Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and detailed syllabus (DJ19)

Second Year B.Tech

in

Production Engineering

(Semester III and IV)

Revision: 1 (2019)
With effect from the Academic Year: 2020-2021

1st July, 2020

SHRI VILEPARLE KELAVANI MANDAL'S
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC ACCREDITED with "A" GRADE (CGPA : 3.18)

Scheme for Second Year B. Tech Program in Production Engineering : Semester III (Autonomous)
(Academic Year 2020-2021)

Sr. No	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)							Aggregate (A+B)	Credits earned	
																Term work						
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration	Theory	Oral	Practical	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Laboratory Work	Tutorial / Mini project / Presentation	Term Work Total	CA Total (B)			
1	DJ19PEC301	Engineering Mathematics-III	3	--	--	3	3	75	--	--	--	**75**	25	25	25	--	--	--	**25**	**100**	3	**4**
	DJ19PET301	Engineering Mathematics-III Tutorial	--	--	1	1	--	--	--	--	--	**--**	--	--	--	--	--	25	**25**	**25**	1	
2	DJ19PEC302	Applied Thermodynamics and Fluid Mechanics	3	--	--	3	3	75	--	--	--	**75**	25	25	25	--	--	--	**25**	**100**	3	**3**
3	DJ19PEC303	Engineering Materials & Metallurgy	3	--	--	3	3	75	--	--	--	**75**	25	25	25	--	--	--	**25**	**100**	3	**4**
	DJ19PEL303	Engineering Materials & Metallurgy Lab.	--	2	--	1	--	--	--	--	--	**--**	--	--	--	--	--	25	**25**	**25**	1	
4	DJ19PEC304	Manufacturing Processes	3	--	--	3	3	75	--	--	--	**75**	25	25	25	--	--	--	**25**	**100**	3	**5**
	DJ19PEL304	Manufacturing Processes Lab.	--	4	--	2	--	--	--	--	--	**--**	--	--	--	--	--	50	**50**	**50**	2	
5	DJ19PEC305	Mechanics of Materials	3	--	--	3	3	75	--	--	--	**75**	25	25	25	--	--	--	**25**	**100**	3	**3**
6	DJ19PEL306	Computer Aided Machine Drawing Lab.	--	2*+ 2	--	2	--	--	--	50	--	**50**	--	--	--	--	--	50	**50**	**100**	2	**2**
7	DJ19PEL307	Python Programming Lab.	--	2	--	1	--	--	--	--	--	**--**	--	--	--	--	--	25	**25**	**25**	1	**1**
8	DJ19A2	Innovative Product Development -I	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-	--
9	DJ19A3	Constitution of India	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-	--
		Total	**16**	**14**	**0**	**22**	--	**375**	**0**	**50**	--	**425**	**125**	**125**	**125**	--	--	**175**	**300**	**725**	**22**	

* Theory of entire class to be conducted.

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NAAC ACCREDITED with "A" GRADE (CGPA : 3.18)

Scheme for Second Year B. Tech. Program in Production Engineering : Semester IV (Autonomous)
(Academic Year 2020-2021)

Sr. No	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)								Aggregate (A+B)	Credits earned	
																Termwork							
			Theory (hrs.)	Practical (hrs.)	Tutorial (hrs.)	Credits	Duration	Theory	Oral	Practical	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Laboratory Work	Tutorial / Mini project / Presentation	Term Work Total	CA Total (B)			
1	DJ19PEC401	Applied Statistics	3	--	--	3	3	75	--	--	--	**75**	25	25	25	--	--	--	**25**	**100**	3	**4**
	DJ19PET401	Applied Statistics Tutorial	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	25	**25**	**25**	1	
2	DJ19PEC402	Mould and Metal Forming Technology.	3		--	3	3	75	--	--	--	**75**	25	25	25	--	--	--	**25**	**100**	3	**4**
	DJ19PEL402	Mould and Metal Forming Technology Lab.	--	2	--	1	--	--	--	--	25	**25**	--	--	--	--	--	25	**25**	**50**	1	
3	DJ19PEC403	Theory of Machines.	3	--	--	3	3	75	--	--	--	**75**	25	25	25	--	--	--	**25**	**100**	3	**4**
	DJ19PEL403	Theory of Machine Lab.	--	2	--	1	--	--	--	--	--	--	--	--	--	--	--	25	**25**	**25**	1	
4	DJ19PEC404	Applied Electrical and Electronics.	3	--	--	3	3	75	--	--	--	**75**	25	25	25	--	--	--	**25**	**100**	3	**4**
	DJ19PEL404	Applied Electrical and Electronics Lab.	--	2	--	1	--	--	--	--	--	--	--	--	--	--	--	25	**25**	**25**	1	
5	DJ19PEC405	Advanced Manufacturing Processes.	3	--	--	3	3	75	--	--	--	**75**	25	25	25	--	--	--	**25**	**100**	3	**5**
	DJ19PEL405	Advanced Manufacturing Processes Lab.	--	4	--	2	--	--	--	50	--	**50**	--	--	--	25	--	--	**25**	**75**	2	
6	DJ19IHC1	Universal Human Values.	2	--	--	2	3	75	--	--	--	**75**	25	25	25	--	--	--	**25**	**100**	2	**2**
	DJ19IHT1	Universal Human Values Tutorial	-	--	1	1	--	--	--	--	--	--	--	--	--	--	--	25	**25**	**25**	1	**1**
7	DJ19A4	Innovative Product Development - II	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			17	**12**	**1**	**24**	--	**450**	--	**50**	**25**	**525**	**150**	**150**	**150**	**25**	--	**125**	**300**	**825**	**24**	

<table>
<tr><td colspan="8">Program: Second Year Production Engineering</td><td colspan="3">Semester : III</td></tr>
<tr><td colspan="8">Course : Engineering Mathematics-III</td><td colspan="3">Course Code:DJ19PEC301</td></tr>
<tr><td colspan="8">Course : Engineering Mathematics-III Tutorial</td><td colspan="3">Course Code:DJ19PET301</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
<tr><td colspan="5">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="5">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="5">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">25</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">--</td><td rowspan="2">1*</td><td rowspan="2">4</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td colspan="2">Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>--</td><td colspan="2">25</td><td>25</td></tr>
</table>

Objectives:

1. To provide sound foundation in the mathematical fundamentals necessary to formulate, solve and analyze engineering problems.
2. To study the basic principles of Laplace Transform, Fourier series, Complex variables.

Outcomes: On completion of the course, learner will be able to:

1. Use Laplace and inverse Laplace Transform to the Ordinary Differential Equations.
2. Identify analytic and harmonic functions and solve real integrals using complex integration.
3. Find Fourier series of periodic functions and simplify infinite series.
4. Solve certain partial differential equations analytically and numerically.
5. Correlate different variables of data.

Detailed Syllabus: (unit wise)		
Unit.	**Description**	**Duration**
1	**Laplace Transform** LT of standard functions such as 1, t^n,e^{at}, sin*at*, cos*at*, sinh*at*, cosh*at*, Heaviside Unit step function, Dirac Delta function, Periodic functions. Linearity property of Laplace Transform, First Shifting property, Second Shifting property, Change of Scale property of L.T. (without proof). $L\{t^n f(t)\}, L\left\{\frac{f(t)}{t}\right\}, L\left\{\int_o^t f(u)\,du\right\}, L\left\{\frac{d^n f(t)}{dt^n}\right\}$	**05**
2	**Inverse Laplace Transform** Linearity property, Partial fractions method and convolution theorem. Applications to solve ordinary differential equations with one dependent variable with given boundary conditions.	**06**
3	**Complex Variables, Differentiation and Integration** Analytic functions, Cauchy-Riemann equations in Cartesian and polar coordinates (only statement). Milne-Thomson method to determine analytic function when it's real or imaginary or its combination is given. Harmonic function, orthogonal trajectories. Bilinear Transformation with fixed points, cross-ratio**(For Self-Study)** Taylor's and Laurent's series. Residue at removable singularity, poles and isolated singularity and its evaluation. Residue theorem, application to evaluate real integral of type $\int_0^{2\pi} f(cos\theta, sin\theta)d\theta, \int_{-\infty}^{\infty} f(x)dx.$	**12**
4	**Fourier Series and Partial Differential Equations** Fourier series of periodic function with period 2π & 2*l.* Even and odd functions, Half range sine and cosine series, Parseval's identities (without proof) Orthogonal and Orthonormal functions. Numerical Solution of PDE using Bender-Schmidt Method and Crank-Nicolson method.	**10**
5	**Linear Algebra** Characteristic equation, Eigenvalues and Eigenvectors with properties. Cayley-Hamilton theorem to find higher order matrices and inverse of matrix. Diagonalizability of similar matrices. Functions of a matrix. Quadratic Forms: Canonical form using Congruent transformations, Orthogonal Transformation to find rank, index, signature and value class.	**09**

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Consisting **Two Compulsory Class Tests for 25 marks**, First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

*Term-Work (Journal):

At least total 08 tutorials covering entire syllabus will be given during class wise tutorial. Term work assessment will be based on the overall performance of the student with every tutorial graded from time to time. The average of grades converted into marks should be taken into account for term work assessment.

Books Recommended:

Text books:

1. *Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication*
2. *Advanced Engineering Mathematics, E. Kreyszing, Wiley Eastern Limited*

Reference books:

1. *Higher Engineering Mathematics, B.V. Ramana, McGraw Hill Education, New Delhi*
2. *Complex Variables: Churchill, Mc-Graw Hill*
3. *Integral Transforms and their Engineering Applications, Dr B. B. Singh, Synergy Knowledgeware, Mumbai*
4. *Numerical Methods, Kandasamy, S. Chand & CO*
5. *Fundamentals of Mathematical Statistics by S.C. Gupta and Kapoor*.

