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

Mechanical Engineering

(Semester III and IV)

Revision: 1 (2019)

With effect from the Academic Year: 2020-2021 with modifications in 2021-22

SHRI VILEPARLE KELAVANI MANDAL'S
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)

Scheme for Second Year of B.Tech. Program in Mechanical Engineering: Semester III (Autonomous)
(Academic Year 2021-2022)

Semester III

	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)					Aggregate (A+B)	Credits earned	
			Theory (hrs.)	Laboratory (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Term Work Total	CA Total (B)			
1	DJ19MEC301	Engineering Mathematics III	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19MET301	Engineering Mathematics III Tutorial	--	--	1	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
2	DJ19MEC302	Engineering Thermodynamics	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	3
3	DJ19MEC303	Strength of Materials	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19MEL303	Strength of Materials Laboratory	--	2	--	1	--	--	25	--	--	25	--	--	--	25	25	50	1	
4	DJ19MEC304	Manufacturing Processes	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	3
5	DJ19MEC305	Materials Technology	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19MEL305	Materials Technology Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
6	DJ19MEL306	Computer Aided Machine Drawing Laboratory	--	4	--	2	--	--	--	--	50	50	--	--	--	50	50	100	2	2
7	DJ19MEL307	Machine Shop Practice I	--	4	--	2	--	--	--	50	--	50	--	--	--	50	50	100	2	2
8	DJ19A2	Innovative Product Development I	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
9	DJ19A3	Constitution of India	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		Total	16	14	1	22	15	375	25	50	50	500	125	125	125	175	300	800	22	

SHRI VILEPARLE KELAVANI MANDAL'S
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)

Scheme for Second Year of B.Tech. Program in Mechanical Engineering: Semester IV (Autonomous)
(Academic Year 2021-2022)

Semester IV

	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)					Aggregate (A+B)	Credits earned	
			Theory (hrs.)	Laboratory (hrs.)	Tutorial (hrs.)	Credits	Duration (Hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Avg (TT1 & TT2)	Term Work Total	CA Total (B)			
1	DJ19MEC401	Engineering Mathematics IV	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19MET401	Engineering Mathematics IV Tutorial	--	--	1	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
2	DJ19MEC402	Fluid Mechanics	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19MEL402	Fluid Mechanics Laboratory	--	2	--	1	--	--	25	--	--	25	--	--	--	25	25	50	1	
3	DJ19MEC403	Mechanical Measurements and Metrology	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19MEL403	Mechanical Measurements and Metrology Laboratory	--	2	--	1	--	--	25	--	--	25	--	--	--	25	25	50	1	
4	DJ19MEC404	Advanced Manufacturing Processes	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	3
5	DJ19MEC405	Kinematics of Machinery	3	--	--	3	3	75	--	--	--	75	25	25	25	--	25	100	3	4
	DJ19MEL405	Kinematics of Machinery Laboratory	--	2	--	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
6	DJ19MEL406	Machine Shop Practice II	--	4	--	2	--	--	--	50	--	50	--	--	--	50	50	100	2	2
7	DJ19IHC1	Universal Human Values	2	--	--	2	3	75	--	--	--	75	25	25	25	--	25	100	2	3
	DJ19IHT1	Universal Human Values Tutorial	--	--	1	1	--	--	--	--	--	--	--	--	--	25	25	25	1	
8	DJ19A4	Innovative Product Development II	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
		Total	17	12	2	24	18	450	50	50	0	550	150	150	150	175	325	875	24	

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-2022)

<table>
<tr><td colspan="9">Program: Second Year Mechanical Engineering</td><td colspan="3">Semester: III</td></tr>
<tr><td colspan="9">Course: Engineering Mathematics III</td><td colspan="3">Course Code: DJ19MEC301</td></tr>
<tr><td colspan="9">Course: Engineering Mathematics III Tutorial</td><td colspan="3">Course Code: DJ19MET301</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="5">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>Tutorial / Mini project / presentation/ Journal</td></tr>
<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>25</td><td>25</td></tr>
</table>

Pre-requisite: Knowledge of integration, complex numbers and differential equations along with basic concepts in Mathematics.

Objectives:

1. To provide sound foundation in the mathematical fundamentals necessary to formulate, solve and analyse 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

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

Unit	Description	Duration in Hours
1	**Laplace, Inverse Laplace Transform and its applications** 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). $L\{t^n f(t)\}, L\left\{\frac{f(t)}{t}\right\}, L\left\{\int_o^t f(u)\,du\right\}, L\left\{\frac{d^n f(t)}{dt^n}\right\}$ Linearity property, Partial fractions method and convolution theorem. Applications to solve ordinary differential equations with one dependent variable with given boundary conditions	**09**
2	**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)** Line integral **(For Self-Study)**, Cauchy's theorem for analytic function, Cauchy's integral formula (all without proof) 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 $\int_0^{2\pi} f(cos\theta, sin\theta)d\theta,\ \int_{-\infty}^{\infty} f(x)dx$	**13**
3	**Fourier Series** 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) Complex form of Fourier series. Orthogonal and Orthonormal functions.	**07**
4	**Partial Differential Equations** Numerical Solution of PDE using Bender-Schmidt Method and Crank- Nicolson method Partial differential equations governing transverse vibrations of an elastic string its solution using Fourier series. Heat equation, steady-state configuration for heat flow **(For Self-Study)**	**07**
5	**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 $y = e^{bx}$	**06**

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

Books Recommended:

Text books:

1. Higher Engineering Mathematics, Dr B. S. Grewal, Khanna Publication
2. Advanced Engineering Mathematics, E Kreyzig, 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

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. 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.

Tutorial (Term-Work):

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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
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<table>
<tr><td colspan="8">Program: Second Year Mechanical Engineering</td><td colspan="3">Semester: III</td></tr>
<tr><td colspan="8">Course: Engineering Thermodynamics</td><td colspan="3">Course Code: DJ19MEC302</td></tr>
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</table>

Pre-requisite: Knowledge of basic Physics

Objectives:

1. To familiarize the concepts of Energy in general and Heat and Work in particular.
2. To study the fundamentals of quantification and grade of energy.
3. To study the effect of energy transfer on properties of substances in the form of charts and diagrams.
4. To familiarize application of the concepts of thermodynamics in vapour power, gas power cycles.

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

1. Demonstrate application of the first law of thermodynamics to wide range of systems.
2. Write steady flow energy equation for various flow and non-flow thermodynamic systems
3. Compute heat and work interactions in thermodynamics systems
4. Demonstrate the interrelations between thermodynamic functions to solve practical problems.
5. Use steam table and mollier chart to compute thermodynamics interactions
6. Compute efficiencies of heat engines, power cycles etc.

