Hrs.**
List of Experiments for course IHP **1.** Study of Hydraulic power pack and elements of hydraulic circuit. **2. Experiments on hydraulic trainer kit with following circuits (6 hrs.)** a. Basic hydraulic circuit for linear and rotary motion. b. Regenerative circuit c. Traverse and feed circuit d. Meter-in, meter-out and bleed-off circuit. e. Sequencing circuit with sequence valve f. Synchronization motion of cylinders. **3**. Study of hydraulic intensifier and accumulator, Hydraulic jack or Hydraulic puller **4.** Study of filter, regulator and lubricator of pneumatic system **5. Experiments on pneumatic trainer kit with following circuits (6 hrs.)** Pneumatic circuits for linear and rotary motion Sequencing circuits of type $A^+ B^+ A^- B^-$ and $A^+ B^+ B^- A^-$	**20 Hrs.**
List of experiments for course Quality Engineering for Manufacturing 1) Quality Characteristics of Product and Service. 2) Case study using Taguchi Technique. (4 hrs.) 3) Demonstration on statistical software/tools. 4) A Case Study data collecting, processing, analysis, interpretation and conclusion for machining problem. (6 hrs.) 5) Interpretation and analysis of quality management systems: ISO 9001:2008.	**20 Hrs.**
List of Experiments for course manufacturing of non-metallic products 1. Manufacturing of fiber composites. 2. Machining of composites. 3. Preparation of mountings for microstructure analysis using polymer. 4. Demonstration of blow moulding machine. 5. Manufacturing of plastic filaments for use of fused deposition modeling using different polymers. 6. Nonmetallic components preparation using Fused deposition modeling. 7. Machining or deposition of non-metals using fiber laser machine. 8. Industrial visit and report submission.	**20 Hrs.**
Professional Elective – 2 (Experiments from any one elective as selected by student)	
List of Experiments for course Project Management (Minimum eight experiments)	**20**

1. Case study to understand the different types of projects and documenting the project specifications. 2. Two case studies to understand the various costs associated with any project, taking in to consideration the budget uncertainty and risk management. 3. Know and understand the various aspect of planning in a project and with the help of a case study write down the detail planning. 4. Study the Project feasibility analysis, Pay back and cash flow with the help of a case study. 5. Application of critical path network in project management. Two examples on networking. 6. A case study on application of Gantt chart. 7. Explain logical steps of project resource scheduling with a case study. 8. Estimating and Evaluation of various resources. Use different projects for the analysis 9. Prepare various commercial documents required in project execution. 10. A write up on the various Government regulations (e.g. factories act, minimum wage act etc.)	**Hrs.**
List of Experiments for course Design for Manufacture and Assembly (Minimum eight experiments) 1. Life cycle of mechanical equipment design based on requirements of customer, management, marketing, manufacturing, transportation etc. - Case study. 2. Appropriate example of DFMA for improving product quality, cost and time to the market. 3. Case study based on design considerations for manual, automated and flexible assembly. 4. Realistic problem of geometric dimensioning and tolerance considerations for manufacturing and assembly. 5. Application of tools like lean manufacturing in the perspective of DFMA. 6. Application of tools like six sigma in the perspective of DFMA. 7. Use of DFMA for sand casting with example. 8. Use of DFMA for machining with example. 9. Use of DFMA for extrusion with example. 10. Use of DFMA for welding with example.	**20 Hrs.**
List of experiments for Precision engineering 1. Demonstration and hands-on on micromachining-center. 2. Study of Geometrical tolerances, tolerance zones in precision measurements. 3. Demonstration on CNC machine and component analysis (process capability) on CMM (6 hours) 4. Study and analysis of diamond tool in precision machining. (4 hours) 5. Surface roughness measurement and analysis. 6. Visit to industry and report submission based on processes such as honing, lapping, ultra-precision grinding and super-finishing etc.	**20 Hrs.**
List of Experiments for course Costing and Cost Control (Minimum eight experiments) 1. Estimation of weight and material cost for an assembly for two components.	**20 Hrs.**

2. Valuation of inventory by LIFO, FIFO, Weighted average method. 3. Estimation for machine hour rate for representative machines – one conventional machine and one CNC lathe or machining center. 4. Case study on estimation of overheads for a manufacturing unit. 5. Study of different methods for allocation, apportionment, absorption of overheads. 6. Case study in industry using appropriate method of costing. 7. Different examples illustrating cost control. 8. Two case studies on cost reduction.	

Mandatory Life Skill Courses

There are no courses under this category for this semester.

Value Added
Professional Courses

There are no courses under this category for this semester.

EVEN Semester

Professional Core (Theory) Courses

Title of the Course: Advanced Manufacturing Processes 4PR521	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

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. AmitabhaGhosh, 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.