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<tr><td colspan="5">Program: Second Year Production Engineering</td><td colspan="5">Semester : III</td></tr>
<tr><td colspan="5">Course : Applied Thermodynamics and Fluid Mechanics</td><td colspan="5">Course Code: DJ19PEC302</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</td><td colspan="9">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="4">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
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<tr><td colspan="4">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
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</table>

Objectives:

1. To acquaint with basic concepts, various processes and cycles of Thermodynamics and its applications.
2. To familiarize the student with the understanding about basic laws of thermodynamics and its applications.
3. To impart the fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
4. To understand the various energy losses during fluid flow through pipes.

Outcomes: On completion of the course, learner will be able to:

1. Understand the concept of thermodynamics and laws of thermodynamics.
2. Apply the first law of thermodynamics for various systems.
3. Apply the second law of thermodynamics for various systems.
4. Understand the various properties of fluid and kinematics of fluid flow.
5. Apply fluid mechanics principle to understand the dynamic of flow and various losses during flow through pipe.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Fundamental Concepts and Definitions:** System, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Path, Process, cycle, Exact & Inexact Differentials, Quasi-static Process, Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Dalton's law. **Zeroth law of Thermodynamics:** Concept of Temperature and it's measurement, Temperature scales. **First law of Thermodynamics:** Thermodynamic definition of work, Displacement work and flow work, Displacement work for various non flow processes, First law analysis for closed system (non-flow processes), Internal energy and Enthalpy. Limitations of first law of Thermodynamics, PMM-I, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer.	**10**
2	**Second law of Thermodynamics:** Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, Thermodynamic Temperature Scale, PMM-II. **Entropy:** Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, T-ds equation, Principle of entropy increase, T-S diagram, Statement of the third law of Thermodynamics.	**08**
3	**Properties of Steam and Rankine cycle:** Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Sub-cooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, T-S and H-S diagrams, use of property diagram, Steam-Tables & Mollier chart, Dryness fraction and it's measurement, processes involving in steam in closed and open systems. Simple Rankine cycle.	**08**
4	**Fluid Properties:** Concept of fluid and flow, continuum concept, Types of fluids, Mass Density, Specific Weight, Specific Gravity, Newton's Law of Viscosity, Dynamic and Kinematics Viscosity, Surface Tension Capillarity, Compressibility, Vapour pressure. **Fluid Kinematics:** Eulerian and Lagrangian description of fluid motion, Types of fluid flow, Types of flow lines, continuity equation in Cartesian coordinates, Velocity potential and stream function.	**08**
5	**Fluid dynamics:** Euler's equation of motion along a stream line, Bernoulli's equation, Application of Bernoulli's equation to Venturi meter, Orifice meter and Pitot tube. (No derivation on rate of flow is required) **Dynamics of Viscous Flow:** Introduction to Laminar and Turbulent flow, Flow of viscous fluid in circular Pipes – Hagen Poiseuille flow. Flow Through Pipes: Major and	**08**

	Minor losses in pipes, Pipes in series, Pipes in parallel and Equivalent pipe.	

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Consisting **Two Compulsory Class Tests for 25 marks**, First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)
2 Total duration allotted for writing each of the paper is 1 hr.
3 Average of the marks scored in both the tests will be considered for final grading.

Books Recommended:

Text books:

1. *Engineering Thermodynamics by P. K. Nag, Tata McGraw Hills.*
2. Thermal Engineering, R. K. Rajput, Laxmi Publication.
3. Engineering Thermodynamics: An Engineering Approach by Yunus A. Cengel, McGraw Hills.
4. Thermodynamics: Basic and Applied by V. Ganesan, McGraw Hills.
5. Introduction to Fluid Mechanics, 4th Edition by R. W. Fox, and A. T. McDonald, John Wiley and Sons.
3. Engineering Fluid Mechanics: Theory and Practice by S. B. Thool and S. L. Sinha, Narosa Publication.

Reference Books:

1. Fluid Mechanics, 3rd Edition by Frank M. White, McGraw-Hill
2. Fluid Machines and Fluid Power Engg., 7th Edition by D.S Kumar, S. K. Kataria publications
3. Thermal Engineering, Mahesh Rathore, Tata McGraw Hill
4. Engineering Thermodynamics by C.P. Arora, Tata McGraw Hill Publications

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Course Objectives:

1. To provide students a fundamental understanding of engineering materials, their structure-properties-performance relationship and applications, microscopic techniques, crystal defects and plastic deformation mechanism.
2. To make the students familiarize with the concepts of material failure and failure analysis under different working environments.
3. To provide students an understanding of various alloy phase diagrams, solidification process, iron, and iron carbide equilibrium diagram.
4. To provide students a fundamental understanding of various heat treatment processes, alloying elements and their effect for selecting and developing materials with an engineering application.
5. To provide an insight for the latest developments in engineering materials and techniques and to know their needs and applications.
6. To provide practical knowledge about material testing and evaluation of mechanical properties.

Course Outcomes: On completion of the course, learner will be able to:

1. Explain the basic elements of engineering metallurgy and its related applications along with crystal defects, deformation mechanism and appreciate the significance of advancement in microscopy with respect to processing-structure-property –performance correlation.
2. Identify and comprehend failure modes of engineering materials and related issues.
3. Explain the concept of various alloy phase diagrams, solidification principles and appreciate the significance of Iron-Iron Carbide phase diagram.
4. Select and justify the proper heat treatment process for steel in order to obtain desirable properties to suit application requirements.
5. Classify and describe engineering alloys, their properties, applications and also design and recognize the need for modern new age materials to cater to the engineering application demands.

6. Conduct various destructive and nondestructive mechanical testing on common engineering materials, interpret test data and to evaluate their mechanical properties.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Fundamentals of Engineering Materials and Metallurgy:** Evolution and Classification of Engineering Materials, their properties and applications. Structure- property correlation. **Defects in crystalline materials:** Point defects, line defects, surface defects and their significance, dislocation interaction dislocation multiplication by frank reed source. **Mechanism of plastic deformation:** Deformation in crystalline materials, critical resolved shear stress, slip systems, strain hardening and necessity of recrystallization annealing. **Microscopy and Microstructural evaluation:** Need for microscopic examination, basic concept, working principles and applications of optical and electron microscopy (basics only).	**09**
2	**Failure modes** Mechanism of fracture, types of fracture, ductile to brittle to transition (DBTT) and its significance, Griffith's theory of brittle fracture, fracture toughness, fatigue failure, fatigue testing and interpretation of test data, factors influencing fatigue, types of fatigue, creep behavior of material, creep test and interpretation of test data, types of creep and creep resistant material.	**05**
3	**Constitution of alloy and alloy phase diagram:** Solidification of metals and alloy formation, types of alloys and solid solution, construction and interpretation of alloy phase diagrams- binary, ternary, isomorphous, eutectic and peritectic (basics only), invariant reactions and Lever rule and Gibb's phase rule for phase mixtures and their applications. **Iron – Iron Carbide Phase diagram:** Equilibrium phase diagram, allotropy forms of pure iron, Iron-Iron Carbide phase diagram, microstructure of slowly cooled steels and cast irons. **Plain carbon steels and Cast Iron:** Classification, composition, microstructure, production route and applications of plain carbon steel and cast irons based on Iron- Iron carbide phase diagram.	**09**
4	**Heat treatment processes of steel:** Importance of heat treatment, annealing, normalizing, hardening, quench crack, hardenability test, Construction of TTT and CCT diagram and its engineering significance, and other related heat treatment process such as Austempering, Martempering, and Maraging. **Case/surface hardening treatments:** Carburizing, Nitriding, Carbonitriding, Flame and Induction Hardening. **Effect of alloying elements:** Effect of alloying elements on plain carbon steel, ferrite, carbide and austenite. Classification, composition, applications and commercial heat treatment practices for stainless steel and HSS.	**10**

	Effect of alloying elements on TTT diagram. (Basic treatment only).	
5	**Advanced structural and functional materials:** Properties , design optimization , and applications of advanced structural and functional materials such as special steels, high temperature materials and super alloys , Al and Ti alloys, composites, nanomaterial's, biomaterials, smart materials. (Application areas includes- Aerospace, Biomedical, Automotive, Sports and other industries)	**09**

List of Laboratory Experiments:

Part A: Material Testing and Evaluation of Mechanical Properties (Any four).

1. To study the stress strain behavior of mild steel by conducting tensile test on UTM.
2. To determine the hardness of steel/copper/aluminum material by conducting Brinell and Rockwell hardness test.
3. To determine the young's modulus of steel/wood/Al specimen by conducting deflection test on simply supported beam.
4. To determine the modulus of rigidity by performing torsion test.
5. To perform compression test on bricks and concrete specimens to determine the compressive strength.
6. To conduct charpy and Izod impact test on steel specimen.
7. To carry out any two NDT test (Magnetic Particle Inspection, Liquid/dye penetrant test, ultrasonic testing, radiographic testing).

Part B: Heat treatment Process and Microscopic Observation (Any Three).

1. Study and demonstration of metallurgical/optical microscope: Principles and Operation.
2. To study the specimen preparation methods.
3. To prepare the specimens of steels/cast iron for metallographic observation.
4. To carry out the heat treat process (Annealing/Normalizing/quenching) of steel observe the changes in microstructure and hardness.
5. To determine the hardenability of steel by conducting Jominy-End Quench test.

Part C:

Detail reports of industrial visit based on syllabus, which would help the learner to understand related topic/concept.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Consisting **Two Compulsory Class Tests for 25 marks**, First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of any four experiments from part A, any three experiments from part B and detailed report on industrial visit..

