

**PANDIT DEENDAYAL PETROLEUM UNIVERSITY**  
**SCHOOL OF TECHNOLOGY**  
**COURSE STRUCTURE FOR B.TECH. MECHANICAL ENGINEERING**

SEMESTER VI			B.TECH. MECHANICAL 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	ME 307T	Design of Mechanical System	3	0	-	6	3	30	60	10	--	--	100
	ME-307P		--	--	2	1	2	--	--	--	25	25	50
2	ME 308T	Non Conventional Energy Sources	3	0	--	6	3	30	60	10	--	--	100
	ME 308P		--	--	2	1	2	--	--	--	25	25	50
3	ME 309T	Refrigeration & Air - Conditioning	3	0	--	6	3	30	60	10	--	--	100
	ME 309P		--	--	2	1	2	--	--	--	25	25	50
4	ME 310T	Work Design And Measurement	3	0	0	6	3	30	60	10	--	--	100
5	ME 311T	Production Technology	3	0	--	6	3	30	60	10	--	--	100
	ME 311P		--	--	2	1	2	--	--	--	25	25	50
6	HS 3XXT	Elective – HM	2	0	0	4	2	30	60	10	--	--	100
		Total	<b>17</b>	<b>0</b>	<b>8</b>	<b>38</b>	<b>25</b>						800

MS = Mid Semester, ES = End Semester;  
LW = Laboratory work; LE = Laboratory Exam

IA = Internal assessment (like quiz, assignments etc)

ME 307T DESIGN OF MECHANICAL SYSTEMS										
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
<p><b>UNIT I</b> <span style="float: right;"><b>08</b></span>  <b>Design of Crane hook:</b> introduction, stresses in curved beams, Expression for radius of neutral axis for rectangular, circular, trapezoidal and T-Section. Design of crane hooks, C-clamps.</p> <p><b>UNIT II</b> <span style="float: right;"><b>08</b></span>  <b>Design of Power Transmission Systems:</b> Types of power transmission devices, advantages and disadvantages  <b>Design of Belt and Rope Drives:</b> Components of belt drive, Mechanism of belt drive, Belt Materials, Types of belts and pulleys and their selection, Stresses in belts, Transmission efficiencies, Chain drives  <b>Design of Gear Drives:</b> Gear terminology, Kinematics of gear drive, Standard system of gear tooth, Gear materials, Design of Spur, helical and bevel gears (Tooth proportions, Force analysis, Dynamic loading of gear tooth, Heat Treatment and Wear Resistance, Gear Construction and stress concentration), Design of worm gear set</p> <p><b>UNIT III</b> <span style="float: right;"><b>08</b></span>  <b>Design of Bearings:</b> Types, materials and selection of bearings, Working conditions for the bearings, Hydrodynamic lubrication theory for journal bearings, Design factors (minimum film thickness, flow variable, heat balance etc.) for journal bearings, Design procedure for journal bearings, Design of bearings (bearing materials, bearing housings, bearing shells etc.), Design of thrust (pivot and collar) bearings, Ball and roller bearings, Load and life rating of bearings</p> <p><b>UNIT IV</b> <span style="float: right;"><b>15</b></span>  <b>Design of Engine Parts:</b> Components of I.C. engine, Materials for engine components, Working conditions, Forces and stresses acting on various engine components, Design of cylinder and cylinder liner, Design of piston, Design of Connecting Rod, Thrust in connecting rod, Stress due to whipping action on connecting rod ends, Design of cranks and crank shafts, Strength and proportions of over hung and center cranks, Design of crank pins.  <b>Design of Machine Tool Elements:</b> Design of beds, slide ways, spindles, material selection, design of strength and rigidity of parts.</p>										
<b>Approximate Total : 39 Hrs</b>										
<b>Texts and References</b>										
<ol style="list-style-type: none"> <li>1. C. Sharma and K. Purohit, Design of Machine Elements, PHI Publishers.</li> <li>2. U. Jindal, Machine Design, Pearson Publishers.</li> <li>3. N. Pandya and C. Shah, Machine Design, Charotar Publishers.</li> <li>4. J. Shigley, C. Mischke, R. Budynas, Mechanical Engineering Design, Tata-McGraw Hill Publishers.</li> <li>5. R. Juvinall, K. Marshek, Fundamental of Machine Component Design, John Wiley and Sons Publishers.</li> <li>6. R. Norton, Machine Design: An Integrated Approach, Pearson Education Publishers.</li> <li>7. V. Bhandari, Machine Design, Tata-McGraw Hill Publishers.</li> <li>8. S. Kazimi, Solid Mechanics, Tata-McGraw Hill Publishers.</li> </ol>										