Detailed Syllabus: (unit wise)

Unit	Description	Duration in Hours
1	**Basic Concepts & First Law of Thermodynamics:** Basics concepts of thermodynamics, quasi-static process, Relation between Heat and Work- Joules Constant, First law of thermodynamics for a cyclic process, First law of thermodynamics for a closed system undergoing a process, Conservation principle, First Law of Thermodynamics applied to open system – Steady Flow Energy Equation, Perpetual motion Machine of First kind, Application of first law of thermodynamics to closed system or Non flow Process, Application of	**08**

	first law of thermodynamics to Open Systems like Steam Nozzle, Boiler, Steam Turbine, Pump, Heat Exchanger, Throttling Process – Joules Thompson Coefficient and its significance	
2	**Second Law of Thermodynamics:** Limitation of first law of thermodynamics, Thermal Reservoir – Source and Sink, Concept of Heat Engine, Heat Pump and Refrigerator, Second law of thermodynamics – Kelvin Planck and Clausius Statements. Equivalence of Clausius and Kelvin Planck Statement, Reversible and Irreversible Process. Causes of Irreversibility, Perpetual Motion Machine of Second Kind, Need of Carnot theorem and its corollaries, Carnot cycle, Thermodynamic Temperature Scale and its equivalence with Ideal Gas Scale Entropy: Clausius Inequality, Clausius Theorem, Entropy is Property of a system, Isentropic Process, Temperature Entropy Plot and its relationship with heat interactions, Entropy Principle, Entropy change During a Process. Interpretation of concept of entropy.	**09**
3	**Thermodynamic Relations:** Reciprocal Relation, Cyclic Relation Property relations, Maxwell Relations, TdS equations, Heat capacity relations, Volume Expansivity, Isothermal Compressibility, Clausius Clapeyron Equation **Exergy:** High grade and Low-Grade Energy, Available and Unavailable Energy, Dead State, Available energy with respect to a process and a cycle.	**05**
4	**Properties of Pure Substance:** Pure substance and Phase changes: Phase change processes of pure substance, Property diagrams for phase change process (T-v, T-s and p-h diagrams), Understanding of Steam Table and Mollier chart with suitable examples. **Vapour Power cycle:** Carnot cycle and its limitations as a vapour cycle, Rankine cycle with different turbine inlet conditions, mean temperature of heat addition, Methods to improve thermal efficiency of Rankine cycle – Reheat cycle and Regeneration Cycle. **Gas Power cycles**: Assumptions of Air Standard Cycle, Otto cycle, Diesel Cycle and Dual cycle, Brayton Cycle, Actual Brayton cycle, open and closed cycle gas turbine, methods to improve efficiency and specific output, open cycle with intercooling, reheat, and regeneration, Effect of operating variable on thermal efficiency and work ratio.	**13**
5	**Compressors:** Reciprocating Air Compressor, Single stage compressor – computation of work done, isothermal efficiency, effect of clearance volume, volumetric efficiency, Free air delivery, Theoretical and actual indicator diagram, Multistage compressors – Constructional details of multistage compressors, Need of multistage, Computation of work done, Volumetric efficiency, Condition for maximum efficiency, Inter cooling and after cooling (numerical), Theoretical and actual indicator diagram for multi stage compressors.	**07**

Books Recommended:

Text books:

1. Thermodynamics by P K Nag, Tata McGraw Hill Publishers
2. Thermodynamics by Onkar Singh, New Age International

Reference Books:

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

1. Thermodynamics: An Engineering Approach by Yunus A. Cengel and Michael ABoles,7th edition, TMH
2. Fundamentals of Engineering Thermodynamics by Michael J. Moran and Howard N. Shapiro, Wiley
3. Fundamentals of Thermodynamics by Claus Borgnakke and Richard E. Sonntag, Wiley
4. Engineering Thermodynamics by P Chattopadhyay, Oxford University Press India
5. Applied thermodynamics for engineering technologists by T. D. Eastop and A McConkey, Pearson Education
6. Thermodynamics from Concepts to Applications by Arthur Shavit and Chaim Gutfinger

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. 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.

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Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

<table>
<tr><td colspan="8">Program: Second Year Mechanical Engineering</td><td colspan="3">Semester: III</td></tr>
<tr><td colspan="8">Course: Strength of Materials</td><td colspan="3">Course Code: DJ19MEC303</td></tr>
<tr><td colspan="8">Course: Strength of Materials Laboratory</td><td colspan="3">Course Code: DJ19MEL303</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme
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<tr><td colspan="4">Laboratory Examination</td><td colspan="2">Term work</td><td rowspan="2">Total Term work</td><td rowspan="3">50</td></tr>
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<tr><td>25</td><td>--</td><td>--</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Pre-requisite: Knowledge of Engineering mechanics.

Objectives:

1. To gain knowledge of different types of stresses, strains and deformations induced in the mechanical components due to external loads.
2. To study the effect of component dimensions and properties of materials due to stresses and deformations.
3. To study the distribution of various stresses in the mechanical elements that deform under loads..

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

1. Evaluate stresses, strains, deformation and properties of materials in mechanical components/ structures.
2. Draw SFD and BMD for different types of loads and support conditions for a beam.
3. Compute and plot direct, bending and shear stresses across sections of given beam.
4. Compute torsional shear stresses and strain energy in mechanical components.
5. Compute deflections and slopes in beams.
6. Analyze buckling phenomenon in columns and struts.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
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Detailed Syllabus: (unit wise)

Unit	Description	Duration in Hours
1	**Stress and Strain:** Definition**, S**imple stress-strain, uni-axial, bi-axial and tri-axial stresses, tensile stress, compressive stress and shear stresses, elastic limit, Hooke's Law, deformation due to self-weight, bars of varying sections, composite sections, deformation of tapering members, Thermal Stresses. **Elastic Constants and their relations:** Poisson's Ratio, Modulus of elasticity, Modulus of rigidity, Bulk modulus, Yield stress, Ultimate stress. Factor of safety, state of simple shear, relation between elastic constants, Volumetric strain for tri-axial loading. **Principal stresses and Strains:** Principal plane and principal stresses, analytical and graphical method (Mohr's circle) for determining of stresses on oblique section.	**10**
2	**Shear Force and Bending Moment in Beams:** Axial force, shear force and bending moment diagrams for statically determinate beams (excluding beams with internal hinges), relationship between rates of loading, shear force and bending moment. **Moment of Inertia:** Area Moment of Inertia, Parallel Axis theorem, Polar Moment of Inertia, Principal axes, Principal moment of inertia.	**08**
3	**Bending stresses:** Theory of pure Bending, Assumptions, Flexural formula for straight beams, moment of resistance, bending stress distribution, Section modulus, beams of uniform strength. **Direct & Bending Stresses**: Combined stresses, Eccentricity, Stress distribution, Core /kernel of Section. **Shear Stresses:** Distribution of shear stresses for the section of beam.	**08**
4	**Torsion:** Torsion of circular shafts-solid and hollow, stresses in shafts when transmitting power, shafts in series and parallel. **Strain Energy:** Resilience, Proof Resilience, strain energy stored in the member due to gradually applies load, suddenly applied load, impact load. Strain energy stored due to Shear, Bending and Torsion.	**08**
5	**Deflection of Beams:** Deflection of Cantilever, simply supported and over hanging beams using Macaulay's or double integration method for different type of loadings. **Columns and Struts:** Buckling load, crushing load, Types of end conditions for column, Euler's column theory and its limitations, Rankine- Gordon Formula.	**08**

List of Laboratory Experiments:

1. Tension test on mild steel bar (stress-strain behaviour, determination of yield strength and modulus of elasticity) using Universal Testing Machine (UTM).

2. Torsion test on mild steel bar / cast iron bar.
3. Impact test on metal specimen (Izod test/ Charpy test)
4. Hardness test on metals – (Brinell Hardness Number / Rockwell Hardness Number)
5. Flexural test on beam (central loading)
6. Flexural test on beam (three-point loading)

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. Strength of Materials by S. Ramamrutham, Dhanpat Rai Pvt. Ltd
2. Mechanics of Materials by S.S.Ratan, Tata McGraw Hill Pvt. Ltd
3. Strength of Materials by R. Subramanian, Oxford University Press, Third Edition 2016

Reference Books:

1. Strength of Materials by Ryder, Macmillan
2. Mechanics of Materials by James M. Gere and Barry J. Goodno, Cengage Learning.
3. Mechanics of Materials by Gere and Timoshenko, CBS
4. Strength of Materials by Basavrajaiah and Mahadevappa, Khanna Publishers,New Delhi
5. Elements of Strength of Materials by Timoshenko and Youngs, Affiliated East -West Press
6. Mechanics of Materials byBeer, Jhonston, DEwolf and Mazurek, TMH Pvt Ltd., New Delhi
7. Mechanics of Structures by S.B. Junnarkar, Charotar Publication
8. Introduction to Solid Mechanics by Shames, PHI
9. Strength of Materials by Nag and Chandra, Wiley India
10. Strength of Materials by W.Nash, Schaum's Outline Series, McGraw Hill Publication, Special Indian Edition

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.

