

**Pandit Deendayal Petroleum University**  
**School of Technology**  
**Course Structure for B. Tech. Industrial Engineering**

SEMESTER V			B. TECH. INDUSTRIAL ENGINEERING												
Sr. No.	Course Code	Course Name	Teaching Scheme					Exam Scheme					Total Marks		
			L	T	P	C	Hrs./Wk.	Theory			Practical				
								MS	ES	IA	LW	LE/Viva			
1		Industrial Orientation				3									
2	IE 301 (ME 315)	Production & Operations Management	3	-	-	6	3	30	60	10	-	-			100
4	IE 302T	Measurement and Design of Work (Theory)	3	-	-	6	3	30	60	10	-	-			100
5	IE 302P	Measurement and Design of Work (Practical)	-	-	2	1	2	-	-	-	25	25			50
6	MA 303T	Applied Statistics	3	1	-	7	4	30	60	10	-	-			100
7	IE 303	Operations Research - 1	3	1	-	7	4	30	60	10	-	-			100
8	IE 304	Economics	3	-	-	6	3	30	60	10	-	-			100
9	ME 301T	Manufacturing Processes - 2 (Theory)	3	-	-	6	3	30	60	10	-	-			100
10	ME 301P	Manufacturing Processes - 2 (Practical)	-	-	2	1	2	-	-	-	25	25			50
		<b>Total</b>	<b>18</b>	<b>2</b>	<b>4</b>	<b>43</b>	<b>24</b>								<b>700</b>

MS = Mid Semester  
LW = Laboratory Work

ES = End Semester  
LE = Laboratory Exam

IA = Internal Assessment (like quiz, assignments, etc.)

ME 301T MANUFACTURING PROCESS - II										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100
<b>UNIT I</b>										<b>09</b>
<p><b>Casting:</b> Steps involved in making a casting – Advantage of casting and its applications. – Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Principles of Gating, Gating ratio and design of Gating systems</p> <p>Solidification of casting – Concept – Solidification of pure metal and alloys, short &amp; long freezing range alloys. Risers – Types, function and design, casting design considerations, special casting processes Centrifugal; Die, Investment. Methods of Melting: Crucible melting and cupola operation, steel making processes, special.</p>										
<b>UNIT II</b>										<b>15</b>
<p><b>Welding:</b> Classification of welding process types of welds and welded joints and their characteristics, design of welded joints, Gas welding, ARC welding, Forge welding, resistance welding, Thermit welding and Plasma (Air and water) welding.</p> <p><b>Cutting of Metals:</b> Oxy – Acetylene Gas cutting, water plasma. Cutting of ferrous, non-ferrous metals. Inert Gas welding, TIG &amp; MIG, welding, Friction welding, Induction welding, Explosive welding, Laser Welding, Soldering &amp; Brazing. Heat affected zones in welding;</p> <p><b>Welding defects:</b> causes and remedies – destructive nondestructive testing of welds. Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth, Comparison of properties of Cold and Hot worked parts.</p>										
<b>UNIT III :</b>										
<b>Classification of Metal Forming Processes</b>										<b>09</b>
<p><b>Rolling:</b> Rolling fundamentals – theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements.</p> <p><b>Stamping, forming and other cold working processes :</b> Blanking and piercing – Bending and forming Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning – Types of presses and press tools. Forces and power requirement in the above operations. Sheet metal operations.</p> <p><b>Extrusion of Metals:</b> Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion Hydrostatic extrusion.</p>										
<b>UNIT IV</b>										<b>06</b>
<p><b>Forging processes:</b> Principles of forging – Tools and dies – Types Forging – Smith forging, Drop Forging– Roll forging – Forging hammers, Rotary forging – forging defects. Coating techniques</p> <p><b>Processing of Plastics:</b> Types of Plastics, Properties, applications and their Processing methods &amp; Equipment (blow &amp; injection molding).</p>										
										<b>Approximate Total : 39 Hrs</b>
<b>REFERENCES/BOOKS :</b>										
<ol style="list-style-type: none"> <li>1. Kalpakjin S, Manufacturing Engineering and Technology,</li> <li>2. Lindberg, Process and materials of manufacturing, Pearson Edu.</li> <li>3. Roenthal, Principles of Metal Castings.</li> <li>4. Paramar , Welding Process</li> <li>5. Sarma P C, Production Technology</li> <li>6. Suresh Dalela&amp; Ravi Shankar, Production Engineering, Galgotia Publications Pvt. Ltd.</li> </ol>										