Experiments from Part A: 10 marks

Experiments from Part B: 10 marks

Industrial Visit Report Part C: 05 Marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Books Recommended:

Text books:

1. *"Mechanical Metallurgy", 3rd Edition, G. E. Dieter, McGraw Hill International New Delhi, 2017.*
2. *"Engineering Materials and Metallurgy", R. K. Rajput, S. Chand and Company Ltd., 2006.*
3. *"Heat Treatment: Principles and Techniques", 2nd edition, T.V. Rajan, C.P. Sharma, and Ashok Sharma, PHI Learning Pvt Ltd., 2011.*
4. *"Physical Metallurgy: Principles and Practice", Raghavan V, PHI Learning Pvt. Ltd., 2006.*
5. *"Composites Manufacturing – Materials, Product, and Process Engineering", Sanjay K. Muzumdar, CRC Press, 2002.*

Reference Books:

1. *"Experimental Techniques in materials and Mechanics", by C. Suryanarayana, CRC press, Taylor & Fraancis Group, 2011.*
2. *"Materials Science and Engineering: An Introduction", 10th Edition, William D. Callister, David G. Rethwisch, John Wiley and Sons, 2020.*
3. *"Essentials of Materials Science and Engineering", 3rd Edition by Donald R Askeland, Wendelin J Wright, Cengage Learning, 2013.*
4. *"Composite Materials – Science and Engineering", 3rd Edition, Krishnan K. Chawla, Springer, 2013.*
5. *"Materials for Engineers and Technicians", 6th Edition, W. Bolton, R.A. Higgins, Routledge, 2015.*
6. *"Engineering Materials", Henry Tindell, The Crowood Press ltd., 2014.*
7. *"The Science and Engineering of Materials", 7th Edition by Donald R. Askeland, Wendelin J Wright, cengage Learning (2015).*
8. *"Advanced Structural Materials", WINSON O SOBOYEJO, T.S. SRIVATSAN, CRC press, Taylor and Francis Group, 2011.*

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Program: Second Year Production Engineering	Semester: III
Course: Manufacturing Processes	Course Code:DJ19PEC304
Course: Manufacturing Processes Lab.	Course Code:DJ19PEL304

Teaching Scheme (Hours / week)				Evaluation Scheme						
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				75			25	25	25	100
				Laboratory Examination			Term work		Total Term work	50
3	4	--	5	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal		
				--	--	--	--	--	50	

Objectives:

1. To impart the knowledge of machine tools and basic machining processes like turning, drilling, boring, broaching, milling, shaping, planning and slotting etc.
2. To impart the fundamentals of various metal cutting practices, fundamentals of machine tools and processes.
3. To familiarize the students with unconventional machine tools & machining processes.
4. To understand the concept, principles and capabilities of CNC system.
5. To train the students into machining operations to enrich their practical skills.
6. To educate the students about ethical, environmental and safety standards.

Outcomes: Learner will be able to…

1. Describe types of machine tools, their classification, specifications and constructional features.
2. Illustrate machine tools capabilities, limitations of machining operations to generate cylindrical, circular and planar components.
3. Describe features and applications of screw thread processes and gear manufacturing processes.
4. Demonstrate finishing processes like grinding, reaming, honing, lapping and burnishing.
5. Illustrate the fundamentals of various non-conventional machining processes, capabilities with their application area.
6. Understand the working principle and applications of CNC machines.
7. Follow safe machine practices and perform various machining operations.

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Detailed Syllabus: (Unit wise)		
Unit	**Description**	**Duration**
01	**Introduction to Manufacturing Processes:** Definition, need and classification of manufacturing process based on chip-less and chip-removal processes. Various generating & forming processes. **Lathe, Drilling, Boring and Broaching Machines:** Machine specifications, Types of cutting off machines with their applications, Lathe machine components, Types of Lathe and accessories, Lathe operations, Types and working of Drilling, Boring and Broaching machines. Drilling operations and Drill nomenclature. Numerical on Machining time estimation.	**08**
02	**Milling Machine:** Milling operations and their difference, Milling parameters, special attachments (Dividing head) and accessories, Types of milling machines, Types of milling cutters and numerical on machining time estimation. **Reciprocating Machine:** Types of shapers, working of shaping machine, quick return mechanisms, shaper operations, Planning machines: types of planning machines. Slotting machines: types of slotting machines.	**06**
03	**Thread Cutting, Gear cutting and Finishing processes:** Principles and operation of Thread rolling, Thread chasing, Gear hobbing, Gear shaping and Gear shaving. Types of Grinding machines, their working and operations, Grinding wheel specification. Trueing, Dressing and Balancing of grinding wheel. Finishing processes like Reaming, Honing, Lapping, Buffing and Polishing.	**06**
04	**Unconventional machining processes:** Classification of the Non-traditional machining process. Basic principles, advantage, disadvantages, and applications of Electrical discharge machining (EDM), Electron beam machining (EBM), Plasma arc machining (PAM), Laser beam machining (LBM), Electrochemical machining (ECM), Chemical machining (CHM), Ultrasonic machining (USM), Abrasive jet machining (AJM), Water jet machining (WJM), Abrasive water jet machining (AWJM).	**07**
05	**CNC Basics and Hardware:** DNC, Motion controller, Interpolation, Adaptive control system, Spindle drive, Axis drive, Actuation and feedback devices, ATC, APC, Tool presetter, Touch probe system. **CNC Tooling and Programming:** CNC Turning and Milling tools. Tool nose, Radius and length compensation. Canned cycle, Looping, Jumping and Subprogram. Turning and Vertical Machining Centre programming.	**15**

Part A. List of Laboratory Experiments:

1. One job on Power hacksaw/Band saw and drilling machine.
2. One job on plain turning, taper turning, screw cutting, and other operations performed on lathe machine.
3. One job on shaping/milling machine to make horizontal and inclined surfaces.

4. One job on any unconventional machining process.
5. Demo job on CNC Turning and CNC Milling.

Part B. Industrial Visit

Detail reports of industrial visit based on syllabus, which would help the learner to understand topic/concept.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Consisting **Two Compulsory Class Tests for 25 marks**, First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

The distribution of marks for term work shall be as follows:

Laboratory work (Four Experiments)	: 40 Marks.
Industrial visit report on Machining practices	: 05 Marks
Attendance (Practical)	: 05 Marks.

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Books Recommended:

Text books:

1. *Elements of Workshop Technology: Machine Tools (Volume-2) by S. K. Hajra Choudhary, A. K. Hajra Choudhary, Nirjhar Roy, Media Promoters (2010).*
2. *A Text book of Production Technology Vol. II by O. P. Khanna, Dhanpat Rai Publication (2000).*
3. *CAD CAM, Principle and Applications, P. N. Rao, Tata McGraw Hill, 3rd edition, 2012.*
4. *A Course in Workshop Technology Vol. II (Machine Tools) by B. S. Raghuvanshi, Dhanpat Rai & Co. (2001).*

Reference Books:

1. *Manufacturing, Engineering and Technology, 4th Edition by Serope Kalpakjian, Steven R. Schmid, Pearson (2005).*
2. *Fundamentals of Modern Manufacturing-Materials, Processes and Systems, 3rd Edition by Mikell P. Groover, Wiley India (2002).*
3. *Manufacturing Processes for Engineering Materials, 4th Edition by Sarape Kalpakjian, Steven R. Schmid, Pearson (2007).*

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Program: Second Year Production Engineering										Semester : III	
Course : Mechanics of Materials										Course Code:DJ19PEC305	
Teaching Scheme (Hours / week)				Evaluation Scheme							
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)				Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.		
				75			25	25	25		100
				Laboratory Examination			Term work			Total Term work	--
3	--	--	3	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal			
				--	--	--	--	--	--		

Objectives:

1. To impart the concept of various types of forces, their modes of action and resulting stresses and strains on various materials under various operating conditions.
2. To impart the knowledge of Bending Moment, Shear force and Moment of Inertia as applied on various structures.

Outcomes: On completion of the course, learner will be able to:

1. Illustrate stress-strain behavior of ductile and brittle materials under load.
2. Understand and analyze behavior of components with different cross sections under mechanical and thermal loads.
3. Understand basic concepts pertaining to theory of bending and shearing and hence develop bending moment and shear force diagrams under different types of loading conditions.
4. Illustrate basic concepts of combined stresses and principal stresses due to axial loads, transverse loads, torsion, and buckling.
5. Develop skills to understand and interpret deflection in simply supported and cantilever beams under various loading patterns

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to Moment of Inertia:** Theorem of parallel and perpendicular Axis, Polar Moment of Inertia. **Direct stress and direct strain:** Concept of different types of stresses; Stress−strain curves for ductile and brittle material; factor of safety; deformation of uniform/tapering rectangular and circular and circular cross−section bars; deformation of members made of composite materials; shear stress and shear strain; Poisson's ratio; volumetric strain; bulk modulus; relationship between Young's modulus, bulk modulus and modulus of elasticity; temperature stresses in simple and compound bars.	**09**
2	**Shear Force and Bending Moment:** Axial force, shear force and bending moment diagrams for statically determinate beams excluding beams with internal hinges for different types of loading.	**08**
3	**Theory of Bending:** Flexure formula for straight beams; principal axes of inertia; moments of inertia about principal axes; transfer theorem. Simple problems involving application of flexure formula, section modulus and moment of resistance of a section. **Shear Stress in Beams:** Distribution of shear stress across plane sections used commonly for structural purposes.	**09**
4	**Theory of Torsion:** Torsion of circular shafts−solid and hollow, stresses in shafts transmitting power, shafts in series and parallel. **Principal Stresses:** General equations for transformation of stress; principal planes and principal stresses, determination using Mohr's circle maximum shear stress, principal stresses in beams principal stresses in shafts subjected to torsion, bending and axial thrust; concept of equivalent torsion and bending moments.	**08**
5	**Deflection of Beams:** Deflection of cantilevers sample supported and overhanging beams using double integration and Macaulay's method for different types of loadings. **Columns:** Columns subjected to axial loads, concept of buckling. Euler's formula for columns with different support conditions. Euler's and Rankin's design formulae.	**08**

Assignments:

Five assignments based on syllabus, which would help the learner to understand topic/concept.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Consisting **Two Compulsory Class Tests for 25 marks**, First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

Books Recommended:

Text books:

1. *Bansal R..K.., A Text Book of Strength of Materials*, Lakshmi Publications Pvt. Limited, New Delhi.
2. *S. Ramamrutham, Strength of Materials*, Dhanpat rai Publication.
3. *Beer and Johnston, Mechanics of Materials*, McGraw Hill Publication.
4. *Singer, Strength of Materials*, Longman Publishers.