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 Learning Outcomes:

CO	Upon completion of this course the student will be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Distinguish the process parameters and operations in various traditional and non-traditional machining processes.	II	understanding
CO2	Identify appropriate machining process for miniaturized components.	IV	Analyzing
CO3	Recommendmodern equipment's, techniques, tools and methodology for micro features.	V	Evaluating

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2				
CO2		2	3			
CO3			2	2	2	

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**7 Hrs.**
Introduction of traditional and nontraditional machining processes, need for non-traditional machining processes. Introduction of micromachining technology. Advances in machining technology, characterization of micro-machining. Micro-machinability of materials.	
Module 2	**7 Hrs.**
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	
Module 3	**7 Hrs.**
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).	
Module 4	**7 Hrs.**
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.	
Module 5	**7 Hrs.**
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.	
Module 6	**7 Hrs.**
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.	

Module wise Measurable Students Learning Outcomes :

Student will be able to:

1. Summarize the traditional and non-traditional machining processes, micro- machining, its applications / limitations, characteristics, etc.
2. Explain the micro-turning, micro-milling and micro-drilling processes, tools used and applications of these processes.
3. Apply the processes such as diamond micro-machining, abrasive micro-machining and micro-grinding processes, micro-lapping, micro-honing, and magneto abrasive micromachining and finishing (MAF),

4. Analyze the ultrasonic micro-machining, micro-EDM, micro-WEDM, micro-ECM and ECG,process parameters and its applications.
5. Examine the Laser micro-machining, WJM and hybrid machining processes, equipment's and tools used.
6. Use the measuring techniques in micro-machining.

Title of the Course: Industrial Automation and Mechatronics 4PR522	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

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.

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 Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	To outline potential areas of automation and justify need for automation	II	Understanding
CO2	To 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

CO-PO Mapping :

PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2				2	
CO2			3		2	
	1				2	

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30

ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Module 1	**6 Hrs.**
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).	
Module 2	**7Hrs.**
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.	
Module 3	**6 Hrs.**
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,	
Module 4	**7 Hrs.**
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	
Module 5	**7 Hrs.**
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.	
Module 6	**7Hrs.**
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.	

Module wise Measurable Students Learning Outcomes :
After the completion of the course the student should be able to:
1. Classify different type's automation and study both technological and economic issues related to automation.
2. Use effectively hydraulic and pneumatic systems in automation.
3. Design and control of proper automation systems with the knowledge of control elements.
4. Define the role of sensors, actuators, control, and machine intelligence in product design and explain the requirements for signal conditioning.
5. Describe the basic structure of a microprocessor and microcontroller and how to integrate them in systems.
6. Implement the PLC Programming in real life systems for automation.

Professional Core (Lab) Courses

Title of the Course: **Production Engineering Lab 3- 4PR571**

L	T	P	Cr
0	0	4	2

Text Books:
As per the course details.

References:
As per the course details.

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 Learning Outcomes:

CO	**After the completion of the lab the student should be able to**	Bloom's Cognitive	
		level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		1			
CO2					2	1
CO3	2					1

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of 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.	
List of experiments for course Advanced Manufacturing Processes(Minimum eight experiments) 1. Case study on Micro-Turning machine. 2. Case study on Micro-Milling machine. 3. Case study on Micro drilling machine. 4. Case study on Micro-EDM machine. 5. Case study on Micro-WEDM machine. 6. Case study on WEDG machine. 7. Case study on Reverse EDM process. 8. Case study on Fibre laser machining set-up. 9. Study and use of interface camera for micro-feature measurement. 10. Industrial / R&D organization visit and report submission related to traditional, non – traditional machining processes.	20 Hrs.
List of experiments for course Industrial Automation and Mechatronics (Minimum Eight Experiments) 1. Study and demonstration of bottle filling plant. 2. Study and demonstration of Robot Anatomy. 3. Study and demonstration of various sensors used in practice. 4. Robot programming methods and languages. 5. ON/OFF Temperature controller using PLC. 6. DC motor speed control with PLC. 7. 3 Phase induction motor control using PLC. 8. Water level controller with PLC. 9. Demonstration on Microprocessor and microcontroller 10. Conveyor Belt Monitoring using PLC.	20 Hrs.

Title of the Course: Industrial Project 4PR541	L	T	P	Cr
	-	-	4	2

Pre-Requisite Courses:

Textbooks: As per topic Selected and Journal papers, Conference papers, Handbooks.

References: As per topic Selected and Journal papers, Conference papers, Handbook.