Laboratory:

1. Oral examination will be based on the entire syllabus including, the experiments performed during laboratory sessions.

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.

Laboratory: (Term work)

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

Term work shall consist of minimum 5 experiments and 6 assignments.

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

i. Laboratory work (Performance of Experiments): 15 Marks
ii. Journal Documentation (Write-up and 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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

<table>
<tr><td colspan="9">Program: Second Year Mechanical Engineering</td><td colspan="3">Semester: III</td></tr>
<tr><td colspan="9">Course: Manufacturing Processes</td><td colspan="3">Course Code: DJ19MEC304</td></tr>
<tr><td colspan="9">Course:</td><td colspan="3">Course Code:</td></tr>
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<tr><td rowspan="2">3</td><td rowspan="2">--</td><td rowspan="2">--</td><td rowspan="2">3</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>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
</table>

Pre-requisite: Knowledge of basic Chemistry and Physics.

Objectives:

1. To study basic manufacturing processes.
2. To study how to select appropriate production processes for a specific application.

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

1. Demonstrate understanding of various machine tool operations for machining.
2. Understand applications of casting process to produce metal/polymer components.
3. Demonstrate understanding of joining of metals through fastening, soldering, brazing and welding.
4. Illustrate the concept of producing semi-finished rolled products, forged components, extrusions, wires and sheet metal components.
5. Illustrate the concept of producing powder metallurgical components.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration in Hours**
1	**Introduction to Various Production Processes:** Examples and Application**.** **Machine Tools for Machining:** Lathe Machine, Milling Machine, Drilling Machine, Shaping Machine, Broaching Machine, Grinding Machine, Lapping/Honing Machines. Gear Manufacturing -Gear milling, standard cutters and limitations, gear hobbing, gear shaping, gear shaving and gear grinding processes. **Metal Cutting Tools:** Machining parameters, Mechanics of machining process, Concept of shear plane, chip reduction coefficient, force analysis, Merchants circle of cutting forces, Merchants theory-original and	**10**

	modified, effect of various parameters on cutting forces. Expression for shear plane angle and coefficient of friction in terms of cutting forces and tool angles, Velocity in cutting, Power requirement in cutting. Different types of dynamometers and their operations, Tool life definition, Mechanism of tool wear and measurement, Factors influencing tool life, cutting tool material, cutting fluids, Machinability, Surface finish, Factors affecting surface finish. Cutting Tools: geometry of single point cutting tool, Types of milling cutters and their geometry, Geometry of drill, Geometry of broach. Specification & Selection of grinding wheel, dressing & truing and balancing of grinding wheels.	
2	**Metal Casting:** Sand casting, Pattern materials and allowances, Types of pattern, Sand properties, Sand moulding/Machine moulding, Gating system- Types of riser, types of gates, Solidification during casting process, Melting- Electric arc & induction furnaces. **Special Casting Processes**: CO2 and shell moulding, Investment casting, Die casting, Vacuum casting, Inspection and Quality control of casting, Casting defects and remedies. **Producing Plastic Components**: Injection Moulding, Compression moulding, Transfer moulding, Blow moulding, Rotational Moulding, Thermoforming and Extrusion.	**10**
3	**Joining Processes:** Fusion and Non fusion joining processes. Welding: Classification of welding, working principle, equipment used, process parameters, fluxes used in welding, working method/procedure, applications of following welding techniques: Oxy-acetylene Flame welding, metal arc welding, TIG & MIG welding, submerged arc welding, electro-slag welding, PAM welding., Laser welding, electron beam welding, Thermit welding, Resistance welding, Friction welding, Welding defects and remedies. Soldering & brazing techniques and applications.	**8**
4	**Forming Processes**: Rolling, Forging, Extrusion and Wire Drawing processes. Principles and process characteristics, Rolling types, Rolling parameters, Calculation of Rolling load and Power, Thread rolling roll forging, Production of seamless tubes through rolling, Rolling defects, Forging : Types of Forging, Forging press, Forging dies, Analysis of Forging process, Forging Defects. Extrusion: types of extrusion, extrusion process parameters, Extrusion defects, Wire drawing process, wire drawing equipment, geometry of wire drawing die. **Sheet Metal Forming**: Introduction to Press Tools, Sheet metal operations, Types of Dies, scrap strip layout centre of pressure, selection of die sets, stock guides, strippers. Study and analysis of bending, forming and drawing operations.	**10**
5	**Powder Metallurgy:** Working principle, Powder metallurgy process: Processes of powder making, mechanisms of sintering, CIP and HIP, Finishing operations in Powder metallurgy, Applications of Powder metallurgy.	**4**

Books Recommended:

Text Books:

1. Manufacturing Engineering and Technology SI by Serope Kalpakjian, Steven R. Schmid, Prentice Hall

Reference Books:

1. Manufacturing Processes by P. N. Rao, Vol. 1 and 2, McGraw Hill Publishers

2. Production Technology by R. C. Patel and C. G. Gupta Vol I, II.

3. Foundry technology by P.L. Jain
4. Production Technology by P.C. Sharma
5. Workshop Technology by W. A. J. Chapman part I, II & III
6. Production Technology, HMT publishers

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 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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

<table>
<tr><td colspan="8">Program: Second Year Mechanical Engineering</td><td colspan="3">Semester: III</td></tr>
<tr><td colspan="8">Course: Materials Technology</td><td colspan="3">Course Code: DJ19MEC305</td></tr>
<tr><td colspan="8">Course: Materials Technology Laboratory</td><td colspan="3">Course Code: DJ19MEL305</td></tr>
<tr><td colspan="4" rowspan="3">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>15</td><td>10</td><td>25</td></tr>
</table>

Pre-requisite: Knowledge of basic Chemistry and Physics and Engineering Mechanics.

Objectives:

1. To study basic engineering materials, their properties, applications & selection.
2. To study types and causes of failure of components in service.
3. To study new materials and their applications.