Reference Books:

1. *Ferdinand P.Beer, and Rusell Johnston, E., Mechanics of Materials*, SI Metric Edition, McGraw Hill.
2. *James M. Gere, Mechanics of Materials Fifth Edition*, Brooks/Cole, USA, 2001.
3. *William A Nash, Theory and problems of strength of materials*, Schaum's outline Series, McGraw Hill International Edition.
4. *Shigley, J. E., Applied Mechanics of Materials*, International Student Edition, McGraw Hill Koyakusha Limited.

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Program: Second Year Production Engineering				Semester : III						
Course : Computer Aided Machine Drawing Lab.				Course Code:DJ19PEL306						
Teaching Scheme (Hours / week)				Evaluation Scheme						
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)
Lectures	Practicals	Tutorials	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				–			–	–	–	--
				Laboratory Examination			Term work		Total Term work	100
–	2*+2	--	2	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project / presentation/ Journal		
				--	--	50	25	25	50	

* Theory for entire class to be conducted.

Objectives:

1. To prepare students to read, draw auxiliary views and intersection/development of surfaces for sheet-metal applications.
2. To train students to prepare part drawings from assembly drawings and vice versa.
3. To impart knowledge for preparing production drawings, specifying tolerances/fits, surface roughness and using conventional representation of various mechanical details.
4. To prepare students to become conversant with 2-D and 3-D drafting using any CAD Software.

Outcomes: On completion of the course, learner will be able to:

1. Prepare drawings depicting auxiliary views and intersection/development of surfaces for sheet-metal applications.
2. Read and interpret part drawings from assembly drawings.
3. Prepare assembly drawings from detailed drawings of machine subassemblies.
4. Prepare production drawings, specifying tolerances, fits, surface roughness and using conventional representations of various mechanical details.
5. Develop/Create and assemble 3D machine parts, to get subassemblies and convert 3D parts/assemblies to 2D drawings, using any CAD software.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Standard machine elements and Conventional representations:** Preparation of 2-D drawings of standard machine elements like nuts, bolts, screws, studs, keys, cotter, screws, springs, circlips, etc.). Conventional representation of machine components and materials. Conventional representation for assembly of threaded parts in external and sectional views. Types of threads & thread designation. **Solid Geometry:** Intersection and development of surfaces for sheet-metal applications. Auxiliary views/projections of simple machine parts.	**10**
2	**Detailed and Assembly drawings of Pipe Joints and Power Transmission Units:** Introduction to assembly drawings. Steps involved in preparing assembly drawing from details and vice-versa using manual drafting as well as using 3D CAD software. CAD software modelling -Solid modelling majorly and introduction to Surface modelling. Pipe joints: Flanged joint, Gland and stuffing box expansion joint. Frictional Bearings – Simple bearing, Solid bearing, Bushed bearing, Pedestal (Plummer block) bearing and Footstep bearing. Antifriction Bearings – Ball Bearing and Roller Bearing Pulleys and Gears: Flat belt pulley, V-belt pulley, Fast and loose pulleys. Introduction to different types of gears used in mechanical machinery.	**16**
3	**Detailed and Assembly drawings of Machine Parts:** Valves: Stop Valve and Check/Non-return Valve. Engine parts: Piston, Connecting rod, Crankshaft and Spark plug. Machine tools: Single tool post, Clapper block, etc.	**14**
4	**Limits, Fits and Tolerances:** Representation of Dimensional Tolerances on drawings - Methods of showing limit dimensions, Deviations, Allowances, Types of Fits and Tolerances. Hole basis and Shaft basis systems. Representation of Geometrical Tolerances on drawings. Representation of Surface roughness on drawings. Assembly and detailed drawings of a machine subassembly showing dimensional tolerances, geometrical tolerances, fits and surface roughness.	**08**
5	**Preparation of Detailed and Assembly drawings from Actual/Physical Assembly:** Reverse Engineering of any physical model/assembly - Dismantling of any assembly, having around 8 to 10 parts. Measure all the required dimensions of each part and sketch the minimum views required. Using any CAD software, create 3D parts from these sketches and assemble them. Convert this 3D assembly into 2D assembly drawing.	**06**

Continuous Assessment :

Term work -

A. Questions from theory part of each module should be solved as home work in A-3 size drawing sheet/sketch book, as follows: -

1. Minimum 4 questions from module 1.
2. Minimum 3 questions from module 2.
3. Minimum 1 question/module from module 3 to 5.

B. Printouts/plots of the problems solved in practical class from the practical part of each module, as follows: -

1. 3 two dimensional detailed drawings: - Preparation of 3-D models of parts from given 2-D assembly drawing. Converting the 3-D parts into 2-D detailed drawings.
2. 3 two-dimensional Assembly drawings: - Preparation of 3-D models of parts, from given 2-D detailed drawings. Assembling the 3-D parts and Converting the 3-D Assembly into 2-D assembly drawing.

Problems from practical parts of each module should be solved using standard CAD packages like Inventor, NX, PRO-E, CATIA and Solid Works.

The distribution of marks for Term work shall be as follows:

Homework: sketch book	……. 25 marks
Printouts/Plots	…….25 marks

Evaluation Scheme:

Practical/Oral examination:

1. Practical examination duration is of three hours, based on Part-B of the Term work, and should contain two sessions as follows:

Session-I: Preparation of 3-D models of parts, from given 2-D detailed drawings. Assembling the 3-D parts and Converting the 3-D Assembly into 2-D assembly drawing.

Session-II: Preparation of 3-D models of parts from given 2-D assembly drawing. Converting the 3-D parts into 2-D detailed drawings.

Oral examination should be conducted to check the knowledge of conventional and CAD drawing.

2. Questions provided for practical examination should contain five to ten parts.
3. The distribution of marks for practical examination shall be as follows:

Session-I	25marks
Session-II	15 marks
Oral	10 marks

Books Recommended:

Text books:

1. *Machine Drawing by N.D. Bhatt and V. M. Panchal, Charotar Publishing House, Gujarat. (2014)*
2. *Machine Drawing by P. S. Gill, S. K. Kataria & Sons. New Delhi. (2013)*
3. *Textbook of Machine Drawing by K. C. John, PHI, New Delhi. (2009)*

Reference Books:

1. *Machine Drawing by K. Narayana, P. Kannaiah and K. Venkata Reddy. New Age International Publishers. New Delhi. (2019)*
2. *Machine Drawing by N. Sidheswar, P. Kannaiah and V. V. S. Sastry, Tata McGraw Hill Education, New Delhi. (2017)*
3. *Autodesk Inventor 2020 for Engineers and Designers by Sham Tickoo, S. Raina, Dreamtech Press, New Delhi. (2020).*

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<table>
<tr><td colspan="8">Program: Second Year Production Engineering</td><td colspan="2">Semester : III</td></tr>
<tr><td colspan="8">Course : Python Programming Lab.</td><td colspan="2">Course Code: DJ19PEL307</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="6">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">25</td></tr>
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<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>25</td><td>25</td></tr>
</table>

Objective:

The course will help the students to get familiar with:

1. Basics of Python programming
2. Decision Making and Functions in Python
3. Object Oriented Programming using Python
4. Files Handling in Python
5. GUI Programming and Databases operations in Python
6. Network Programming in Python

Outcomes: Upon Completion of the course the learner should be able to:

1. Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python
2. Express different Decision Making statements and Functions
3. Interpret Object oriented programming in Python
4. Understand and summarize different File handling operations
5. Explain how to design GUI Applications in Python and evaluate different database operations
6. Design and develop Client Server network applications using Python

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
01	Write python programs to understand Expressions, Variables, Quotes, Basic Math operations, Strings: Basic String Operations & String Methods, List, Tuples, Dictionaries, Arrays. (Minimum Three Programs based on math operations, Strings and List/Tuples/ Dictionaries)	**4**
02	Write python programs to understand different decision making statements and Functions. (Minimum Three Programs based on Decision making, Looping Statements and Functions)	**4**
03	Write python programs to understand different Object oriented features in Python (Minimum four programs based on (a) Classes & objects, (b) Constructors, (c) Inheritance & Polymorphism, (d) Exception handling)	**4**
04	Write python programs to understand different File handling operations	**4**
05	Write python programs to understand GUI designing and database operations (Minimum Three programs based on GUI designing using Tkinter, Mysql database creation & Database connectivity with DML operations using python	**4**
06	Write python programs to understand TCP and UDP Sockets in Python (Minimum One programs based on TCP or UDP Sockets)	**4**

Term Work:
Laboratory work 25 Marks

Books Recommended:

Text books:

1. *Wesley J Chun," Core Python Applications Programming", Third Edition, Pearson Publication.*
2. *E. Balguruswamy," Introduction to Computing and Problem Solving using Python", McGraw Hill Publication*
3. *Learn to Master Python, from Star EDU solutions , by Script Demics*

Reference Books:

1. *James Payne, "Beginning Python: Using Python 2.6 and Python 3.1",Wrox Publication*
2. *Dr. R. Nageswara Rao,"Core Python Programming" ,Dream tech Press, Wiley Publication.*
3. *Magnus Lie Hetland,"Beginning Python From Novice to Professional", Second Edition", Apress Publication.*

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Program: Second Year Production Engineering										Semester : III and IV
Course : Innovative Product Development - I										Course Code: DJ19A2
Teaching Scheme (Hours/week)				Evaluation Scheme						
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				--			--	--	--	--
				Laboratory Examination			Semester review		Total	
--	02	--	--	Oral	Practical	Oral & Practical	Review 1	Review 2		100
				--	--	--	50	50	100	

Objectives:

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found out to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualise and create a successful product.