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 Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		Level	Descriptor
CO1	Apply the existing knowledge on real life problems	III	Applying
CO2	Investigate the selected topic/ system.	IV	Analyzing
CO3	Verify the outcomes of the work have solved the specified problems.	V	Evaluating

CO-PO Mapping:

PO	**1**	**2**	**3**	**4**	**5**	**6**
CO1	2	2	1			
CO2	3				1	
CO3		3			2	

Assessment:

There are four components of assessment, LA1, LA2, LA3 and Lab ESE.

IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Project Progress	Course Faculty/ Industrial Guide	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Project Progress	Course Faculty/ Industrial Guide	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Project Progress	Course Faculty/ Industrial Guide	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Project Progress	Course Faculty/ Industrial Guide	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of Semester.
Project activities/Project performance shall include literature review, problem statement, presentations, drawings, programming and other suitable activities, as per the nature and requirement of the industrial project.

Course Contents:

The industrial project work will start in semester II and should be an industrial 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. Student should undergo industrial project in registered company/organization after consulting with faculty guide assigned by the department. Industrial project should be based preferably in the area in which the candidate is interested to undertake the dissertation work. The student has to be in regular contact with guide and the topic of industrial project must be mutually decided. The examination shall consist of the preparation of report consisting literature review, detailed problem statement, methodology, 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.

Professional Elective (Theory) Courses

Title of the Course: PE3:CAD/CAM/CNC - 4PR531	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

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

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 Learning Outcomes:

CO	At the end of the course, each student should be able to:	Bloom's Cognitive level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			2			2
CO2		3				
CO3				3		2

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**6 Hrs.**
-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	
Module 2	**7 Hrs.**
-CAD Standards: Standardisation, Graphical Kernel system, other systems -Drafting Systems: Facilities, Commands, Editing	
Module 3	**7 Hrs.**
-Geometric Modelling Techniques: Solid modelling, various features, utilities, Entities, 3D drawing, Surface modelling, Designing curved shapes	
Module 4	**6 Hrs.**
-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	
Module 5	**7 Hrs.**
-Introduction to CNC: NC modes, NC elements -CNC Hardware basic: Structure, Spindle design, Drives, Actuation system, feedback -CNC tooling: Material, Geometry, ATC, Process parameters	
Module 6	**7 Hrs.**
-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	

Module wise Measurable Students Learning Outcomes :

Student will be able to:

1. Explain different transformation techniques and basic CAD/CAM features.
2. Use different CAD standards for data transfer from one software to other software.
3. Design components by using modeling technique such as solid, surface, curves.
4. Create design and apply FEM procedure to optimize the product.
5. Distinguish between different machine tools and their components.
6. Prepare the part program for milling and turning centers.

Title of the Course: PE3:**Additive Manufacturing - 4PR532**

L	T	P	Cr
3	0	0	3

Text Books:

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.

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 Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	Choose various processes used in additive manufacturingwith 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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1				1		
CO2						2
CO3	2					1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10

ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE

Module 1:**Introduction** Overview, History, Need, Classification -Additive Manufacturing Technology in product development, Materials for Additive Manufacturing Technology, Tooling, Applications.	6 hrs
Module 2:**CAD & 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.	7 hrs
Module 3:**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	7 hrs
Module 4:**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.	6 hrs
Module 5:**Medical And Bio-Additive Manufacturing** Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing, Computer Aided Tissue Engineering (CATE), Case studies	7 hrs
Module 6:**Applications** Design, Concept Models, Form & fit checking, Ergonomic Studies, Functional testing, CAD data verification, Aerospace industry, Construction industry, Retail industry.	6 hrs

Module wise Measurable Students Learning Outcomes :
After the completion of the course the student should be able to:

1. Classify the principle and evolution of additive manufacturing.
2. Investigatedifferent file formats and issues related to part geometry.
3. Identify different additive manufacturing processes.
4. Calculate costing and other related issues of additive manufacturing.
5. Selectvarious materials used along with their properties.
6. Recommenddifferent application areas of additive manufacturing in modern industries and sciences.

Title of the Course: PE3:Micro Electro Mechanical Systems - 4PR533	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

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

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 Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
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	Create

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			1			
CO2					3	
CO3					3	1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10

ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**6 Hrs.**
Introduction to MEMS, Surface micromachining, Oxide anchored Cantilever beam, poly anchored beams.	
Module 2	**7 Hrs.**
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.	
Module 3	**6 Hrs.**
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.	
Module 4	**7 Hrs.**
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.	
Module 5	**6 Hrs.**
Biosensor and BioMEMS; Microfluidics; Digital Microfluidics; Ink jet printer,Optical MEMS: Displays -DMDs, LGVs, active and passive components.	
Module 6	**7 Hrs.**
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, Design parameters of mems devices.	