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

1. Demonstrate fundamental knowledge about various types of materials, crystal structure, crystal imperfection, material property, deformation in materials.
2. Understand different types of failure mechanism in materials and its significance.
3. Interpret Iron-Iron carbide diagram, TTT diagram & their significance.
4. Select appropriate heat treatment process for specific applications.
5. Understand advance engineering materials, their properties, applications & selection.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration in Hours**
1	**Classification of Materials:** Metallic materials, Polymeric Materials, Ceramics and Composites: Definition, general properties and applications with examples. **Lattice Imperfections:** Definition, classification and significance of Imperfections. Point defects: Their formation and effects. Dislocation: Edge and screw dislocations, Burger's vector, Motion of dislocations and their significance.	**10**

	Surface defects: Grain boundary, sub- angle grain boundary and stacking faults. Their significance. Generation of dislocation, Frank Reed source, Conditions of multiplication and significance. **Deformation:** Definition, elastic and plastic deformation, Mechanism of deformation and its significance in design and shaping, Critical Resolved shear stress. Deformation in single crystal and polycrystalline materials. **Strain Hardening:** Definition importance of strain hardening. Dislocation theory of strain hardening, Effect of strain hardening on engineering behaviour of materials. Recrystallization Annealing: stages of recrystallization annealing and factors affecting it.	
2	**Failure mechanisms: Fracture and Failure** **Fracture:** Definition and types of facture, Brittle fracture: Griffith's theory of facture, Orowan's modification. Dislocation theory of facture. Ductile fracture: Mechanism, Notch effect on fracture, Fracture toughness. Ductility to Brittle transition, Definition and signification, Conditions of ductility transition factors affecting it. **Fatigue Failure:** Definition of fatigue and significance of cyclic stress. Mechanism of fatigue and theories of fatigue failure, Fatigue testing. Test data presentation and statistical evolution. S-N Curve and its interpretation. Influence of important factors on fatigue. **Creep Failure:** Definition and significance of creep. Effect of temperature and creep on mechanical behaviors of materials. Creep testing and data presentation & analysis. Mechanism of creep. Creep Resistant materials.	**10**
3	**Theory of Alloys & Alloys Diagrams:** Significance of alloying, Definition, Classification and properties of different types of alloys. Different types of phase diagrams (Isomorphous, Eutectic, Peritectic, Eutectoid, Peritectoid) and their analysis. Importance of Iron as engineering material, Allotropic forms of Iron, Influence of carbon in Iron-Carbon alloying. Iron-Iron carbide diagram and its analysis, TTT diagram, CCT diagram, Hardenability concepts and tests, Steels – types steels, microstructure, properties and applications. Cast Irons- Grey iron, White iron, Nodular and Malleable irons. Their microstructures, properties and applications. **Effect of Alloying Elements in Steels:** Limitation of plain carbon steels. Significance of alloying elements. Effects of major and minor constituents, Effect of alloying elements on ferrite, carbide, austenite, Effect of alloying elements on phase transformation. Stainless steels- types and applications Classification of tool steels and metallurgy of tool steels.	**08**
4	**Heat treatment Process:** **Technology of heat treatment**. Classification of heat treatment process. Annealing- various annealing processes and applications, Normalizing, Hardening & Tempering, Austempering, Martempering, Maraging and Ausforming heat treatment processes and Applications	**08**

	Surface hardening: Surface hardening methods. Their significance and applications. Carburizing, Nitriding, Cyaniding, Carbonitriding, induction hardening and flame hardening processes.	
5	**Introduction to New materials:** Composites: Basic concepts of composites, Processing of composites, advantages over metallic materials, various types of composites and their applications. Nano Materials: Introduction, Concepts, synthesis of nano materials, examples, applications and nano composites. High temperature alloys, Smart materials.	**06**

List of Laboratory Experiments:

1. Study of metallurgical microscope.
2. Metallographic sample preparation and etching
3. Microstructures of plain carbon steels
4. Microstructures of cast irons
5. Annealing, Normalizing and Hardening of medium carbon steel and observation of microstructures
6. Study of tempering characteristics of hardened steel
7. Determination of hardenability of steel using Jominy end Quench Test
8. Fatigue test – to determine number of cycles to failure of a given material at a given stress

Books Recommended:

Text books:

1. Materials Science and Engineering, William D. Callister, Jr. – Adapted by R.Balasubramaniam, Wiley India (P) Ltd.

Reference Books:

1. Mechanical Metallurgy, G.E. Dieter, McGraw Hill International New Delhi
2. Engineering Physical Metallurgy, Y. Lakhtin, Mir Publishers, Moscow
3. Introduction to Physical Metallurgy, Sydney Avner, McGraw Hill
4. Metallurgy for Engineers, E.C. Rollason - ELBS SOC and Edward Arnold, London
5. Material Science and Metallurgy, V.D. Kodgire, Everest Publishing House

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. 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.

Laboratory: (Term work)

Term work shall consist of minimum 6 experiments and 5 assignments.

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

1. Laboratory work (Performance of Experiments): 15 Marks
2. Journal Documentation (Write-up and 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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

Program: Second Year Mechanical Engineering	**Semester: III**
Course:	**Course Code:**
Course: Computer Aided Machine Drawing Laboratory	**Course Code: DJ19MEL306**

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			**Term work**		**Total Term work**	**100**
-	**4**	--	**2**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	--	**50**	**50**	-	**50**	

Pre-requisite: Knowledge of engineering drawing.

Objectives:

1. To familiarize conversion of an object into a drawing
2. To study conventional representation of various machining and mechanical details as per IS
3. To become conversant with 2-D and 3-D drafting

Outcomes: Learner will be able to…

1. Visualize and prepare detail drawing of a given object.
2. Read and interpret the drawing
3. Draw details and assembly of different mechanical systems.
4. Convert detailed drawing into assembly drawing using modelling software
5. Convert assembly drawing into detailed drawing using modelling software
6. Prepare detailed drawing of any given physical object/machine element with actual measurements

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration in Hours**
1	**Machine Elements:** Preparation of 2-D drawings of standard machine elements (nuts, bolts, keys, cotter, screws, spring etc) Conventional representation of threaded parts, Types of threads; thread designation, Conventional representation of machine components and materials, Designation of standard components	**06**

	Solid Geometry: Intersection of surfaces and interpenetration of solids- Intersection of prism or cylinder with prism; cylinder or cone, both solids in simple position only. Primary auxiliary views.	
2	**Geometric Dimensioning and Tolerancing (GD&T)** : Dimensioning with tolerances indicating various types of fits, **Details and assembly drawing**: Types of assembly drawings, part drawings, drawings for catalogues and instruction manuals, patent drawings, drawing standards, Introduction to unit assembly drawing, steps involved in preparing assembly drawing from details and vice-versa, **Preparation of details and assembly drawings** of *any three* from: Clapper block, Single tool post, Lathe and Milling tail stock, jigs and fixtures **Cotter, Knuckle joint, Keys**: keys-sunk, parallel woodruff, saddle, feather etc. **Couplings**: simple, muff, flanged Protected flange coupling, Oldham's coupling, Universal coupling	**16**
3	**Preparation of details and assembly drawings of Bearings:** Simple, solid, Bushed bearing, I.S. conventional representation of ball and roller bearing, Pedestal bearing, footstep bearing	**09**
4	**Preparation of details and assembly drawings of pulleys, Pipe joints:** Classification of Pulleys, pipe joints **Pulleys**: Flat belt, V-belt, rope belt, Fast and loose pulleys. **Pipe joints** *(any two)*: Flanged joints, Socket and spigot joint, Gland and stuffing box, expansion joint **Engine parts:** Types of Valves, introduction to I.C. Engine **Preparation of details and assembly drawings** *(any three):* Air cock; Blow off cock, Steam stop valve, Gate valve, Globe valve, Non-return Valve, I.C. Engine parts: Piston, Connecting rod, Cross head, Crankshaft, Carburettor, Fuel pump, injector, and Spark plug.	**20**
5	**Reverse Engineering of a physical model**: disassembling of any physical model having not less than five parts, measure the required dimensions of each component, sketch the minimum views required for each component, convert these sketches into 3-D model and create an assembly drawing with actual dimensions.	**05**

List of Laboratory Experiments:

1. Details of machine system-1
2. Details of machine system-2
3. Details of machine system-3
4. Details of machine system-4
5. Details of machine system-5
6. Assembly of machine system-1
7. Assembly of machine system-2
8. Assembly of machine system-3
9. Assembly of machine system-4
10. Assembly of machine system-5
11. Reverse engineering drawing of machine system