Outcome:

Learner will be able to:

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualising a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/ experimental/simulations and analyse the impact of the proposed method of design and development of the product.
5. Develop interpersonal skills, while working as a member of the team or as the leader.
6. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which could eventually prepare themselves to be successful entrepreneurs.
7. Demonstrate product/project management principles during the design and development work and also excel in written (Technical paper preparation) as well as oral communication.

Guidelines for the proposed product design and development:

- Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).
- Students should carry out a survey and identify the need, which shall be converted into conceptualisation of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
- Students in the team shall understand the effective need for product development and accordingly select the best possible design in consultation with the faculty supervisor.
- Students shall convert the best design solution into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
- Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
- A record in the form of an activity log-book is to be prepared by each team, wherein the team can record weekly progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.
- The design solution is to be validated with proper justification and the report is to be compiled in a standard format and submitted to the department. Efforts are to be made by the students to try and publish a technical paper, either in the institute journal, "Techno Focus: Journal for Budding Engineers" or at a suitable publication, approved by the department research committee/ Head of the department.
- The focus should be on self-learning, capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the year long course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, i.e. during the semesters III and IV.

Guidelines for Assessment of the work:

- The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
- In the continuous assessment, focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.
- Distribution of marks individually for the both reviews as well as for the first review during the subsequent semester shall be as given below:
    - Marks awarded by the supervisor based on log-book : 20
    - Marks awarded by review committee : 20
    - Quality of the write-up : 10

. In the last review of the semester IV, the marks will be awarded as follows.

- Marks awarded by the supervisor (Considering technical paper writing) : 30
- Marks awarded by the review committee : 20

Note:- A candidate needs to secure minimum of 50% marks to be declared to have completed the audit course.

Review/progress monitoring committee may consider the following points during the assessment.

- In the semester III, the entire design proposal shall be ready, including components/system selection as well as the cost analysis. Two reviews will be conducted based on the presentation given by the student's team.
    - First shall be for finalisation of the product selected.
    - Second shall be on finalisation of the proposed design of the product.
- In the semester IV, the expected work shall be procurement of components/systems, building of the working prototype, testing and validation of the results based on work completed in semester III.
    - First review is based on readiness of building the working prototype.
    - Second review shall be based on a presentation as well as the demonstration of the working model, during the last month of semester IV. This review will also look at the readiness of the proposed technical paper presentation of the team.

The overall work done by the team shall be assessed based on the following criteria;

1. Quality of survey/ need identification of the product.
2. Clarity of Problem definition (design and development) based on need.
3. Innovativeness in the proposed design.
4. Feasibility of the proposed design and selection of the best solution.
5. Cost effectiveness of the product.
6. Societal impact of the product.
7. Functioning of the working model as per stated requirements.
8. Effective use of standard engineering norms.
9. Contribution of each individual as a member or the team leader.
10. Clarity on the write-up and the technical paper prepared.

- The semester reviews (III and IV) may be based on relevant points listed above, as applicable.

Guidelines for Assessment of Semester Reviews:

- The write-up should be prepared as per the guidelines given by the department.
- The design and the development of the product shall be assessed through a presentation and demonstration of the working model by the student team to a panel of Internal and External Examiners, preferably from industry or any research organisations having an experience of more than five years, approved by the Head of the Institution. The presence of the external examiner is desirable only for the 2nd presentation in semester IV. Students are compulsorily required to present the outline of the technical paper prepared by them during the final review in semester IV.

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<table>
<tr><td colspan="8">Program: Second Year Production Engineering</td><td colspan="3">Semester : III</td></tr>
<tr><td colspan="8">Course : Constitution of India</td><td colspan="3">Course Code : DJ19A3</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="4">Laboratory Examination</td><td colspan="3">Term Work</td><td rowspan="3">-</td></tr>
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</table>

Objectives:

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.
3. To understand human rights and its implications.

Outcomes: On completion of the course, learner will be able to

1. Have general knowledge and legal literacy and thereby to take up competitive examinations.
2. Understand state and central policies, fundamental duties.
3. Understand Electoral Process, special provisions.
4. Understand powers and functions of Municipalities, Panchayats and Co- operative Societies,
5. Understand Engineering ethics and responsibilities of Engineers
6. Understand Engineering Integrity & Reliability

Detailed Syllabus : (unit wise)		
Unit	**Description**	**Duration**
1	**Introduction to the Constitution of India** The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.	**02**
2	**Directive Principles of State Policy:** Relevance of Directive Principles State Policy Fundamental Duties. Union Executives – President, Prime Minister Parliament Supreme Court of India.	**03**
3	**State Executives:** Governor, Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th & 91st Amendments.	**03**
4	**Special Provision**s: For SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. **Human Rights:** Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchayats and Co – Operative Societies.	**03**
5	**Scope & Aims of Engineering Ethics**: Responsibility of Engineers Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering	**03**

Books Recommended:

Text books:

1. *Durga Das Basu: "Introduction to the Constitution on India", (Students Edn.) Prentice – Hall EEE, 19th / 20th Edn., 2001*
2. *Charles E. Haries, Michael S Pritchard and Michael J. Robins "Engineering Ethics" Thompson Asia, 2003-08-05.*

Reference Books:

1. *M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.*
2. *M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice – Hall of India Pvt. Ltd. New Delhi, 2004*
3. *Brij Kishore Sharma," Introduction to the Constitution of India", PHI Learning Pvt. Ltd., New Delhi, 2011.*
4. *Latest Publications of Indian Institute of Human Rights, New Delhi*

Website Resources:

1. www.nptel.ac.in
2. www.hnlu.ac.in
3. www.nspe.org
4. www.preservearticles.com

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<table>
<tr><td colspan="8">Program: Second Year Production Engineering</td><td colspan="3">Semester : IV</td></tr>
<tr><td colspan="8">Course : Applied Statistics</td><td colspan="3">Course Code:DJ19PEC401</td></tr>
<tr><td colspan="8">Course : Applied Statistics Tutorial</td><td colspan="3">Course Code:DJ19PET401</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
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<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>25</td><td>25</td></tr>
</table>

Objectives:

1. To inculcate an ability to relate engineering problems to mathematical context.
2. To provide a solid foundation in mathematical fundamentals required to solve engineering problem.
3. To study the basic principles of Vector analyses, complex integration, probability, test of hypothesis and correlation between data.
4. To prepare students for competitive exams.

Outcomes: On completion of the course, learner will be able to:

1. Identify diagonalizable and derogatory matrices and find functions of a square matrices using eigenvalues and eigenvectors.
2. Evaluate vector integrals.
3. Use probability to solve real-life engineering problems.
4. Draw conclusions on population based on large and small samples taken.
5. Analyze the variances of multiple variables simultaneously.

Detailed Syllabus: (unit wise)		
Module No.	**Description**	**Duration**
1	**Correlation, Regression and Curve-Fitting** Correlation-Karl Pearson's coefficient of correlation, Spearman's Rank correlation, Regression analysis- lines of regression. Curve fitting by the method of least squares- fitting of the curves of the form, $y = ax + b$, $y = ax^2 + bx + c$ and $y = e^{bx}$. Multi variate regression, Shrinkage method, Lasso and Ridge regression. Principal component analysis, Response surface methodology.	**13**
2	**Probability** Discrete and Continuous random variables, Probability mass and density function, Probability distribution for random variables, Expected value, Variance. Probability Distributions: Binomial, Poisson and Normal Distributions (for detailed study).	**10**
3	**Sampling Theory** Sampling distribution. Test of Hypothesis. Level of significance, critical region. One tailed and two tailed tests. Interval Estimation of population parameters. Large and small sample. Test of significance for Large samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples. Student's t-distribution and its properties. Test of significance of small samples: Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two Samples, paired t-test. Chi-square test, Test for the Goodness of fit, Association of attributes.	**09**
4	**ANOVA** Analysis of Variance (F-Test): One way classification, Two-way classification (short-cut method).	**03**
5	**Design of Experiments #** Introduction, Strategy of Experimentation, Typical Applications of Experimental Design, Guidelines for Designing Experiments. Two-Level Factorial Designs ,The 2^2Design,The 2^3 Design. The General 2^k Design, A single Replicate of the 2^k Design, The Addition of Center Points to the 2^k Design.	**07**
	TOTAL	**42**

- The topic is for continuous Internal Assessment ONLY.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Two term tests of 25 marks each will be conducted during the semesterout of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

Term-Work (Journal):

At least total 08 tutorials covering entire syllabus will be given during class wise tutorial. Term work assessment will be based on the overall performance of the student with every tutorial graded from time to time. The average of grades converted into marks should be taken into account for term work assessment.

Books Recommended:

Text books:

1. *Higher Engineering Mathematics, Dr B. S. Grewal, Khanna Publication.*
2. *Advanced Engineering Mathematics, E Kreyszing, Wiley Eastern Limited.*
3. *Box, G. E., Hunter, W. G., Hunter, J. S., Hunter, W. G., Statistics for Experimenters: Design, Innovation, and Discovery, 2nd Edition, Wiley, 2005.*
4. *Krishnaiah K, and Shahabudeen P, Applied Design of Experiments and Taguchi Methods,* PHI, India, 2011.

References:

1. *Higher Engineering Mathematics, B.V. Ramana, McGraw Hill Education, New Delhi.*
2. *Integral Transforms and their Engineering Applications, Dr B. B. Singh, Synergy Knowledgeware, Mumbai.*
3. *Numerical Methods, Kandasamy, S. Chand & CO.*
4. *Fundamentals of Mathematical Statistics by S.C. Gupta and Kapoor.*
5. *An introduction to statistical learning with Applications in R, Gareth James Daniela Witten, Springer.*
6. *Principal component analysis, I.T. Jollief, Springer.*
7. *The Elements of Statistical Learning, Trevor Hastie Robert Tibshirani, Springer series in Statistics.*
8. *Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition,John Wiley & Sons, New York, 2001.*
9. *D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001.*

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Program: Second Year Production Engineering	Semester : IV
Course : Mould and Metal Forming Technology	Course Code:DJ19PEC402
Course : Mould and Metal Forming Technology Lab.	Course Code:DJ19PEL402

Teaching Scheme (Hours / week)				Evaluation Scheme						
				Semester End Examination Marks (A)			Continuous Assessment Marks (B)			Total marks (A+ B)
Lectures	Practical	Tutorial	Total Credits	Theory			Term Test 1	Term Test 2	Avg.	
				75			25	25	25	100
				Laboratory Examination			Term work		Total Term work	50
3	2	--	4	Oral	Practical	Oral & Practical	Laboratory Work	Tutorial / Mini project/ presentation/ Journal		
				25	--	--	15	10	25	

Objectives:

1. To study and analyse casting and forming processes like forging, rolling and extrusion of ferrous and non-ferrous metals.
2. To familiarize the students with the design of sand moulds, die casting dies and multi impression forging die.