**ME 301P MANUFACTURING PROCESS - II**

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	2	1	2	--	--	--	25	25	50

**List of Experiments:**

1. Shielded metal arc welding,
2. Gas metal arc welding,
3. Gas tungsten arc welding,
4. Gas welding, Gas cutting,
5. Plasma cutting
6. Resistance welding – spot, projection, butt welding,
7. Soldering and Brazing.
8. Injection molding of plastics
9. Development of macro and microstructure of welded joints.
10. Industrial visit to foundry/ forming industry/ plastic industry.
11. Friction Welding
12. Friction Stir Welding

IE 308T ERGONOMICS, HUMAN FACTORS AND PRODUCT DESIGN										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	6	3	30	60	10	--	--	100
<p><b>UNIT I</b> <span style="float: right;"><b>14</b></span>  Product design methodology and the structure of design process, introduction of product methodology, methodological problems, characteristics of methods, the phases of product design process, foundations of phase models, three phase models etc. Understanding customer needs, establishing product function, generation/selection of concepts, establishing specifications, design for manufacture and assembly.</p> <p><b>UNIT II</b> <span style="float: right;"><b>12</b></span>  Introduction to ergonomics, definition and history of ergonomics, introduction to ergonomic design, models of human performance, ergonomics methods. The human system, anthropometry, definition and scope, use of anthropometric data, statistical analysis, product design and workstation/workspace design using anthropometric data. Static work: design for standing and seated workers, design of repetitive tasks, repetitive stress injuries.</p> <p><b>UNIT III</b> <span style="float: right;"><b>12</b></span>  Design of manual handling tasks, work capacity, stress and fatigue. Human-machine system interfaces, communication and display design, measurement and prediction of human performance and learning/forgetting. Ergonomics in maintenance and repair, product quality and usability. Introduction to environmental ergonomics.</p> <p style="text-align: right;"><b>APPROXIMATE TOTAL</b> <span style="float: right;"><b>38</b></span></p>										
<b>Texts and References</b>										
<ol style="list-style-type: none"> <li>Otto and Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Pearson</li> <li>Ulrich, Eppinger and Goyal, Product Design and Development, 4<sup>th</sup> edition, Tata McGraw-Hill</li> <li>Sanders and McCormick, Human Factors In Engineering and Design, 7<sup>th</sup> edition, McGraw-Hill</li> <li>Bridger, R. S., Introduction to Ergonomics, Taylor and Francis</li> <li>Lehto and Buck, Introduction To Human Factors And Ergonomics For Engineers, Taylor and Francis</li> <li>Chakrabarti, D.,1997: Indian Anthropometric Dimensions for Ergonomic design Practice, NID, Ahmedabad</li> </ol>										

IE 308P ERGONOMICS, HUMAN FACTORS AND PRODUCT DESIGN										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
0	0	2	1	2	--	--	--	25	25	100
<p><b>LIST OF EXPERIMENTS</b> <span style="float: right;"><b>14</b></span></p> <ol style="list-style-type: none"> <li>1. Anthropometry – standing heights</li> <li>2. Anthropometry – sitting heights</li> <li>3. Anthropometry – work surface heights</li> <li>4. Body movement ranges</li> <li>5. Effect of work environment</li> <li>6. Lifting</li> <li>7. Anthropometric design</li> </ol>										