ME 307P DESIGN OF MECHANICAL SYSTEMS										
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
<p><b>List of Design Problems:</b></p> <ol style="list-style-type: none"> <li>1. Design exercise for crane hook</li> <li>2. Design exercise for power transmissions systems</li> <li>3. Design exercise for bearings</li> <li>4. Design exercise for I.C. Engine components</li> <li>5. Design exercise for Machine tool element</li> <li>6. Design Project</li> </ol>										

ME 308T NONCONVENTIONAL ENERGY SOURCES										
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
<p><b>UNIT I</b> <span style="float: right;"><b>15</b></span>  Introduction: Man and Energy, world production and reserve of conventional energy sources, Indian production and reserves, Energy alternatives.  Solar radiation and measurement: Origin, nature and availability of solar radiation, estimation of solar radiation date. Effects of receiving surface location and orientation. Heat transfer considerations relevant to solar energy.  Solar energy collectors: Characteristics of materials and surfaces used in solar energy absorption. Devices for thermal collection and storage. Design consideration and performance of different types of solar cells. Flat plate, focusing collectors.  Solar energy storage: Energy storage devices such as water storage systems, packed Bed storage systems, phase change storage systems.  Application: systems for space heating, solar water pumps, solar pond, Solar Thermal Power plants, solar distillation, Solar Refrigeration and solar air conditioning.  Solar PV systems.</p> <p><b>UNIT II</b> <span style="float: right;"><b>10</b></span>  Energy from bio mass: Generation, conversion technologies and utilization of biogas, design of biogas plants and gasifiers Fuel Cell Technologies</p> <p><b>UNIT III</b> <span style="float: right;"><b>10</b></span>  Wind energy: nature, power, forces, conversion and estimation. Components of wind energy system, types, design considerations. Generation systems, safety and environment.  Geothermal Energy Systems. Tidal energy systems. Oceanic power generation. Design considerations, Installation and Performance Evaluation. MHD power generations</p> <p><b>UNIT IV</b> <span style="float: right;"><b>4</b></span>  Role of the unconventional energy, sources in power planning. <b>Introduction to energy conservation and audit</b></p> <p style="text-align: right;"><b>Approximate Total : 39</b></p> <p><b>Hrs</b></p> <p><b>Texts and References</b></p> <ol style="list-style-type: none"> <li>1. Bansal Keemann, Meliss, Renewable energy sources and conversion technology, Tata Mc Graw Hill.</li> <li>2. Kothari D.P., Renewable energy resources and emerging technologies, Prentice Hall of India Pvt. Ltd.</li> <li>3., Rai G.D, Non-Conventional energy SourcesKhanna Publishers.</li> <li>4. Desai Ashok V., Nonconventional Energy, , New Age International Publishers Ltd.</li> <li>5. S.P. Sukhatme, " Solar Energy", Tata-Mcgraw hill, New Delhi.</li> <li>6. Duffie J. A. &amp; Beckman W.A., Solar engineering of thermal processes, Wiley- international Publication</li> </ol>										

ME 308P NONCONVENTIONAL ENERGY SOURCES										
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
<p><b>List of Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Measurement of solar insolation, duration and instruments</li> <li>2. Performance characteristic of solar flat plate collector</li> <li>3. Performance characteristic of solar box cooker</li> <li>4. Performance characteristic of solar concentrator</li> <li>5. Performance evaluation of Solar PV power plant</li> <li>6. Performance evaluation of wind mill power plant</li> <li>7. Performance evaluation of bio gas plant</li> <li>8. Case study on power conservation aspects</li> <li>9. Performance evaluation of gasifiers driven power plant</li> <li>10. Feasibility study of ocean power plant</li> <li>11. Walk through industrial/institute energy audit.</li> </ol>										