Outcomes: On completion of the course, learner will be able to:

1. Explain the concepts of metal casting & metal forming processes and analyse various defects, their probable causes and remedial measures.
2. Identify the equipment, machinery and tooling used to design sand mould casting.
3. Identify the equipment, machinery and tooling used to design cold chamber die casting.
4. Identify the equipment, machinery and tooling used to design Multi impression Forging Die.
5. Explain the processes involved in rolling of metals.

Detailed Syllabus: (unit wise)		
Units	**Description**	**Duration**
1	**Sand Casting of Metals** Mould materials: Moulding sand; Constituents of moulding sand and its property requirements; Testing of sand properties. Design and manufacture of Patterns and Cores: Pattern allowances, Types of patterns, Core print, pattern design and manufacture, Core making. Design and manufacturing of gating system: Pouring basin, Sprue, Runners and Ingates. Design and manufacturing of feeding system: Caine's equation, Modulus method, Chvorinov's mould constant, Use of chills, padding and risering. Melting practices: Arc and Induction furnaces. Defects in cast components and their remedies	**14**
2	**Special Casting Processes** Die design and manufacture for pressure die casting of non−ferrous metals, Principle of Hot chamber and Cold chamber die casting processes, Design and manufacture of die-casting dies for Cold chamber die casting process. Casting process used for composites. Defects in die cast components and their remedies. Lost Wax Process Investment Casting: Use of wax as the moulding material, Process description, Features and advantages, Fields of application. Shell Mould casting: Working principle and application.	**10**
3	**Forging of metals** Forging hammers, high speed forging machines, Presses: Construction and principle of operation. Single and multi-impression closed die forging process. Design and drawing of multi-impression drop forging, die set using fuller, edger, bender, blocker and finisher, cavities with flash and gutter. Defects in forged products and their remedies.	**10**
4	**Rolling of metals** Longitudinal, Cross and Cross−spiral Rolling; Contact Angle; Neutral point and angle; Coefficients of spread and Elongation; Forward slip and backward slip; Forces and stresses in longitudinal rolling. Rolling Mills: Blooming, Billet, Slabbing, Plate and Structural mills. Defects in rolled products and their remedies.	**06**
5	**Extrusion of Metals and Miscellaneous Metal Forming Processes** Introduction to metal extrusion and basic concepts of extrusion dies. Drawing of metals: Principle of operation and applications.	**02**

List of Laboratory Experiments (Design Exercise):

1. Design and Drawing of Sand Mould Casting.
2. Design and Drawing of a Cold Chamber Die Casting.
3. Design and Drawing of Multi impression Forging Die.
4.

If required additional Design Exercise, Assignments and Industry Visits may be organized, which would help the learner to understand topic/concept.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Oral:

1. Oral examination will be based on design exercise and contents of the syllabus.

Continuous Assessment (B):

Theory:

1. Consisting **Two Compulsory Class Tests for 25 marks**, First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of three experiments (design exercise)

Design Exercise (Lab work): 15 marks

Journal (Assignments & Report on Industry Visit): 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Books Recommended:

Text Books:

1. *Manufacturing Technology—Foundry, Forming and Welding, 5e,* P. N. Rao, McGraw Hill Education (India) Private Limited (2019).
2. *Manufacturing Processes,* H. N. Gupta, R. C. Gupta and Arun Mittal, New Age (2009).

Reference Books:

1. *Manufacturing Engineering and Technology, 7e,* Serope Kalpakjian and Steven R. Schmid, Pearson (2019).
2. *Mechanical Metallurgy*, 3e, George E. Dieter, McGraw Hill Book Company (2013).
3. *Foundry Technology,* O. P. Khanna, Dhanpat Rai Publications (2013).
4. *Complete Casting Handbook: Metal Casting Processes, Techniques and Design,* John Campbell, Butterworth-Heinemann (2011).
5. *Principles of foundry Technology,* P. L. Jain, Tata McGraw Hill Education Private Limited (2009).
6. *Foundry Technology,* Peter Beeley, Butterworth-Heinemann (2001).

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<table>
<tr><td colspan="8">Program: Second Year Production Engineering</td><td colspan="3">Semester : IV</td></tr>
<tr><td colspan="8">Course : Theory of Machines</td><td colspan="3">Course Code: DPEC403</td></tr>
<tr><td colspan="8">Course : Theory of Machines Lab.</td><td colspan="3">Course Code:DPEL403</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
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<tr><td>--</td><td>--</td><td>--</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Objectives:

1. To prepare the students to understand the Mechanics of machines, principles and its application areas.
2. To familiarize the students with various types of Mechanisms and Motion analysis.
3. To develop the students with the problem solving capabilities in the topics of velocity and acceleration.
4. To familiarize the students with the kinematics and kinetics of simple machine elements and devices.
5. To provide an understanding and appreciation of the variety of mechanisms employed in modern complex machines, such as automobiles, machine tools etc.

Outcomes: On completion of the course, learner will be able to:

1. Understand the common mechanisms used in machines and determine the velocity and acceleration of various links of a mechanism.
2. Illustrate different types of cams, followers with their different motions for their application and develop profiles of cams for engineering applications.
3. Understand various types of gears and their terminology, areas of application and evaluate various parameters pertaining to spur gears and gear trains.
4. Develop basic concepts pertaining to balancing/vibrations in evaluation of simple machine components.
5. Understand different types of clutches, brakes and dynamometers and evaluate the braking force.

Detailed Syllabus: (unit wise)		
Units	**Description**	**Duration**
1	**Basic Concepts and Motion Characteristics of Mechanisms:** Links, kinematics pairs, kinematics pairs giving one, two and three degrees of freedom, kinematics chains, degree of freedom and mobility criterion, mechanism and inversion of four bar chain, single slider crank and double slider crank mechanism. Velocity and acceleration analysis of mechanisms with single degree of freedom system with Coriollis component using graphical method. Instantaneous centre, Kennedy's theorem; analysis of velocities of mechanism using instantaneous centre method.	**10**
2	**CAMS:** Introduction to types of cams, types of followers. Follower motions. viz. simple harmonic motions, constant velocity, uniform and constant acceleration and retardation and cycloidal motion, layout of cam profile for specified displacement characteristics. Cams with oscillating follower systems.	**06**
3	**GEARS:** Introduction: Types of gears and applications, Gear terminology, condition for constant velocity ratio−conjugate profiles, profiles used in gears. Interference of involute teeth, methods of preventing interferences through undercutting, length of path of contact and contact ratio, no of teeth to avoid interference. Gear trains: Simple, compound, planetary and epicyclic gear trains.	**09**
4	**Balancing:** Introduction. Rotary masses: several masses in same plane, several masses in different planes. Balancing of locomotives− Variation of Tractive Effort, Swaying Couple and Hammerblow, The concept of primary and secondary balancing (No numerical problems) **Vibrations:** Introduction−free vibrations; longitudinal, transverse and torsional vibrations. First degree of freedom vibration system. Basic vibration measuring concepts.	**08**
5	**Clutches, Brakes and Dynamometers:** Study and analysis of single plate clutch, multiple plate clutches and cone clutches. Types of brakes. viz. block and shoe brakes, band brake, band and block brakes Types of dynamometers, classification, Prony brake, Rope brake belt transmission dynamometers	**06**

List of Laboratory Experiments: (Any Six)

1. Longitudinal Vibrations of Helical Spring
2. Torsional Vibrations of Shaft
3. Torsional Vibrations of Single Rotor System
4. Torsional Vibrations of Two Rotors System
5. Compound Pendulum
6. Transverse Vibrations - Whirling Speed of Shaft
7. Cam Analysis
8. Coriolli's Component of Acceleration
9. Interference and Undercutting in Gears

Assignments:

Five assignments based on syllabus, which would help the learner to understand topic/concept.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Consisting Two Compulsory Class Tests for 25 marks, First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of any six experiments

Experiments	15 marks
Assignments:	10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Books Recommended:

Text Books:

1. *Theory of Machines, 25th Edition* by P.L. Ballaney, Khanna Publications
2. *Theory of Machines, 4th Edition* by S.S.Ratan,, Tata McGraw Hill

Reference Books:

1. *Theory of Machines and Mechanisms, 5th Edition by John, J Shighley, Oxford University.*
2. *Theory of Machines, 3rd edition by Thomas Bevan, Pearson publication.*
3. *Theory of Machines, Pandya & Shah.*
4. *Mechanisms of Machines, J. Hannah & RC Stephen.*
5. *Theory of Machines,V. Ravi*, PHI Learning publication.