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

Books Recommended:

Text books:

1. Machine Drawing by N.D. Bhatt.
2. A textbook of Machine Drawing by Laxminarayan and M.L. Mathur, Jain brothers Delhi

Reference Books:

1. Machine Drawing, Kamat and Rao
2. Machine Drawing, M. B. Shah
3. A text book of Machine Drawing, R. B. Gupta, Satyaprakashan, Tech. Publication
4. Machine Drawing, K.I.Narayana, P. Kannaiah, K.Venkata Reddy
5. Machine Drawing, Sidheshwar and Kanheya
6. Autodesk Inventor 2011 for Engineers and Designers, ShamTickoo and SurinderRaina, Dreamtech Press
7. Engineering Drawing, P J Shah

Evaluation Scheme:

Semester End Examination (A):

Laboratory:

Practical examination of three hours duration is to be conducted by pair of Internal and External Examiners.
It will be based on Part-B of the Term work, and will have two sessions as follows:
Session-I: Preparation of 3-D models of parts, assembling parts and preparing views of assembly from given 2-D detailed drawing.
Session-II: Preparation of minimum five detailed 3-D part drawings from given 2-D assembly drawing.
Oral examination should also be conducted to check the knowledge of conventional and CAD drawing.
Questions provided for practical examination should contain minimum five and not more than ten parts.
The distribution of marks for practical examination shall be as follows:

- Session-I …… ….20 marks
- Session-II …… …20 marks
- Oral …… …….10 marks

Evaluation of practical examination to be done based on the printout of students work
Students work along with evaluation report to be preserved till the next examination

Continuous Assessment (B):

Laboratory: (Term work)

A. Minimum two questions from theory part of each module should be solved as a home work in A-3 size sketch book.
B. A-3 size Printouts/plots of the minimum 7 problems solved in practical class from the practical part of each module. Problems from practical parts of each module should be solved using any standard CAD packages like IDEAS, PRO-E, CATIA, Solid Works, Inventor etc.

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

- Homework: sketch book 25 marks
- Printouts/Plots 25 marks

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

<table>
<tr><td colspan="8">Program: Second Year Mechanical Engineering</td><td colspan="3">Semester: III</td></tr>
<tr><td colspan="8">Course:</td><td colspan="3">Course Code:</td></tr>
<tr><td colspan="8">Course: Machine Shop Practice I</td><td colspan="3">Course Code: DJ19MEL307</td></tr>
<tr><td colspan="4" rowspan="3">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>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>50</td><td>--</td><td>--</td><td colspan="2">50</td><td>50</td></tr>
</table>

Pre-requisite: Knowledge of Engineering drawing, and Manufacturing Processes

Objectives:

1. To study basic machining processes.
2. To perform various machining operations and machine protocols.

Outcomes: Learner will be able to…

1. Perform plain turning, taper turning, and thread cutting etc. on lathe machine.
2. Perform machining operations on shaper.
3. Perform Drilling-Boring operations on drilling machine and milling operations.
4. Perform grinding operations to obtain a finished assembly

Module	Details	Duration in Hours
1	Introduction to Lathe Machine, demonstration of various machining operations performed on Lathe Machine. One Job on Plain and Taper Turning -- Precision Turning, Taper Turning and Thread Cutting	**16**
2	Introduction to Shaping Machine, demonstration of various machining operations performed on Shaping Machine One job on shaping machine to make horizontal and inclined surface.	**12**
3	One job involving Drilling-Boring operations and Milling operation.	**16**
4	Grinding operation to the above jobs to obtain finished components and assembly of these components.	**12**

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

Books Recommended:

Reference Books:

1. Workshop Technology by W. A. J. Chapman Vol I & II
2. Workshop Technology by Hazra Choudhary Vol. I & II

Evaluation Scheme:

Semester End Examination (A):

Laboratory:

Practical examination of three hours duration will be held and evaluation will be done based on the performance during the examination for 50 marks.

Continuous Assessment (B):

Laboratory: (Term work)

Term work shall consist of Work-Shop book giving details of drawings of the completed jobs and time sheet.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of job and workshop book): 50 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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

<table>
<tr><td colspan="8">Program: Second Year Mechanical Engineering</td><td colspan="2">Semester: III and IV</td></tr>
<tr><td colspan="8">Course: Innovative Product Development I & II</td><td colspan="2">Course Code: DJ19A2 & DJ19A4</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours/week)</td><td colspan="6">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>
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<tr><td colspan="5">Laboratory Examination</td><td colspan="2">Semester review</td><td rowspan="2">Total</td><td rowspan="3">100</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">--</td><td rowspan="2">--</td><td rowspan="2">--</td><td>Oral</td><td>Practical</td><td colspan="2">Oral & Practical</td><td>Review 1</td><td>Review 2</td></tr>
<tr><td>--</td><td>--</td><td colspan="2">--</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 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, 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

A candidate needs to secure a 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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester III (Autonomous)
(Academic Year 2021-22)

Program: Common for All programs								**Semester: III**
Course: Constitution of India								**Course Code: DJ19A3**
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			**Term Work**	
1	**-**	**-**	**-**	**Oral**	**Practical**	**Oral & Practical**	-	**-**
				-	-	-		

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 in Hours**
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:**	03

	Governor, Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th & 91st Amendments.	
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, Panchyats 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

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

<table>
<tr><td colspan="8">Program: Second Year Mechanical Engineering</td><td colspan="3">Semester: IV</td></tr>
<tr><td colspan="8">Course: Ekingineering Mathematics-IV</td><td colspan="3">Course Code: DJ19MEC401</td></tr>
<tr><td colspan="8">Course: Engineering Mathematics-IV Tutorial</td><td colspan="3">Course Code: DJ19MET401</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>
<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>
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</table>

Pre-requisite: Knowledge of differentiation, integration, matrices and probability along with basic concepts in Mathematics.

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 as a square matrix 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)		
Unit	**Description**	**Duration in Hours**
1	**Linear Algebra** Characteristic equation, Eigenvalues and Eigenvectors with properties	**10**

	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	
2	**Vector differentiation and Integration** Scalar and vector point functions. Gradient of a scalar function, Divergence, curl and Scalar Potential of a vector function. Solenoidal, Irrotational and conservative Fields. Line integrals, Green's theorem (without proof) for planes and verification of line integrals Stokes theorem and Gauss divergence theorem (without proof and verification)	**10**
3	**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)	**09**
4	**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**
5	**ANOVA** Analysis of Variance (F-Test): One-way classification, Two-way classification (short-cut method)	**04**

Books Recommended:

Text books:

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

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, McGraw Hill Education, New Delhi
2. Integral Transforms and their Engineering Applications, Dr B. B. Singh, Synergy Knowledge ware, Mumbai
3. Numerical Methods, Kandasamy, S. Chand & CO
4. Fundamentals of Mathematical Statistics by S.C. Gupta and Kapoor

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

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. 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.

Tutorial (Term-Work):

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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

<table>
<tr><td colspan="8">Program: Second Year Mechanical Engineering</td><td colspan="3">Semester : IV</td></tr>
<tr><td colspan="8">Course : Fluid Mechanics</td><td colspan="3">Course Code: DJ19MEC402</td></tr>
<tr><td colspan="8">Course : Fluid Mechanics Laboratory</td><td colspan="3">Course Code: DJ19MEL402</td></tr>
<tr><td colspan="4" rowspan="3">Teaching Scheme
(Hours / week)</td><td colspan="7">Evaluation Scheme</td></tr>
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<tr><td>25</td><td>--</td><td>--</td><td>15</td><td>10</td><td>25</td></tr>
</table>

Pre-requisite: Knowledge of Partial Differential Equations, Calculus and Engineering Mechanics

Objectives:

1. To study fluid statics and fluid dynamics.
2. To study application of mass, momentum and energy equations in fluid flow.
3. To learn various flow measurement techniques.