ME 309T REFRIGERATION & AIR CONDITIONING										
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>10</b>					
<p><b>Introduction:</b> Introduction to Refrigeration; Necessity and applications; Ideal refrigeration cycles; air-refrigeration, Bell-Coleman cycle, open and dense air systems, actual air-refrigeration system.</p> <p><b>Vapour Compression Refrigeration:</b> Working principle and essential components of the plant, simple vapour compression refrigeration cycle - COP, Representation of cycle on T-S and p-h charts - effects of sub cooling and super heating - cycle analysis - Actual cycle, Influence of various parameters on system performance – necessity of multi-staging, multistage compression system, and their analysis, necessity and working of cascading system.</p>										
<b>UNIT II</b>					<b>10</b>					
<p><b>Refrigerants:</b> Desirable properties of refrigeration's; classification of refrigerants; ozone depletion global warming, secondary refrigerants, future industrial refrigerants, recent development.</p> <p><b>Vapour Absorption Refrigeration:</b> vapor absorption system working principles; description and working of NH<sub>3</sub>- water system and Li Br –water; three fluid absorption system and its salient features; steam jet refrigeration system - working principle, basic components and analysis; principle and operation of vortex tube or hilsch tube.</p>										
<b>UNIT III</b>					<b>09</b>					
<p><b>Psychometric &amp; Human Comfort:</b> Psychometric – Composition of air and its effect on human comfort; psychometric terms – specific humidity, relative humidity percentage humidity and absolute humidity; temperatures – dry bulb, wet bulb and dew point; Psychometric processes: different types of psychometric processes sensible heating and cooling process, Latent heating and cooling process, heating with humidification, cooling with dehumidification, adiabatic cooling; air washer process; contact and bypass factor; apparatus dew pint; condition line; sensible heat factor; calculation of ADP with the help of the chart; Requirement of human comfort.</p>										
<b>UNIT IV</b>					<b>10</b>					
<p><b>Air Conditioning:</b> comfort air-conditioning; summer and winter air-conditioning; concept of effective temperature, comfort chart; requirements of industrial air-conditioning, air-conditioning load calculations.</p> <p><b>Control:</b> Refrigeration and air-conditioning control, air handling, air distribution and duct design.</p>										
<b>Texts and References</b>										
<ol style="list-style-type: none"> <li>1. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill</li> <li>2. Whitman, Jhonson and Tomczyk, Thomson Delmer Learning, Refrigeration and Air Conditioning Technology</li> <li>3. Abdul Ameen , Refrigeration and Air Conditioning , Prentice Hall of India Ltd.</li> <li>4. P. N. Ananthanarayan, Basic Refrigeration and Air Conditioning, Tata McGraw Hill</li> <li>5. Wilbert F. Stoecker and Jerold W. Jones, Refrigeration and Air Conditioning, Tata McGraw Hill</li> <li>6. Richard Charles Jordan, Gayle B. Priester, Refrigeration and Air Conditioning, Prentice hall of India Ltd.</li> <li>7. ASHRAE Handbook – Refrigeration</li> </ol>										

ME 309P REFRIGERATION & AIR CONDITIONING										
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
<b>List of Experiments:</b> <ol style="list-style-type: none"> <li>1. Performance on Vapor Compression Refrigeration system</li> <li>2. Study of domestic refrigerator</li> <li>3. Performance on Vapor Absorption Refrigeration system</li> <li>4. Performance on Ice Plant</li> <li>5. Performance on window air conditioning unit</li> <li>6. Study and design of Industrial refrigeration system</li> </ol>										