Module wise Measurable Students Learning Outcomes :
After the completion of the course the student should be able to:
1. Demonstrate MEMS concepts and technologies.
2. Justify the role of etching, LIGA in MEMS.
3. Explain the requirements for stiction, pressure sensors.
4. Study the fundamentals of Beams and Tunnel.
5. Describe the basic structures of a BioMEMS and Microfluidics and how to integrate the device in a smart product.
6. Create the Programme for CAMSOL and Intellisuite.

Title of the Course: PE3: Modeling and Simulation in Manufacturing - 3PR534	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

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.

Course Objectives :

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

Course Learning Outcomes:

CO	Upon completion of this course the student will be able to	Bloom's Cognitive level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1			3		
CO2					2	
CO3						3

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 Introduction	**6 Hrs.**
Introduction to Simulation, Concept of system, model and simulation, Components of discrete event simulation Advantages and disadvantages of simulation.	
Module 2 Concepts of Simulation	**6 Hrs.**
Statistical models in simulation, Probability distribution functions, Estimation of statistical parameters.	
Module 3 Queueing System Simulation	**7 Hrs.**
Characteristic of a queueing system, Simulation of single server queueing system Internet, Generation of Random number and Random number Varieties, Testing of random numbers.	
Module 4 Input Modeling	**6 Hrs.**
Input modeling: Estimation of parameters, Fit tests of distributions.	
Module 5 Output Data Analysis	**7 Hrs.**
Output data analysis for single system: Statistical analysis for terminating and non-terminating simulations, Comparing alternative system configurations.	
Module 6 Validation of models	**7 Hrs.**
Verification, validation and credibility of simulation models, Simulation of manufacturing and material handling systems, Monte Carlo simulation, Case studies.	

Module wise Measurable Students Learning Outcomes :

Student will be able to:

1. Summarize different types of modeling systems employed in manufacturing and industrial enterprises.
2. Solve practical problems related to simulation models in manufacturing organization.
3. Solve practical problems related to queuing systems.
4. Explain various aspects of modeling and simulation in manufacturing.
5. Analyze practical applications and case studies in manufacturing engineering.
6. Assess and validate various simulation models of manufacturing and material handling systems.

Title of the Course: PE4: Product Lifecycle Management - 4PR535	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

Textbooks:

1. Grieves Michael, Product Lifecycle Management- Driving the Next Generation of Lean Thinking, McGraw-Hill, 2006. ISBN 0071452303
2. AnttiSaaksvuori, AnselmiImmonen, Product Life Cycle Management - Springer, 1st Edition (Nov.5, 2003)
3. Stark, John. Product Lifecycle Management: 21st Century Paradigm for Product Realization, Springer-Verlag, 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") inQuality Manager's Complete Guide to ISO 9000, Prentice Hall, 1993. ISBN 013017534X.

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 Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Discussthe importance and the concept of Product Lifecycle Management & its need.	II	understanding
CO2	Exploit the methodology to Set the Product Lifecycle Management Vision & Develop Product Lifecycle Management strategy	III	Applying
CO3	Analyze the recent developments to perform product structure modelling with relationship	IV	Analyzing

CO-PO Mapping :

PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1				1	
CO2			2	3		1
CO3			2	3		1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1	**6Hrs.**
Product life cycle – Introduction, growth, maturity & decline, Product Lifecycle, Management- Definition & Overview, Background for Product Lifecycle Management-corporate challenges, Need of Product Lifecycle Management, Components/Elements of Product Lifecycle Management, Emergence of Product Lifecycle Management, Significance of Product Lifecycle Management - life cycle problems to be resolved.	
Module 2	**7Hrs.**
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). Weaving the threads into Product Lifecycle Management, 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 .	
Module 3	**6 Hrs.**
Collaborative Product Development, Mapping Requirements to specifications. Part Numbering, Engineering Vaulting, Product reuse, Engineering Change Management, Bill of Material and Process Consistency. Digital Mock up and Prototype development. Virtual testing and collateral. Introduction to Digital Manufacturing	
Module 4	**6 Hrs.**
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. Reasons for the deployment of Product Lifecycle Management systems	
Module 5	**7 Hrs.**
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, The Product	

Lifecycle Management Strategy, Principles for Product Lifecycle Management strategy, Preparing for the Product Lifecycle Management strategy.	
Module 6	**7 Hrs.**
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, Functional applications e.g., configuration management. Human resources in product lifecycle.	

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

1. Explain the product life cycle background, corporate challenges, significance and its elements.
2. Decide the plan for Product Lifecycle Management model and integrate the different elements for Product Lifecycle Management execution
3. Identify the various requirements in product development process in consideration to digital manufacturing.
4. Identify the different architecture and different models for product development.
5. Identification of Product Lifecycle Management vision and understand the product data and workflow.
6. Evaluate the different phases of product lifecycle technologies through case study.