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<table>
<tr><td colspan="5">Program: Second Year Production Engineering</td><td colspan="5">Semester : IV</td></tr>
<tr><td colspan="5">Course : Applied Electrical and Electronics</td><td colspan="5">Course Code:DJ19PEC404</td></tr>
<tr><td colspan="5">Course : Applied Electrical and Electronics Lab.</td><td colspan="5">Course Code:DJ19PEL404</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="9">Evaluation Scheme</td></tr>
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<tr><td colspan="2">--</td><td>--</td><td>--</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Objectives:

1. To acquaint the students with the basic concepts involved in electrical machines and their control circuits.
2. To familiarize the students with different types of electrical machines such as ac machines, dc machines, brushless dc machines, stepper motor, servomotor etc.
3. To familiarize the students with generation, transmission and distribution of electrical energy. Also the use of renewable energy resources and its advantages over conventional machines.
4. To familiarize the students with different types of sensors and controllers.
5. To expose the students to domain knowledge in various applications of Production engineering

Outcomes: On completion of the course, learner will be able to:

1. Explain and interpret various characteristics of ac, dc machines, brushless dc motor, stepper motor and servomotor.
2. Explain the specifications and selection of motor for different applications.
3. Understand the complete layout of generation, transmission and distribution of power system and the importance of solar and wind energy resources.
4. Explain different types of power electronic devices, sensors, driver circuits and its applications.
5. Classify application areas for various ac machines, dc machines, stepper motor ,brushless dc motor, OP-AMP,SCR, DIAC-TRIAC.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration**
1	**Dc Machines:** Introduction to dc machines, Classification, Comparison and Characteristics of dc machines, Speed control of dc motor, Torque equation of dc motor, Starter, Applications of dc machines.	**08**
2	**Ac Machines**: Introduction to ac machines (Induction Motor), Classification and Comparison of ac machines, Speed-torque characteristics of IM, Torque equation of 3-phase IM, Applications ac machines.	**08**
3	**Stepper motor & BLDC:** Introduction to stepper motor and BLDC, types and its applications, Driver circuit for controlling BLDC motor. **Solar and wind energy:** Introduction, working and layout of solar energy system and wind energy system and its applications, Necessity of energy storage, specifications of energy storage devices.	**08**
4	**Sensors & Transducers:** Introduction, classification and characteristics of sensors , Speed sensor, Temperature sensor, proximity sensor, pressure sensor, flow and level sensor, humidity sensor, Classification and characteristics of transducers and its applications. IoT devices and its applications.	**10**
5	**Power electronics:** Working of SCR, DIAC, TRIAC, rectifiers, inverters, oscillators and its types. **Control systems:** Block reduction techniques, open loop and closed loop control systems, PID controllers, Servomotors in control systems. Data acquisition systems, Automation system design.	**08**

List of Laboratory Experiments: (Any Seven)

Any three from SIMULATION based

1. To design and simulate speed control of dc motor using simulation.
2. To design and simulate speed-torque characteristics of induction motor using simulation.
3. To design and simulate bldc motor using simulation.
4. To design and simulate solar based system for driving ac or dc motor using simulation
5. To design sensors using simulation.

Any four from HARDWARE based circuits

1. To design speed control of dc motor using field flux control method and armature control method.
2. To design speed-torque characteristics of induction motor.
3. To design half controlled and full controlled rectifiers circuits.
4. To design single phase inverter circuits.
5. To explain and perform characteristics of SCR AND TRIAC.
6. To explain and perform characteristics of DIAC.

7. To explain applications of SCR.
8. To explain applications of DIAC-TRIAC .
9. To explain different controllers.
10. To design and explain open loop control systems and closed loop control systems.
11. Experiments based on heat treatment methods.

Any other experiment, assignments, mini-projects and detail reports of industrial visit based on syllabus may be included, which would help the learner to understand topic/concept.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Consisting Two Compulsory Class Tests for 25 marks, First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

Laboratory: (Term work)

Term work shall consist of any four experiments covering the tests mentioned from sr.no 1 to7. In all, total 7 experiments are to be performed.

Experiments & Report on Industrial visit: 15 marks

Assignments: 10 marks

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Books Recommended:

Text Books:

1. *Electrical machinery fundamentals fourth edition by Stephen Chapman* Mc Graw hill. July 2017.
2. *Electric machinery sixth edition* by A.E Fitzgerald , Charles Kingsley,Jr , Stephen D. Umans . Mc Graw hill.2003.
3. *Electrical machinery seventh edition by P.S Bimbhra,* Khanna publications.2003

Reference Books:

1. *Electrical machines sigma series by D.P Kothari and I.JNagarth* . Mc Graw hill.2006.
2. *Power system engineering third edition by D.P Kothari and I.JNagarth* . Mc Graw hill.2019.

3. *Stepper motors fundamentals, applications and design by V V Athani.* New Age international publishers.1997.
4. *Kleitz, Wm.ninth edition, Digital Electronics: A Practical Approach,* Pearson Prentice Hall, 2020.
5. *Electrical power system seventh edition by C.L Wadhwa* . New Age international publishers.2016.
6. *Charles H Roth, Fundamentals of logic design enhanced edition by Cennage learning.2020.*
7. *Power electronics Indian edition by Daniel W Hart.2017.*
8. *Control systems engineering fifth edition by I.J Nagarth and M.Gopal*. New Age international publishers.2009.

E- books

1. Electrical machines. http://www.freeengineeringbooks.com/Electrical/Electrical-Machines-Ebooks.php
2. Electrical machinery.https://www.amazon.in/Electric-Machines-P-S-Bimbhra-ebook/ dp/ B077Q8B1ZY
3. Electrical machines.https://www.pdfdrive.com/electrical-machines-e151757.html
4. Power electronics. http://site.iugaza .edu.ps/malramlawi /files/RASHID Power Electronics Hand book.pdf
5. Power electronics. https://easyengineering.net/power-electronics-by-bimbhra/
6. Power system. https://easyengineering.net/power-systems-books/
7. Control system. https://easyengineering.net/control-systems-books/

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Program: Second Year Production Engineering	Semester : IV
Course : Advance Manufacturing Processes	Course Code:DJ19PEC405
Course : Advance Manufacturing Processes Lab.	Course Code:DJ19PEL405

<table>
<tr><th colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</th><th colspan="8">Evaluation Scheme</th></tr>
<tr><th colspan="4">Semester End Examination Marks (A)</th><th colspan="3">Continuous Assessment Marks (B)</th><th rowspan="2">Total marks (A+ B)</th></tr>
<tr><th rowspan="3">Lectures</th><th rowspan="3">Practical</th><th rowspan="3">Tutorial</th><th rowspan="3">Total Credits</th><th colspan="3">Theory</th><th>Term Test 1</th><th>Term Test 2</th><th>Avg.</th></tr>
<tr><td colspan="3">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
<tr><td colspan="3">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">75</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">4</td><td rowspan="2">--</td><td rowspan="2">5</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project/ presentation/ Journal</td></tr>
<tr><td>--</td><td>50</td><td>--</td><td>25</td><td>--</td><td>75</td></tr>
</table>

Objectives:

1. To impart the knowledge of Additive Manufacturing processes, working principle and process parameters of hybrid machining processes and to prepare the students with Micro Machining techniques like Meso, Micro and Nano manufacturing techniques.
2. To impart the knowledge on finishing techniques, like Abrasive flow machining, magnetic abrasive machining, Magneto rheological abrasive flow techniques etc.
3. To impart knowledge on Metal joining processes, polymer composite manufacturing techniques and powder metallurgy.

Outcomes: learner will be able to:

1. Differentiate between traditional and additive manufacturing techniques including solid-based, liquid-based and powder-based techniques.
2. Illustrate the MEMS and Non-MEMS based manufacturing techniques.
3. Describe basic Nano finishing techniques.
4. Describe metal joining processes along with their advantages, disadvantages and applications.
5. Illustrate the Composite manufacturing and powder metallurgy process along with its advantages, disadvantages and applications.

Detailed Syllabus: (unit wise)		
Module	**Contents**	**Hrs.**
01	**Introduction to Additive Manufacturing(AM)** Traditional manufacturing v/s Additive Manufacturing, Discussion on different materials used in AM, Role of solidification rate in AM, Grain structure and microstructure in AM. Powder-based AM processes involving sintering and melting (selective laser sintering (SLS), shaping, electron beam melting. involvement). Solid-based AM process (extrusion based fused deposition modelling (FDM), Laminated object manufacturing (LOM)). Liquid based AM Process (Stereo lithography(SLA))	10
02	**Introduction to Micro Manufacturing** Challenges in Meso, Micro, and Nano manufacturing, MEMS based - Overview about micro fabrication methods - Chemical vapor deposition (CVD); Physical vapor deposition (PVD), optical and electron beam lithography; Dry and wet etching. NON – MEMS based - Traditional Micromachining (Micro turning, Micro Milling, Micro grinding, Diamond turning).	08
03	**Introduction Nano Finishing Techniques** Abrasive Flow Machining (AFM), Magnetic Abrasive Finishing (MAF), Magneto rheological Finishing (MRF), Magneto rheological Abrasive Flow Finishing (MRAFF), Magnetic Float Polishing (MFP), Elastic Emission Machining (EEM), Chemical Mechanical Polishing (CMP).	08
04	**Metal Joining Processes:** Gas micro welding, micro arc welding, Resistance micro welding, Micro Solid state welding, Electron beam micro welding, Laser beam micro welding, Thermo-chemical welding processes, soldering and brazing processes, welding defects, inspection & testing of welds, Safety in welding.	06
05	**Polymeric composites manufacturing processes:** Thermo set and Thermoplastic composite processing, advantages & disadvantages. Manufacturing process for thermoset composites (applications, basic processing steps, advantages and limitations only) pre peg layup, wet layup, spray up, filament winding, pultrusion and resin transfer molding. **Powder Metallurgy:** Powder manufacturing methods; Advantages, disadvantages, and applications of powder metallurgy. Case studies like Oil Impregnated Bearings.	10

List of Experiments:

1. One simple assembly job involving the use of lathe shaping, milling and grinding machines.
2. Introduction to CNC lathe and milling, Use of measuring instruments, Coordinate system, Explanation of codes. Getting familiar with control, MDI, Offset measurement, Simulation of programs.Practicing various turning cycles like OD / ID turning, grooving, threading etc. and canned cycles like drilling, reaming, boring etc.
3. Group job on CNC Turning Centre.
4. Group job on CNC Milling Centre.