ME 310T WORK DESIGN AND MEASUREMENT										
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
<b>UNIT I</b>					<b>12</b>					
Introduction to Work Study, Work of F.W. Taylor; Frank and Lillian Gilbreth and others; definition of productivity; means of increasing productivity; definition of work study; productivity and work study; human factors in the application of work study. Motion Study, definition, aims; procedure for method study; selection of jobs; recording techniques; micro-motion study; Therbligs; cyclograph and chronocyclograph; principles of motion economy; design of work place layout; analysis in the form of a chart; operation chart; flow process chart; flow diagram; string diagram; man-machine chart; two hand chart; simo chart.										
<b>UNIT II</b>					<b>12</b>					
Introduction to work measurement, definition, uses, procedure; time study equipment; selection of operator, performance rating, allowances, synthesis, standard data, production interruption study, analytical estimation, work sampling, statistical concepts, confidence limits, number of cycles to be studied; determination of standard time; PMTS, MTM, WFS.										
<b>UNIT III</b>					<b>8</b>					
Introduction to job evaluation; objectives of job evaluation; job analysis, job description, methods of job evaluation like factor comparison, point system, etc. Job design, psychological aspects of job design. Introduction to ergonomics in the work environment. Wages and incentives, characteristics of a good wage/incentive system, methods of wage payment. Halsey's premium plan, piece rate system.										
<b>UNIT IV</b>					<b>7</b>					
Value Engineering, concept of value; product life cycle, value engineering approaches, job plan, value tests. Introduction to plant layout, importance and relevance of plant layout, various types of plant layout, process layout, product layout, cellular layout, fixed layout; layout algorithms. Layout of service facilities. Types and methods of cost estimation, cost elements, allocation of overheads, break-even point.										
					<b>APPROXIMATE TOTAL 39hrs.</b>					
<b>Texts and References</b>										
1. ILO, Introduction to Work Study, Universal Publishing Corporation, Bombay.										
2. Mundel, Motion and Time Study, Prentice Hall of India.										
3. Ralph M. Barnes, Motion and Time Study; John Wiley and Sons.										
4. Miles; L. D., Techniques of Value Engineering and Analysis, McGraw Hill.										
5. R. C. Patel , Work Study										



ME 311T PRODUCTION TECHNOLOGY										
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>08</b>					
<p><b>Elementary treatment of metal cutting theory</b> – Element of cutting process – Geometry of single point tool and angles chip formation and types of chips – built up edge and its effects chip breakers. Mechanics of orthogonal cutting –Merchant’s Force diagram, cutting forces – cutting speeds, feed, depth of cut, tool life, coolants, machinability – Tool materials</p> <p>Introduction – Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications.</p>										
<b>UNIT II</b>					<b>05</b>					
<p><b>Ultrasonic machining</b> – Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.</p> <p>Abrasive jet machining, Water jet machining and abrasive water jet machine: Basic principles, equipments, process variables, And mechanics of metal removal, MRR, application and limitations.</p>										
<b>UNIT III</b>					<b>10</b>					
<p><b>Electrochemical Process:</b> Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy economic aspects of ECM – Simple problems for estimation of metal removal rate. Fundamentals of chemical, machining, advantages and applications.</p> <p><b>Thermal metal removal processes:</b> General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.</p>										
<b>UNIT IV</b>					<b>14</b>					
<p>Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.</p> <p>Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.</p> <p>Chemical machining-principle- maskants –etchants- applications. Magnetic abrasive finishing, Abrasive flow finishing, Electro-stream drilling, Shaped tube electrolytic machining.</p>										
<b>Approximate Total : 39 Hrs</b>										
<b>References &amp; Text Books:</b>										
<ol style="list-style-type: none"> <li>1. VK Jain, Advanced machining processes, Allied publishers.</li> <li>1. Pandey P.C. and Shah H.S., Modern Machining Process, Tata McGraw Hill.</li> <li>2. Bhattacharya A, New Technology, The Institution of Engineers, India</li> </ol>										

ME 311P PRODUCTION TECHNOLOGY										
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
<p><b>List of Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Initial experiments with conventional machining processes</li> <li>2. Hands on experiment with CNC lath machine</li> <li>3. Hands on experiment with CNC milling machine</li> <li>4. Visit to Water jet machining workshop.</li> <li>5. Visit to advance machining workshop of INDO-GERMAN TOOL, CIPET,etc.</li> </ol>										