Title of the Course: PE4: **Processing of Plastics and Composites** – 4PR536	L	T	P	Cr
	3	0	0	3

Pre-Requisite Courses:

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.

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 Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**		**2**			
CO2					**3**	**2**
CO3			**3**	**2**		**1**

Assessments :
Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	**Marks**
ISE 1	**10**

MSE	**30**
ISE 2	**10**
ESE	**50**

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:Processing of Plastics

Module 1	**8 Hrs.**
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. Moulding temperature pressure. Effect of various factors on curing. Materials properties and shrinkage. Faults in moulded articles and remedies. Process limitations.	
Module 2	**8 Hrs.**
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.	
Module 3	**6 Hrs.**
Laminate forming: High and low pressure laminates, materials, reinforcements, Processing conditions and operation, industrial and decorative laminates and their applications.	
Processing of Composites	
Module 4	**6 Hrs.**
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.	
Module 5	**8 Hrs.**
Various models analyzing the design and performance of composite materials;studying the composite modulus, strength and fracture behaviour for structural applications,Composites in Electrical, Superconducting and Magnetic Applications, Nano-composite devices, Civil constructions of structures/pannels, Aerospace industries,Automobile and other surface transportindustries, Packaging industries, Household and sports components etc.	
Module 6	**6 Hrs.**
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 & Compocasting, Screw extrusion, Liquidmetal impregnation technique – Squeeze casting, Pressure infiltration, Lanxide process)	

Module wise Measurable Students Learning Outcomes :

After the completion of the course the student should be able to:

1.Discuss the Compression Moulding process and their process limitations.
2Summarize the Transfer Moulding process.
3.Classify the Laminate forming process and their applications.
4. Examimne the composite materials and nano composite materials.
5.Analyze the design and performance of composite materials.
6. Select the fabrication process of composites.

Title of the Course: **PE 4:Advanced Tool Design - 4PR537**

L	T	P	Cr
3	0	0	3

Text Books:

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.

Course Objectives :

1. To developability 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 Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		1			
CO2						1
CO3	2		1			

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE

Module 1:**Introduction to Tool Design** Introduction –Tool Engineering ,Tool Classifications ,Tool Design Objectives , Tool Design in manufacturing- Challenges and requirements- Standards in tool design- Tool drawings -Surface finish – Fits and Tolerances. Tooling Materials- Ferrous and Nonferrous Tooling Materials- Carbides, Ceramics and Diamond -Nonmetallic tool materials-Designing with relation to heat treatment.	6 hrs
Module 2:**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, mechanics of chip formation, types of chip 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, theory and application of cutting fluid, methods of tool failure, 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 Chatter and its effect.	7 hrs
Module 3:**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 Form relieved and profile relieved cutters-Design of gear and thread milling Cutters. Economics of Machining: Gilbert's model: Minimum cost, Maximum production and Maximum profit rate.	6 hrs
Module 4:**Design of Jigs and Fixtures** Introduction, Fixed Gages, Gage Tolerances, selection of material for Gages, Indicating Gages and Automatic gages. 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 ForceCalculations.	7 hrs
Module 5:**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 , Short-run tooling for Piercing – Bending dies – Forming dies – Drawing dies-Design and drafting.	7 hrs
Module 6:**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 Presetting– General explanation of the Brown and Sharp machine.	6 hrs
Module wise Measurable Students Learning Outcomes : **After the completion of the course the student should be able to:** 1. Select appropriate tool, tool materials for given job. 2. Apply the principles of metal cutting. 3. Acquire the knowledge and skills related to the economy of cutting tool and ways to increase the tool life 4. Apply the principles of design jigs and fixture s for given job. 5. Design the dies for press tools. 6. Design the tooling for CNC machines.	

Title of the Course: Professional Elective 4 Optimization and Quantitative Techniques, 4PR538	L 3	T 0	P 0	Cr 3

Pre-Requisite Courses:

Textbooks:

1. Vohra N.D., *"Quantitative Techniques in Management"*,McGraw Hill, fourth edition, 2010
2. Taha H.A., "*Operations Research: An Introduction*", Prentice Hall India Pvt. Ltd., eighth edition, 2007.
3. Deb K., "*Optimization for Engineering Design: Algorithms and Examples"*, Prentice Hall of India, 2012

References:

1. Hillier and Libermann, "*Introduction to Operations Research"*, McGraw Hill Publ. 2009
2. Harvey M Wagner, "*Principles of Operations Research*" Prentice Hall of India 2010
3. Rao S., "*Engineering optimization, Theory and Practice"*, John Wiley & Sons Inc., 2009