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

1. Explain the key fluid properties, calculate the pressure, hydrostatic pressure force, buoyant force and discuss the stability of floating or submerged bodies.
2. Identify various flow characteristics based on the velocity field and determine the streamline pattern and acceleration field given a velocity field.
3. Explain the development, uses, and limitations of the Bernoulli equation and apply the Reynolds transport theorem and the material derivative, analyze certain types of flows using the Navier–Stokes equations.
4. Identify and understand various characteristics of the flow in pipes, calculate losses in straight portions of pipes as well as those in various pipe system components, apply appropriate equations and principles to analyze a variety of pipe flow situations.
5. Explain the fundamental characteristics of a boundary layer, including laminar, transitional, and turbulent regimes, calculate boundary layer parameters for flow past a flat plate, provide a description of boundary layer separation.
6. Understand some important features of different categories of compressible flows of ideal gases, solve useful problems involving isentropic and non-isentropic flows including flows across normal shock waves.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration in Hours**
1	**Properties of fluids and Fluid Statics:** Fluid Definition and properties, Newton's law of viscosity concept of continuum, Classification of fluids, Fluid Statics: Definition of body and surface forces, Pascal's law, Basic hydrostatic equation, Forces on surfaces due to hydrostatic pressure, Buoyancy and stability of floating or submerged bodies. **Fluid Kinematics**: Eulerian and Lagrangian approach to solutions; Velocity and acceleration in an Eulerian flow field; Definition of streamlines, path lines and streak lines; types of fluid flows; Definition of control volume and control surface, circulation, vorticity. Understanding of differential and integral methods of analysis. Definition and equations for stream function, velocity potential function in rectangular and cylindrical co-ordinates, rotational and irrotational flows; Definition and equations for source, sink, irrotational vortex.	**12**
2	**Fluid Dynamics:** Integral equations for the control volume: Reynold's Transport theorem, equations for conservation of mass, energy and momentum, Bernoulli's equation and its application in flow measurement, pitot tube, Venturi, orifice and nozzle meters. Differential equations for the control volume: Mass conservation in 2 and 3 dimension in rectangular coordinates, Euler's equations in 2,3 dimensions and subsequent derivation of Bernoulli's equation; Navier-Stokes equations (without proof) in rectangular Cartesian co-ordinates; Exact solutions of Navier-Stokes Equations to viscous laminar flow between two parallel planes (Couette flow and plane Poiseuille flow)	**08**
3	**Real fluid flows:** Definition of Reynold's number, Laminar flow through a pipe (Hagen-Poiseuille flow), velocity profile and head loss; Turbulent flows and theories of turbulence-Statistical theory, Eddy viscosity theory and Prandtl mixing length theory; velocity profiles for turbulent flows universal velocity profile, Velocity profiles for smooth and rough pipes Darcy's equation for head loss in pipe (no derivation),Moody's diagram, pipes in series and parallel, major and minor losses in pipes.	**08**
4	**Boundary Layer Flows:** Concept of boundary layer and definition of boundary layer thickness, displacement, momentum and energy thickness; Growth of boundary layer, laminar and turbulent boundary layers, laminar sub-layer; Von Karman Momentum Integral equation for boundary layers (without proof), analysis of laminar and turbulent boundary layers, drag, boundary layer separation and methods to control it, streamlined and bluff bodies, Aerofoil theory: Definition of aerofoil, lift and drag, stalling of aerofoils, induced drag.	**07**
5	**Compressible Fluid flow:** Propagation of sound waves through compressible fluids, Sonic velocity and Mach number; Application of continuity , momentum and energy equations for steady state conditions; steady flow through nozzle, isentropic flow through ducts of varying cross-sectional area, Effect of varying back pressure on nozzle performance, Critical pressure ratio, Normal shocks, basic equations of normal shock, change of properties across normal shock.	**07**

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

List of Laboratory Experiments:

1. Flow measurement using Venturimeter
2. Flow measurement using Orificemeter
3. Flow measurement using Rotameter
4. Determination of friction factor for Pipes
5. Determination of major and minor losses in Pipe systems
6. Verification of Bernoulli's Equation
7. Experiment on Laminar flow in pipes (Reynolds Apparatus).
8. Verification of impulse momentum principle.
9. Flow over notches / weirs.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. Fluid Mechanics by R K Bansal
2. Introduction to Fluid Mechanics and Fluid Machines by S. K. Som and Gautam Biswas

Reference Books:

1. Fluid Mechanics by Frank W. White, McGraw Hill Education
2. Fluid Mechanics by Yunus A Cengel and John M Cimbala, McGraw Hill Education, 3rd Edition
3. Fundamentals of Fluid Mechanics by Bruce Munson, John Wiley and sons
4. Introduction to Fluid Mechanics by Fox and McDonald, John Wiley and sons
5. Fluid Mechanics by Victor Streeter, Benjamin Wylie and K W Bedford, McGraw Hill Education, 9^{th} Edition
6. Fluid Mechanics by john F. Douglas, Prentice Hall
7. Mechanics of Fluids by Merle Potter, Cengage Learning
8. Engineering Fluid Mechanics by Donald F. Elger, John Wiley and sons
9. Fluids Mechanics by Russel C. Hibbeler, Prentice Hall

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.

Laboratory:

1. Oral examination will be based on the entire syllabus including, the practicals performed during laboratory sessions.

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.

Laboratory: (Term work)

Term work shall consist of minimum 7 experiments and 5 assignments.

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

1. Laboratory work (Performance of Experiments): 15 Marks
2. Journal Documentation (Write-up, 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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

Program: Second Year Mechanical Engineering	**Semester : IV**
Course: Mechanical Measurements and Metrology	**Course Code: DJ19MEC403**
Course: Mechanical Measurements and Metrology Laboratory	**Course Code: DJ19MEL403**

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**	

Pre-requisite: Knowledge of basic concepts of Engineering Drawing, Machine Drawing and Manufacturing Processes.

Objectives:

1. To impart knowledge of architecture of the measurement system
2. To deliver working principle of mechanical measurement system
3. To acquaint with measuring equipment used for linear and angular measurements.
4. To familiarize with different classes of measuring instruments and scope of measurement in industry and research
5. To acquaint with operations of precision measurement, instrument/equipment for measurement

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

1. Classify various types of static characteristics and types of errors occurring in the system.
2. Classify and select proper measuring instrument for displacement, strain, pressure and temperature measurement.
3. Classify and select proper measuring instrument for linear and angular measurement.
4. Demonstrate inspection methods and design of different limit gauges.
5. Demonstrate characteristics of surface texture, screw threads, and gear measurements.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration in Hours**
1	**Introduction**: Significance of Mechanical Measurements, Classification of measuring instruments, generalized measurement system, types of inputs: Desired, interfering and modifying Inputs.	**06**