HS 311T SOCIAL SCIENCE APPROACHES TO DEVELOPMENT										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	--	4	2	30	60	10	--	--	100
<b>Unit I</b>					<b>06</b>					
<b>Development and Underdevelopment</b> – Historical genesis, theories, social indicators and measures. Issues of Human Development, MDGs, Poverty and Inequality,										
<b>Unit II:</b>					<b>06</b>					
<b>Indian Experiences with Development</b> – India’s path of planning and mixed economy, Post Independence development experiences, Measures of Achievement of Indian Development, Phase of Economic reforms and liberalization.										
<b>Unit III:</b>					<b>07</b>					
<b>Structures and Frameworks of Development in India</b> – Social Structures and Indian Development Processes of Decentralization, Institutions of Local Governance and impact on Development; Government-Market-Civil Society Interface.										
<b>Unit IV:</b>					<b>07</b>					
<b>Interrogation of the accepted paradigm of development</b> – Gender, Religion, Caste, Environment; Appropriate Technology and Development										
<b>Approximate Total : 26 Hrs</b>										
<b>References &amp; Text Books:</b>										
<ol style="list-style-type: none"> <li>1. Chakravarty.Sukhomoy: Development Planning : The Indian Experience, Clarendon press, Oxford</li> <li>2. Kumar, D. And Bhattacharya, S.,Cambridge Economic History of India: Vol. 2, 1757-2003.Hyderabad: Orient Longman.</li> <li>3. Mathur, B. L., (2002): Economic Planning and Development, Sublime Publications, New Delhi</li> <li>4. Mkandawire, Thandika: Social Policy in a Development Context, UNRISD and Palgrave, New York,</li> <li>5. Prabhu, K. Seetha: Economic Reforms and Social Sector Development: A study of Two Indian States, Sage, New Delhi</li> <li>6. Rajneesh, S., S L Goel,: Panchayati Raj in India: Theory and Practice, Deep and Deep, New Delhi</li> <li>7. Sachs, J.D., Varshney, A., and Bajpai, N, India in the era of economic reforms. New Delhi: Oxford University Press</li> <li>8. Second Administrative Reforms Commission, Local Governance: An Inspiring Journey into Future, Sixth Report, GoI, New Delhi</li> <li>9. Sen, Amartya, Reprinted, Inequality Reexamined, Oxford, New Delhi</li> <li>10. Sen, Amartya, Development as Freedom, OUP, New Delhi</li> <li>11. Singh, Katar, Rural Development: Principles, Policies and Management, Sage, New Delhi.</li> </ol>										

HS 313T Environment Development & Society										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	--	4	2	30	60	10	--	--	100
<p><b>Unit 1.</b> Environment in India: air, water, land and agriculture, biodiversity; forests and wildlife</p> <p><b>Unit 2.</b> Modern notions of development and challenges to environment in India: urbanization; increasing energy needs (nuclear, bio-fuel, solar); climate change</p> <p><b>Unit 3.</b> Sustainable Development: gender and sustainable development; inclusion of sustainable development value in government function</p> <p><b>Unit 4.</b> Challenges of production and issues pertaining to consumption: Fair trade; Emerging Issues in Production rural systems and pressures due to urbanization. Measuring social development in the wake of the macro-processes of liberalization, privatization and globalization.</p> <p><b>References:</b></p> <ol style="list-style-type: none"> <li>1. Environment, development and society in contemporary India by Archana Prasad (2008), Macmillan India Limited, 438 Pages.</li> <li>2. Sustainable Development: Linking economy, society, environment by Tracey Strange and Anne Bayley (2008), OECD Publishing, 142 pages.</li> <li>3. Society And Environment by S. C. Naik and Tiwari (2009), Oxford &amp; Ibh Publishing Co. Pvt Ltd, 316 pages.</li> </ol>										

HS 314T Organizational Psychology										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
2	0	--	4	2	30	60	10	--	--	100
<p><b>Course Content:-</b>            Definition and explanation of the term, 'industrial psychology' or 'occupational psychology.'            Objectives for studying industrial psychology            Work place problems            Ideal workplace environment and its effects.            Motivation and leadership.            Organizational behaviour.            Relation between a personal and professional life.            Character, common sense and intellect.            Working in a team.            Crisis management.            Decision making in an organization.</p> <p><b>Evaluation Parameters:-</b>            Group Projects - 30            Mid- semester Exam – 20            Attendance in lecture – 05            Assignments - 05            End – Semester Exam – 40</p> <p><b>Recommended Reading:</b>  <u>Leadership: Theory and Practice</u>, Peter G. Northouse  <u>Working with Emotional Intelligence</u>, Daniel Goleman  <u>Industrial Psychology</u>, Bulm and Nailen  <u>Occupational Stress in Bureaucracy</u>, S. Kumar  <u>The Seven Habits of Highly Effective People</u>, Stephen Covey  <u>First Break all the Rules</u>, Marcus Buckingham and Curt Coffman.  <u>Organization and Management</u>, R D. Agarwal</p>										