Course Objectives :

1. To prepare the student for formulation of mathematical models in solving variety of optimization problems.
2. To provide the knowledge for testing of inventory models and scheduling models.
3. To impart the knowledge of analysis of real-world problems and finding optimal solutions.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		level	Descriptor
CO1	Demonstrate problem solving skill for linear and non-linear programming models.	III	Applying
CO2	Investigate mathematical models to make rational decisions in solving a variety of optimization problems.	IV	Analyzing
CO3	Recommend models and methodology to meet desired needs within realistic constraints.	V	Evaluating

CO-PO Mapping :

PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1			3		1
CO2	1		2	2	3	1
CO3	1		3	2		1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 70-80% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Module 1 Introduction to optimization	**6 Hrs.**
Framework and overview of optimization, continuous and discrete optimization, unconstrained and constrained problems.	
Module 2 Linear programming	**7 Hrs.**
Linear programming, Model formulation, Solution methods, Graphical and simplex methods, Duality and sensitivity analysis.	
Module 3 Non-linear programming	**7 Hrs.**
NLPP with equality constraints: Lagrange multiplier method, NLPP with inequality constraints: Kuhn-Tucker (KT) conditions, and Quadratic programming	
Module 4 Inventory control models	**7 Hrs.**
Economic order quantity, EOQ models without and with shortages, Multi-item inventory models, and Inventory models with price breaks	
Module 5 Scheduling and sequencing	**6 Hrs.**
Job sequencing, Johnson's algorithm, Heuristc methods, Branch and bound method, Travelling salesman problem.	
Module 6 Combinatorial optimization	**6 Hrs.**
Neighborhood solutions, Search techniques, Evolutionary algorithms, Genetic algorithm, Simulated annealing	

Module wise Measurable Students Learning Outcomes :

Student will be able to:

1. Classify the optimization methods.
2. Solve linear programming problems based on maximization and minimization objectives.
3. Identify and resolve the non-linearity in various optimization models.
4. Investigate the applications inventory control models.
5. Evaluate and apply scheduling models and solution methods.
6. Estimate the capabilities of various optimization methods.

Professional Elective (Lab) Courses

Title of the Course: **Production Engineering Lab 4- 4PR572**

L	T	P	Cr
0	0	4	2

Text Books:
As per the course details

References:
As per the course details

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 Learning Outcomes:

CO	**After the completion of the lab the student should be able to**	Bloom's Cognitive	
		level	Descriptor
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

CO-PO Mapping :

	PO1	PO2	PO3	PO4	PO5	PO6
CO1			1			2
CO2				2	1	
CO3	1					1

Lab Assessment:

There are four components of lab assessment, LA1, LA2, LA3 and Lab ESE.
IMP: Lab ESE is a separate head of passing.

Assessment	Based on	Conducted by	Conduction and Marks Submission	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 4 Submission at the end of Week 5	25
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 5 to Week 8 Submission at the end of Week 9	25
LA3	Lab activities, attendance, journal	Lab Course Faculty	During Week 10 to Week 14 Submission at the end of Week 14	25
Lab ESE	Lab Performance and related documentation	Lab Course faculty	During Week 15 to Week 18 Submission at the end of Week 18	25

Week 1 indicates starting week of 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.

Students should perform experiments based on electives selected from PE 3 and 4

Professional Elective – 3 (Experiments from any one elective as selected by student)	
List of Experiments for course CAD/CAM 1. Problems on 2D transformation 2. Problems on 3D transformation 3. Introduction to different commands of 2D drawing 4. Introduction to different commands of 3D drawing 5. Introduction to different commands of drafting 6. Introduction to different commands of GD&T 7. Introduction to different commands of Assembly drawing 8. Create assembly of minimum 6 components.	20 Hrs.
List of Experiments for course "Additive Manufacturing" 1. Demonstration and selection of job for 3D printing (2 Hrs) 2. Preparation of rough sketch of job (2 Hrs) 3. Preparation of 3D model (2 Hrs) 4. Preparation of .stl, g-code and related activities (2 Hrs) 5. Printing 3D model (4 Hrs) 6. Demonstration of 3D scanner (2 Hrs) 7. Selection of job and calibration of 3D scanner (2 Hrs) 8. Printing of scanned job on 3D printer (4 Hrs)	20 Hrs.
List of experiments for course MEMS 1. Introduction to wet etching 2. PCB machining 3. Micro channel fabrication using wet chemical etching.(4 hrs) 4. Micro milling 5. Micro EDM 6. Micro drilling of PCB 7. Soldering on PCB 8. Industrial Visit and report submission	20 Hrs.
List of Experiments for course Modeling and Simulation in Manufacturing Assignments on following topics 1. Statistical models in simulation 2. Probability distribution functions 3. Estimation of statistical parameters 4. Characteristic of a queuing system 5. Simulation of single server, queuing system Internet, Generation of Random number and Random number Varieties 6. Testing of random numbers Input modeling: Estimation of parameters, Fit tests of distributions. 7. Output data analysis for single system: Statistical analysis for terminating and non-terminating simulations 8. Comparing alternative system configurations 9. Simulation of manufacturing and material handling systems 10. Monte Carlo simulation	20 Hrs.
Professional Elective – 4 (Experiments from any one elective as selected by student)	
List of experiments for course PLM – Product Lifecycle Management 1. Case study on any product by using PLM cycle. (4 Hrs.)	20 Hrs.