	Static characteristics: Static calibration, Linearity, Static Sensitivity, Accuracy, Static Error, Precision, Reproducibility, Threshold, Resolution, Hysteresis, Drift, Span & Range etc. **Errors in measurement:** Types of errors, Effect of component errors, Probable errors.	
2	**Displacement Measurement:** Transducers for displacement, displacement measurement, potentiometer, LVDT, Capacitance Types, Digital Transducers (optical encoder), Nozzle, Flapper Transducer **Strain Measurement:** Theory of Strain Gauges, gauge factor, temperature Compensation, Bridge circuit, orientation of strain gauges for force and torque, Strain gauge-based load cells and torque sensors	**08**
3	**Pressure Measurement:** Elastic pressure transducers viz. Bourdon tubes, diaphragm, bellows and piezoelectric pressure sensors, High Pressure Measurements, Bridge man Gauge. Vacuum measurement: Vacuum gauges viz. McLeod gauge, Ionization and Thermal Conductivity gauges **Flow Measurement:** Bernoulli flow meters, Ultrasonic Flow meter, Magnetic flow meter, Rota meter **Temperature Measurement:** Electrical methods of temperature measurement Resistance thermometers, Thermistors and thermocouples, Pyrometers	**10**
4	Introduction to Metrology: Fundamental Definitions, Types of Standards, Precision and Accuracy, Measurement, Errors, Linear measurements, Angular Measurement **Design of Gauges:** Limits, Fits, Tolerances, Types of Gauges, Taylor's Principle of Limit Gauges, IS 919 for design of gauges.	**08**
5	**Surface Texture measurement:** Surface roughness, Waviness, Roughness Parameter Ra, Rz, RMS etc., working of Tomlinson surface meter, Tally-surf surface roughness tester, Surface roughness symbols **Screw Thread Measurement:** Screw threads Terminology, screw thread errors, Effective diameter measurement of screw thread by Floating Carriage micrometer **Gear Measurement:** Gear Terminology, Gear errors, Measurement by Parkinson Gear tester and Gear tooth Vernier Caliper	**10**

List of Laboratory Experiments:

1. Dead Weight Pressure gauge
2. Calibration of Vacuum Gauges
3. Torque measurement using strain gauges
4. Speed Measurement using tachometer, optical and magnetic pickup
5. Flow measurement using Rota meter
6. Study of Vernier Caliper, Micrometer.
7. Gear measurement using Gear tooth Vernier caliper
8. Thread Measurement using Floating carriage micrometer
9. Optical profile projector for miniature linear / angular measurements of screw / gear or components
10. Tool maker's microscope for linear / angular measurement of single point tools

Books Recommended:

Text books:

1. Mechanical Engineering Measurements, A K Sawhney, Dhanpat Rai& Sons, New Delhi

2. Instrumentation & Mechanical Measurements, A K Thayal
3. Engineering Metrology, K.J. Hume, Kalyani Publications
4. A text book of Engineering Metrology, I.C. Gupta, Dhanpat Rai Publications
5. Engineering Metrology and Measurements, Bentley, Pearson Education

Reference Books:

1. Measurement Systems: Applications and Design, by EO Doebelin,5th Edition, McGraw Hill
2. Instrumentation and Control System, W. Bolton, Elsevier
3. Mechanical Measurements, S P Venkateshan, Ane books, India
4. Mechanical Measurements and Metrology, R K Jain, Khanna Publishers
5. Metrology and Measurement, Anand,Bewoor and VinayKulkarni, McGraw Hill
6. Engineering Metrology and Measurement, N V Raghavendra and Krishnamurthy, Oxford University Press.

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.

Laboratory:

1. Oral and Practical examination of 25 marks will be based on the entire syllabus including, the practicals performed during laboratory sessions.

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.

Laboratory: (Term work)

Term work shall consist of minimum 7 experiments and 5 assignments.

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

1. Laboratory work (Performance of Experiments): 15 Marks
2. Journal Documentation (Write-up, Power Point Presentation and 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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

<table>
<tr><td colspan="8">Program: Second Year Mechanical Engineering</td><td colspan="4">Semester: IV</td></tr>
<tr><td colspan="8">Course: Advanced Manufacturing Processes</td><td colspan="4">Course Code:DJ19MEC404</td></tr>
<tr><td colspan="8">Course:</td><td colspan="4">Course Code:</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="8">Evaluation Scheme</td></tr>
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<tr><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
</table>

Pre-requisite: Knowledge of basic manufacturing processes.

Objectives:

1. To study advanced manufacturing processes.
2. To study how to select appropriate manufacturing processes for a specific application.

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

1. Demonstrate understanding of machining operations through CNC machine.
2. Understand concepts of Additive Manufacturing Technology.
3. Demonstrate understanding of production of metal components through Non-Traditional Machining.
4. Understand techniques of and Destructive testing of components & machines through Non-destructive Testing techniques.
5. Understand basics of some futuristic manufacturing concepts.

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration in Hours**
1	**Computer Enabled Subtractive Processes:** CNC machine: Introduction, principles of operation, Types – Vertical machining centres and horizontal machining centres, major elements, functions, applications, controllers, open loop and closed loop systems Types of Automatic Machines, Transfer Lines.	**10**
2	**Additive Manufacturing**: Fundamentals of Rapid Prototyping, Introduction to Additive Manufacturing (AM), Classifications of AM / RP System	**10**

	New AM Classification Schemes as per ASTM F42 and ISO TC 261. 3D Printing: Procedure, techniques and material used.	
3	**Non-traditional Subtractive Processes (NTM)**: Ultrasonic Machining (USM), Abrasive Jet Machining (AJM), Water Jet Machining, Electrochemical Machining (ECM), Chemical Machining (CHM) Electrical Discharge Machining (EDM), Plasma Arc Machining (PAM), Laser Beam Machining (LBM), Electron Beam Machining (EBM)	**8**
4	**Inspection and Testing of Produced Parts:** **Non-Destructive Testing Techniques (NDT):** Visual Inspection, Dye Penetrant Testing, Magnetic Particle Inspection, X-ray Radiography, Ultrasonic Testing and Eddy Current Testing. Applications of NDT. CMM, Scanning, CT Scan. **Destructive Testing**: UTM, Impact testing, Izod testing, Fatigue testing	**8**
5	**Introduction to Future Manufacturing Scenarios**: Cyber Physical Systems, Parametric Design, Hybrid Manufacturing, AI in Manufacturing VR / AR and MR in manufacturing.	**6**

References

1. Additive Manufacturing Technologies, Ian Gibson, David Rosen, Brent Stucker, Springer Publication.
2. Manufacturing Processes, P. N. Rao, Vol. 1 and 2, McGraw Hill Publishers.
3. Manufacturing, Engineering and Technology, Serope Kalpakjian, Steven R. Schmid, Prentice Hall.
4. Production Technology, HMT.
5. Production Technology, O. P. Khanna, Dhanpat Rai Publications.