IE 303 OPERATIONS RESEARCH - I										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	0	7	4	30	60	10	--	--	100
<p><b>UNIT I</b> <span style="float: right;"><b>12</b></span></p> <p>Introduction to Operations Research and model building, review of basic linear algebra, concepts of convexity. Introduction to linear programming, formulation of linear programs, the graphical method, the simplex method, feasibility, unboundedness, alternative optima, degeneracy, the Big-M method, the Two-Phase method.</p>										
<p><b>UNIT II</b> <span style="float: right;"><b>10</b></span></p> <p>Duality in linear programming, sensitivity analysis. Goal programming. The transportation and transshipment problems, solution methods, optimality test, degeneracy in TP; assignment problem, Hungarian method, the Traveling Salesman Problem.</p>										
<p><b>UNIT III</b> <span style="float: right;"><b>8</b></span></p> <p>Introduction to integer programming, formulation of typical IP problems, the Branch and Bound method for solving pure and mixed IP. The Cutting Plane algorithm.</p>										
<p><b>UNIT IV</b> <span style="float: right;"><b>8</b></span></p> <p>Introduction to Game Theory, two-person zero sum games, saddle points, graphical solution, LP based solution, application of game theory. Use of modeling software in Operations Research.</p>										
<b>APPROXIMATE TOTAL</b>										
<b>38</b>										
<b>Texts and References</b>										
<ol style="list-style-type: none"> <li>1. Winston, W., Operations Research: Applications and Algorithms, Pearson</li> <li>2. Hillier and Lieberman, Introduction to Operations Research, Tata McGraw-Hill</li> <li>3. Taha, H., Operations Research: An Introduction, Pearson</li> <li>4. Render, Stair, Hanna and Badri, Quantitative Analysis for Management, Pearson</li> </ol>										

IE 304 ECONOMICS										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	6	3	30	60	10	--	--	100
<p><b>UNIT I</b> <span style="float: right;"><b>12</b></span>  Introduction to economics, micro and macroeconomics, basics of supply and demand, elasticity and its applications. Consumer preferences, indifference curves, budget constraints. Individual and market demand, income and substitution effects, consumer surplus, network externalities, demand estimation. Marginal cost, marginal revenue and profit maximization. Competitive markets, monopoly, monopsony, oligopoly. Capturing consumer surplus – price discrimination, peak load pricing, two part tariff, bundling.</p> <p><b>UNIT II</b> <span style="float: right;"><b>10</b></span>  Production, technology (economic) of production, isoquants, production with one variable input, production with two variable inputs, returns to scale. Short and long run production costs, cost curves, production with two outputs – economies of scope. The Cobb-Douglas production function. Efficiency in production.</p> <p><b>UNIT III</b> <span style="float: right;"><b>8</b></span>  Measuring a nation’s income, measuring the cost of living, concepts of GDP, GNP. The monetary system, money growth and inflation. Monetary Policy: Demand for and supply of money, Objectives of monetary and credit policy. Fiscal Policy: Public revenues, public expenditure, public debt, development activities financed by public expenditure.</p> <p><b>UNIT IV</b> <span style="float: right;"><b>8</b></span>  Industrial Policies: A brief review of industrial policies since independence, Industrial policy of 1991 and recent developments, Policy on foreign direct investment in Indian industry. Industrial Finance – Sources, Types, Components, Institutional Finance – IDBI, IFCI, SFCs, SIDC, Commercial Banks, Money and Capital Markets – Nature, Constituents, Functions, Indian Money and Capital Market. Various forms of business organization – proprietorship, partnership, limited company, advantages and disadvantages.</p> <p style="text-align: right;"><b>APPROXIMATE TOTAL</b> <span style="float: right;"><b>38</b></span></p>										
<b>Texts and References</b>										
<ol style="list-style-type: none"> <li>1. Pindyck and Rubinfeld, Microeconomics, Pearson</li> <li>2. Mankiw, M., Economics: Principles and Applications, Cengage</li> <li>3. Desai, B., Industrial Economy in India, Himalaya Publishing House</li> <li>4. Gupta, G., Managerial Economics, Tata McGraw-Hill</li> </ol>										