2. Case study on technology based or consumer product company to investigate different product data issues (4 Hrs.) 3. Project report on the PM function, including its staffing, responsibilities, reporting relationships, and placement within the company. (4 Hrs.) 4. Demonstration of different tools of on PLM software. (4 Hrs.) 5. Six assignments based on the entire syllabus. (4 Hrs)	
List of experiments for course Sustainable Manufacturing 1. Case study of manufacturing industry using sustainable manufacturing. (4 Hrs.) 2. Case study on different tools of sustainable manufacturing. (4 Hrs.) 3. Case study on three pillars of sustainability from an engineering perspective. (4 Hrs.) 4. Project report on problem identification, its solution, and evaluate the feasibility of solution in Sustainable manufacturing. (4 Hrs.) 5. Six assignments based on the entire syllabus. (4 Hrs.)	20 Hrs.
List of experiments for course Advanced Tool Design 1) Design of Single point cutting tool (4 Hrs) 2) Design of multi point cutting tool (4 Hrs) 3) Design of press dies (4 Hrs) 4) Design of Jig (4 Hrs) 5) Design of Fixture (4 Hrs)	20 Hrs.
List of experiments for course Processing of plastics and composites (Minimum eight experiments) 1. Study of various Mould Design procedure and its selection criteria for different applications. 2. Study of Compounding of PVC and thermoforming process. 3. Study of Industrial Polymers and Polymerization techniques. 4. Study of plastic welding, bonding process. 5. Study of casting process of epoxy, acrylate resin etc. 6. Study of Manufacturing process of FRP composites like epoxy, polyester polymer . 7. Study of composite materials, Carbon-Carbon composites and Nano-composites. 8. Testing for Mechanical-static and dynamic- tensile strength and Biaxial testing of laminates.	20 Hrs.
List of Experiments/ Case studies for course Optimization and Quantitative Techniques **Case studies on:** 1. Linear programming problem. 2. Non-linear programming problem. 3. Inventory control models. 4. Manufacturing scheduling. 5. Evolutionary algorithm.	20 Hrs.

Mandatory Life Skill Courses

Title of the Course: Constitution of India 4IC601	L	T	P	Cr
	02	-	-	-

Pre-Requisite Courses: -

Textbooks:

1. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
2. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
3. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication

Course Objectives :

The objectives of the course are:

1. To review and create awareness on various provisions in the constitution of India.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Explain the premises informing the twin themes of liberty and freedom from a civil rights perspective.	2	Understanding
CO2	Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.	2	Understanding
CO3	Address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.	2	Understanding

CO-PO Mapping :

	1	**2**	**3**	**4**	**5**	**6**
CO1						
CO2						
CO3						

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), and One Mid Semester Examination (MSE) having 35%, 35% and 30% weights respectively.

Assessment	Marks
ISE 1	35
MSE	30

ISE 2	35

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)

Course Contents:

Module 1	**4 Hrs.**
History of Making of the Indian Constitution Drafting Committee, (Composition & Working)	
Module 2 Philosophy of the Indian Constitution	**4 Hrs.**
Preamble, Salient Features	
Module 3 Contours of Constitutional Rights & Duties	**5 Hrs.**
Fundamental Rights; Right to Equality; Right to Freedom; Right against Exploitation; Right to Freedom of Religion; Cultural and Educational Rights; Right to Constitutional Remedies; Directive Principles of State Policy; Fundamental Duties.	
Module 4 Organs of Governance	**5 Hrs.**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions	
Module 5 Local Administration	**5 Hrs.**
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	
Module 6 Election Commission	**5 Hrs.**
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	

Title of the Course: Pedagogy Studies 4IC602	L	T	P	Cr
	02	-	-	-

Pre-Requisite Courses: -

Textbooks:

1. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
2. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
3. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
4. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
5. www.pratham.org/images/resource%20working%20paper%202.pdf.