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 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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

Program: Second Year Mechanical Engineering	**Semester : IV**
Course : Kinematics of Machinery	**Course Code: DJ19MEC405**
Course : Kinematics of Machinery Laboratory	**Course Code: DJ19MEL405**

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**	**25**
3	**2**	**--**	**4**	**Oral**	**Practical**	**Oral & Practical**	**Laboratory Work**	**Tutorial / Mini project / presentation/ Journal**		
				--	**--**	**--**	**15**	**10**	**25**	

Pre-requisite: Knowledge of Engineering Mechanics and Strength of Materials

Objectives:

1. To acquaint with basic concept of kinematics and kinetics of machine elements
2. To acquaint with various basic mechanisms and inversions
3. To study basics of power transmission

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

1. Analyse kinetics of rigid bodies
2. Define various components of mechanisms
3. Draw velocity and acceleration diagrams of various mechanisms
4. Draw Cam profile for the specific follower motion
5. Select appropriate power transmission system for specific application

Detailed Syllabus: (unit wise)		
Unit	**Description**	**Duration in Hours**
1	**Kinetics of Rigid Bodies:** Mass M.I. about centroidal axis and about any other axis, Radius of Gyration, D'Alembert's Principle of bodies under rotational motion about a fixed axis and plane motion, Application to motion of bars, cylinders and spheres only Kinetics of Rigid bodies: Work and Energy Kinetic energy in translating motion, Rotation about fixed axis and in general plane motion, Work Energy Principle and Conservation of energy	**07**

	Basic Kinematics: Structure, Machine, Mechanism, Kinematic link & its types, Kinematic pairs, Types of constrained motions, Types of Kinematic pairs, Kinematic chains, Types of joints, Degree of freedom (mobility), Kutzbach mobility criterion, Grűbler's criterion & its limitations Four bar chain and its inversions, Grashoff's law, Slider crank chain and its inversions, Double slider crank chain and its inversions	
2	**Velocity Analysis of Mechanisms (mechanisms up to 6 links):** Velocity analysis by instantaneous center of rotation method (Graphical approach), Velocity analysis by relative velocity method (Graphical approach). Analysis extended to find rubbing velocities at joints, mechanical advantage (Graphical approach) **Velocity and Acceleration Analysis of Mechanism:** Velocity and Acceleration- analysis by relative method (mechanism up to 6 link) including pairs involving Coriolis acceleration (Graphical Approach)	**10**
3	**Cam Mechanism:** Fundamentals of cams and followers, Classification of cams and followers, Motion analysis and plotting of displacement - time, velocity-time, acceleration-time, jerk-time graphs for uniform velocity, UARM, SHM, and Cycloid motions (combined motions during one stroke excluded)	**06**
4	**Belts, Chains and Brakes:** **Belts**: Introduction, types and all other fundamentals of belting, dynamic analysis –belt tensions, condition of maximum power transmission **Chains:** Types of chains, chordal action, variation in velocity ratio, length of chain **Brakes:** Introduction, types and working principles, Introduction to braking of vehicles	**10**
5	**Gears and Gear Trains:** **Gears**- Introduction, types, Law of gearing, Details of gear terminology, Involutes and cycloidal tooth profile, Interference in involutes gears, Critical numbers of teeth for interference free motion Methods to control interference in involutes gears, Static force analysis in spur gears. **Gear Trains:** Kinematic analysis of simple and compound gear trains, reverted gear trains, epi-cycle gear trains with spur gear combination	**09**

List of Laboratory Experiments/Sheets:

1. Study of Straight line generating mechanisms (Exact line generating mechanisms - Peaucillier's, Hart's mechanisms, Approximate line generating mechanisms - Watt's, Grasshopper, Tchebicheff's mechanisms)
2. Study of Steering gear mechanisms (Ackerman, Davis steering gears)
3. Study of Offset slider crank mechanisms – (Pantograph, single and double Hook-joint).
4. Analysis of velocity of mechanisms by Instantaneous Center of Rotation (3-5 problems)
5. Analysis of velocity of mechanism by Relative method (3-5 problems)
6. Analysis of acceleration of mechanism by Relative method (3-5 problems)
7. Layout of cam profiles and plotting of displacement–time, velocity-time and acceleration-time, jerk-time and layout of cam profiles (3-5 problems)
8. Construction of Involute and Cycloid gear tooth profile - 2 problems

Students will be given a mini project to design and fabricate any one mechanism. The mini project has to be completed in a group of maximum 4 students

Three assignments based on the syllabus will be included as part of term work, which would help the learner to understand various concepts.

Books Recommended:

Text books:

1. Theory of Machines by S. S. Ratan
2. Theory of Machines by R. S. Khurmi
3. Theory of Machines by P. L. Ballaney

Reference Books:

1. Theory of Mechanisms and Machines, Amitabh Ghosh and A. Kumar Mallik.
2. Theory of Machines and Mechanism, Uicker Jr, Garden Pennock & J.F. Shigley, Oxford University Press.
3. Mechanism Design: Analysis and Synthesis Vol I by A. Erdman and G N Sander, Prentice Hall.
4. Kinematics and Dynamics of Planer mechanisms, Jeremy Hirsihham, McGraw Hill.
5. Theory of Machines, W. G. Green, Bluckie & Sons Ltd.

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. 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.

Laboratory: (Term work)

Term work shall consist of drawing sheets and experiments (minimum 7), 1 mini project and minimum 3 assignments.

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

1. Laboratory work (Drawing sheets/Experiments): 15 Marks
2. Journal Documentation (Assignments): 05 marks
3. Mini – Project: 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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

<table>
<tr><td colspan="8">Program: Second Year Mechanical Engineering</td><td colspan="3">Semester : IV</td></tr>
<tr><td colspan="8">Course :</td><td colspan="3">Course Code:</td></tr>
<tr><td colspan="8">Course : Machine Shop Practice II</td><td colspan="3">Course Code: DJ19MEL406</td></tr>
<tr><td colspan="4" rowspan="2">Teaching Scheme (Hours / week)</td><td colspan="9">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">--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="5">Laboratory Examination</td><td colspan="3">Term work</td><td rowspan="3">Total Term work</td><td rowspan="3">100</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">4</td><td rowspan="2">--</td><td rowspan="2">2</td><td>Oral</td><td>Practical</td><td>Oral & Practical</td><td>Laboratory Work</td><td>Tutorial / Mini project / presentation/ Journal</td></tr>
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Pre-requisite: Knowledge of basic Physics and manufacturing processes.

Objectives:

1. To understand various machining operations done on CNC machine
2. To study various techniques of 3 D Printing.

Outcomes: Learner will be able to…

1. Understand turning operations done on Turning Centre.
2. Understand machining operations done on Vertical Machining Centre.
3. Perform 3 D Printing techniques to manufacture a simple component.

Units	Description	Duration in Hours
1	One job involving turning operations on Turning Centre.	**16**
2	One job involving turning, milling, shaping, drilling, grinding operations on Vertical Machining Centre.	**20**
3	One simple component each (3 components) using 3 D Printing Techniques : 1) Selective Laser Printing 2) Stereolithography 3) Fused Deposition Modelling	**20**

Books Recommended:

Reference Books:

1. Workshop Technology, W. A. J. Chapman Vol I & II
2. Workshop Technology, Hazra Choudhary Vol. I & II
3. Additive Manufacturing Technologies, Ian Gibson, D.W. Rosen, and B. Stucker, , 2nd Edition, Springer 2015

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

Evaluation Scheme:

Semester End Examination (A):

Laboratory:

Practical examination of three hours duration will be held and evaluation will be done based on the performance during the examination for 50 marks.

Continuous Assessment (B):

Laboratory: (Term work)

Term work shall consist of Work-Shop book giving details of drawings of the completed jobs and time sheet.
The distribution of marks for term work shall be as follows:
Laboratory work (Performance of job and workshop book): 50 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.

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

Program: Common for all program	**Semester: IV**
Course: Universal Human Values	**Course Code: DJ19IHC1**
Course: Universal Human Values Tutorial	**Course Code: DJ19IHT1**

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						
2	**--**	**1**	**3**	**Oral**	**Practical**	**Oral & Practical**	**Total Term work (C)**			**25**
				--	--	--	**25**			

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.

Unit	**Description**	**Duration in Hours**
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	**05**

	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.	
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 am 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.	**06**

	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.	

Books Recommended:

Textbooks:

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. 11.India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Evaluation:

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):

Syllabus for Second Year of B.Tech. Program in Mechanical Engineering:
Semester IV (Autonomous)
(Academic Year 2021-2022)

Tutorials: (Term work)

1. Term work shall consist of minimum 5 activities based on activities conducted.
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.