Evaluation Scheme:

Semester End Examination (A):

Theory:

1. Question paper based on the entire syllabus will comprise of 5 questions (All compulsory, but with internal choice as appropriate), each carrying 15 marks, total summing up to 75 marks.
2. Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1. Consisting **Two Compulsory Class Tests for 25 marks**, First test based on approximately 40% of contents and second test based on remaining contents (approximately 40% but excluding contents covered in Test I)
2. Total duration allotted for writing each of the paper is 1 hr.
3. Average of the marks scored in both the tests will be considered for final grading.

A detailed report, based on an Industrial visit to a manufacturing firm, covering various machining practices as mentioned in the subject of Manufacturing Process, also needs to be submitted. The report should contain various machining practices followed, as applicable in the industry visited.

The distribution of marks for term work shall be as follows:

Laboratory work(4experiments)	: 40Marks.
Industrial visit report on Machining practices	: 05 Marks
Attendance (practicals)	: 05Marks.

The final certification and acceptance of term work will be subject to satisfactory performance of laboratory work and upon fulfilling minimum passing criteria in the term work.

Books Recommended:

Reference Books:

1. *Ian Gibson, David W. Rosen, Brent Stucker, Additive manufacturing technologies: rapid prototyping to direct digital manufacturing Springer, 2010.*
2. *Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers, 2011.*
3. *Waqar Ahmed, Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, 2nd Edition, Elsevier, 2015.*
4. *Jain V. K. - 'Introduction to Micromachining' - Narosa Publishing House – 2010.*
5. *Mark J. Jackson, Micro and Nano manufacturing, Springer, 2007.*
6. *A Text Book of Production Technology Vol. II by O. P. Khanna, DhanpatRai Publication (2000).*
7. *Welding Technology by O. P. Khanna, DhanpatRai& Co.*
8. *Composites Manufacturing – Materials, product, and Process Engineering by Sanjay K. Muzumdar, CRC Press (2002).*
9. *Workshop Technology Part 1, 2 and 3, W. A. J. Chapman, Taylor & Francis.*

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<table>
<tr><td colspan="7">Program: Second Year Production Engineering</td><td colspan="4">Semester : IV</td></tr>
<tr><td colspan="7">Course : Universal Human Values</td><td colspan="4">Course Code: DJ19IHC1</td></tr>
<tr><td colspan="7">Course : Universal Human Values Tutorial</td><td colspan="4">Course Code: DJ19IHT1</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
(Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="3">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="3">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="3">75</td><td>25</td><td>25</td><td>25</td><td>100</td></tr>
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<tr><td>--</td><td>--</td><td>--</td><td colspan="3">25</td></tr>
</table>

Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Outcomes: On completion of the course, learner will be able to:

1. Become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability.
2. Become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
3. Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

	Detailed Syllabus: (unit wise)	
Unit	**Contents**	**Hrs.**
1	**Introduction**: **Need, Basic Guidelines, Content and Process for Value Education** Purpose and motivation for the course. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.	**05**
2	**Understanding Harmony in the Human Being - Harmony in Myself!** Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health.	**06**
3	**Understanding Harmony in the Family and Society: Harmony in Human Human Relationship**. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.	**06**
4	**Understanding Harmony in the Nature and Existence: Whole existence as Coexistence** Understanding the harmony in the Nature 19. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all pervasive space. Holistic perception of harmony at all levels of existence.	**05**
5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics**: Natural acceptance of human values 23. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order, b. Ability to identify the scope and characteristics of people friendly and eco-friendly	

	production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b. At the level of society: as mutually enriching institutions and organizations.	**06**

Evaluation Scheme:

Semester End Examination (A):

Theory:

1) Question paper will be based on the entire syllabus summing up to 75 marks.
2) Total duration allotted for writing the paper is 3 hrs.

Continuous Assessment (B):

Theory:

1) Two term tests of 25 marks each will be conducted during the semester out of which; one will be a compulsory term test (on minimum 02 Modules) and the other can either be a term test or an assignment on live problems or a course project.
2) Total duration allotted for writing each of the paper is 1 hr.
3) Average of the marks scored in both the two tests will be considered for final grading.

Continuous Assessment (C):

Tutorials: (Term work)

1. Term work shall consist of minimum 4 activities based on activities suggested.
2. Term work shall carry total 25 marks based on the performance in the tutorials.

The tutorials could be conducted as per the following topics: -

Activity No 1	Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony, and co-existence) rather than as arbitrariness in choice based on liking-disliking.
Activity No 2	Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.
Activity No 3	Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.
Activity No 4	Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Activity No 5	Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. To discuss the conduct as an engineer or scientist etc.

The final certification and acceptance of term work will be subject to satisfactory performance of activities and upon fulfilling minimum passing criteria in the term work.

Text books:

1. *Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010*

Reference books:

1. *Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.*
2. *Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.*
3. *The Story of Stuff (Book).*
4. *The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi*
5. *Small is Beautiful - E. F Schumacher.*
6. *Slow is Beautiful - Cecile Andrews*
7. *Economy of Permanence - J C Kumarappa*
8. *Bharat Mein Angreji Raj - PanditSunderlal*
9. *Rediscovering India - by Dharampal*
10. *Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi*
11. *India Wins Freedom - Maulana Abdul Kalam Azad*
12. *Vivekananda - Romain Rolland (English)*
13. *Gandhi - Romain Rolland (English)*

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<table>
<tr><td colspan="7">Program: Second Year Production Engineering</td><td colspan="4">Semester : III and IV</td></tr>
<tr><td colspan="7">Course : Innovative Product Development - II</td><td colspan="4">Course Code: DJ19A4</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours/week)</td><td colspan="7">Evaluation Scheme</td></tr>
<tr><td colspan="4">Semester End Examination Marks (A)</td><td colspan="3">Continuous Assessment Marks (B)</td><td rowspan="2">Total marks (A+ B)</td></tr>
<tr><td rowspan="3">Lectures</td><td rowspan="3">Practical</td><td rowspan="3">Tutorial</td><td rowspan="3">Total Credits</td><td colspan="4">Theory</td><td>Term Test 1</td><td>Term Test 2</td><td>Avg.</td></tr>
<tr><td colspan="4">--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="4">Laboratory Examination</td><td colspan="2">Semester review</td><td rowspan="2">Total</td><td rowspan="2">100</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">02</td><td rowspan="2">--</td><td rowspan="2">--</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Review 1</td><td>Review 2</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>50</td><td>50</td><td>100</td></tr>
</table>

Objectives:

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found out to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualize and create a successful product.

Outcome:

Learner will be able to:

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualizing a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/ experimental/simulations and analyze the impact of the proposed method of design and development of the product.
5. Develop interpersonal skills, while working as a member of the team or as the leader.
6. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which could eventually prepare themselves to be successful entrepreneurs.
7. Demonstrate product/project management principles during the design and development work and also excel in written (Technical paper preparation) as well as oral communication.

Guidelines for the proposed product design and development:

- Students shall form a team of 3 to 4 students (max allowed: 5-6 in extraordinary cases, subject to the approval of the department review committee and the Head of the department).
- Students should carry out a survey and identify the need, which shall be converted into conceptualisation of a product, in consultation with the faculty supervisor/head of department/internal committee of faculty members.
- Students in the team shall understand the effective need for product development and accordingly select the best possible design in consultation with the faculty supervisor.
- Students shall convert the best design solution into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
- Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
- A record in the form of an activity log-book is to be prepared by each team, wherein the team can record weekly progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.
- The design solution is to be validated with proper justification and the report is to be compiled in a standard format and submitted to the department. Efforts are to be made by the students to try and publish a technical paper, either in the institute journal, "Techno Focus: Journal for Budding Engineers" or at a suitable publication, approved by the department research committee/ Head of the department.
- The focus should be on self-learning, capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the year long course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, ie during the semesters III and IV.

Guidelines for Assessment of the work:

- The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.
- In the continuous assessment, focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.
- Distribution of marks individually for the both reviews as well as for the first review during the subsequent semester shall be as given below:
    - Marks awarded by the supervisor based on log-book : 20
    - Marks awarded by review committee : 20
    - Quality of the write-up : 10

. In the last review of the semester IV, the marks will be awarded as follows.

- Marks awarded by the supervisor (Considering technical paper writing) : 30
- Marks awarded by the review committee : 20

Note:- A candidate needs to secure minimum of 50% marks to be declared to have completed the audit course.

Review/progress monitoring committee may consider the following points during the assessment.

- In the semester III, the entire design proposal shall be ready, including components/system selection as well as the cost analysis. Two reviews will be conducted based on the presentation given by the student's team.
    - First shall be for finalisation of the product selected.
    - Second shall be on finalisation of the proposed design of the product.
- In the semester IV, the expected work shall be procurement of components/systems, building of the working prototype, testing and validation of the results based on work completed in semester III.
    - First review is based on readiness of building the working prototype.
    - Second review shall be based on a presentation as well as the demonstration of the working model, during the last month of semester IV. This review will also look at the readiness of the proposed technical paper presentation of the team.

The overall work done by the team shall be assessed based on the following criteria;

1. Quality of survey/ need identification of the product.
2. Clarity of Problem definition (design and development) based on need.
3. Innovativeness in the proposed design.
4. Feasibility of the proposed design and selection of the best solution.
5. Cost effectiveness of the product.
6. Societal impact of the product.
7. Functioning of the working model as per stated requirements.
8. Effective use of standard engineering norms.
9. Contribution of each individual as a member or the team leader.
10. Clarity on the write-up and the technical paper prepared.

- The semester reviews (III and IV) may be based on relevant points listed above, as applicable.

Guidelines for Assessment of Semester Reviews:

- The write-up should be prepared as per the guidelines given by the department.
- The design and the development of the product shall be assessed through a presentation and demonstration of the working model by the student team to a panel of Internal and External Examiners, preferably from industry or any research organisations having an experience of more than five years, approved by the Head of the Institution. The presence of the external examiner is desirable only for the 2nd presentation in semester IV. Students are compulsorily required to present the outline of the technical paper prepared by them during the final review in semester IV.

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