References: 1. Alexander RJ, 2001, Culture and pedagogy: International comparisons in primary education, Oxford and Boston: Blackwell.
2. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

Course Objectives :

The objectives of the course are:

1. To discuss pedagogical practices being used by teachers in formal and informal classrooms in developing countries.
2. To provide the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners.
3. To explain teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Outline pedagogical practices, and existing evidence on the review topic to inform programme design and policy making undertaken.	2	Understanding
CO2	Explain critical evidence gaps to guide the development	2	Understanding

CO-PO Mapping :

	1	**2**	**3**	**4**	**5**	**6**
CO1						

CO2							
CO3							

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), and One Mid Semester Examination (MSE) having 35%, 35% and 30% weights respectively.

Assessment	Marks
ISE 1	35
MSE	30
ISE 2	35
ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc. MSE: Assessment is based on 50% of course content (Normally first three modules)	

Course Contents:

Module 1 Introduction and Methodology	**5Hrs.**
Aims and rationale, Policy background, Conceptual framework and Terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions**,** Overview of methodology and Searching.	
Module 2	**5 Hrs.**
Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.	
Module 3	**5 Hrs.**
Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.	
Module 4	**5 Hrs.**
Professional development: alignment with classroom practices and follow-up support Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes	
Module 5	**5 Hrs.**
Research gaps and future directions Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment Dissemination and research impact.	

Title of the Course: Disaster Management 4IC603	L	T	P	Cr
	02	-	-	-

Pre-Requisite Courses: -

Textbooks:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep

Course Objectives :

The objectives of the course are:

1. To impart knowledge for critical understanding of key concepts in disaster risk reduction and humanitarian response, and disaster management approaches
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of, planning and programming in different countries, particularly their home country or the countries they work in

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Explain disaster risk reduction and humanitarian response policy and practice from multiple perspectives	2	Understanding
CO2	Summarize standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.	2	Understanding
CO3	Outline the strengths and weaknesses of disaster management approaches, planning and programming in different countries.	2	Understanding

CO-PO Mapping :

	1	**2**	**3**	**4**	**5**	**6**
CO1						
CO2						
CO3						

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), and One Mid Semester Examination (MSE) having 35%, 35% and 30% weights respectively.

Assessment	Marks
ISE 1	35
MSE	30
ISE 2	35

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

Module 1 Introduction	**4 Hrs.**
Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	
Module 2 Repercussions Of Disasters And Hazards	**4 Hrs.**
Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	
Module 3 Disaster Prone Areas In India	**4 Hrs.**
Study Of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	
Module 4 Disaster Preparedness And Management	**4 Hrs.**
Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.	
Module 5 Risk Assessment	**4 Hrs.**
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment and Warning, People's Participation In Risk Assessment. Strategies for Survival.	
Module 6 Disaster Mitigation	**4 Hrs.**
Meaning, Concept and Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	

Title of the Course: Value Education 4IC604	L	T	P	Cr
	02	-	-	-

Pre-Requisite Courses: -

Textbooks:

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Course Objectives :

The objectives of the course are:

1. To impart knowledge on value of education and self- development.
2. To imbibe good values in students.
3. To highlight importance of character.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Cognitive level	Descriptor
CO1	Explain value of education and self- development.	2	Understanding
CO2	Summarize importance of good character, and Behavior development.	2	Understanding

CO-PO Mapping :

	1	**2**	**3**	**4**	**5**	**6**
CO1						
CO2						
CO3						

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), and One Mid Semester Examination (MSE) having 35%, 35% and 30% weights respectively.

Assessment	Marks
ISE 1	35
MSE	30
ISE 2	35

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

Module 1	**6Hrs.**
1. Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. 2. Moral and non- moral valuation. Standards and principles. 3. Value judgments	
Module 2	**6 Hrs.**
1. Importance of cultivation of values 2. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. 3. Honesty, Humanity. Power of faith, National Unity. 4. Patriotism. Love for nature, Discipline	
Module 3	**7 Hrs.**
1. Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. 2. Punctuality, Love and Kindness. 3. Avoid fault Thinking. 4. Free from anger, Dignity of labour. 5. Universal brotherhood and religious tolerance. 6. True friendship. 7. Happiness Vs suffering, love for truth. 8. Aware of self-destructive habits. 9. Association and Cooperation. 10. Doing best for saving nature	
Module 4	**7 Hrs.**
1. Character and Competence –Holy books vs Blind faith. 2. Self-management and Good health. 3. Science of reincarnation. 4. Equality, Nonviolence, Humility, Role of Women. 5. All religions and same message. 6. Mind your Mind, Self-control. 7. Honesty, Studying effectively	

Value Added
Professional Courses

There are no courses under this category for this semester.

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