



**BansilalRamnath Agarwal Charitable Trust's**

# **Vishwakarma Institute of Technology**

*((An Autonomous Institute affiliated to SavitribaiPhule Pune University formerly University of Pune))*

**Structure & Syllabus of**

## **B.Tech. (Mechanical Engineering)**

**Pattern 'A 14'**

**Effective from Academic Year 2016-17**

**(T.Y. B.Tech.)**

**Prepared by: - Board of Studies in Mechanical Engineering**

**Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune**

**Signed by**

**Chairman – BOS**

**Chairman – Academic Board**

## **Vision, Mission and PEOs of B. Tech. Mechanical Engineering**

### **Vision of the Department**

To be recognized as one of the preeminent Mechanical Engineering Programs

### **Mission of the Department**

- To prepare students competent to make their careers in Mechanical Engineering
- To provide value education to students to make them responsible citizen
- To strengthen collaborations with Industries, Academia and Research Organizations to enrich learning environment and to enhance Research Culture
- To be recognized as a leading Mechanical Engineering Department in the field of Knowledge, Skill and Research

### **Program Educational Objectives**

To achieve the mission of the program, Mechanical Engineering graduates will be able:

- To work independently as well as in team to formulate, design, execute solutions for engineering problems and also analyze, synthesize technical data for application to product, process, system design & development
- To understand & contribute towards social, environmental issues, following professional ethics and codes of conduct and embrace lifelong learning for continuous improvement
- To develop expertise towards use of modern engineering tools, instruments, programming languages and software's
- To acquire and develop careers in industries, Research organizations, academia and demonstrate entrepreneurial skill

## Program Outcomes

### Mechanical Engineering

#### Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

### **Program Specific Outcomes (PSO)**

#### **Mechanical Engineering**

##### **Mechanical Engineering Graduates will be able to:**

1. Read & generate 2D & 3D computer based drawings of Mechanical Engineering components & systems and select appropriate materials and manufacturing processes for their production.
2. Conceptually understand Mechanical Engineering components & systems and thereby design & analyze them for enhancement of thermal & mechanical performance.
3. Conduct experiments on mechanical systems to measure different parameters required to evaluate the performance of materials, components & systems and deduce relevant conclusions

**T.Y. B.Tech -Mechanical Engineering Structure with effect from Academic Year 2016-17 MODULE 5**

Code	Subject	Type	Teaching Scheme			Assessment Scheme						Credits
			L	P	Tut.	ISA					ESA	
						Test 1	Test 2	HA	Tut.	CA	ESE	
ME30113	Fluid Machinery and Fluid Power Engineering	Theory - Core	3	-	1	10	20	5	5	-	60	4
ME30115	Mechatronics	Theory – Core / MD	3	-	1	10	20	5	5	-	60	4
ME30109	Internal Combustion Engine	Theory – Core	3	-	-	15	20	5	-	-	60	3
ME31117	Production Metallurgy	Theory – MD	2	-	-	15	20	5	-	-	60	2
ME30309	Internal Combustion Engine	Lab – Core	-	2	-	-	-	-	-	70	30	1
ME30313	Fluid Machinery and Fluid Power Engineering	Lab – Core/MD	-	2	-	-	-	-	-	70	30	1
ME33325	Measurement & Quality Control	Lab – PD	-	2	-	-	-	-	-	70	30	1
ME 30407	Comprehensive Viva Voce	Oral	-	-	-	-	-	-	-	-	100	2
<b>TOTAL</b>			<b>11</b>	<b>6</b>	<b>2</b>							<b>18</b>

**T.Y. B.Tech -Mechanical Engineering Structure with effect from Academic Year 2016-17 MODULE 6**

Code	Subject	Type	Teaching Scheme			Assessment Scheme						Credits
			L	P	Tut.	ISA					ESA	
						Test 1	Test 2	HA	Tut.	CA	ESE	
ME30116	Computational Methods in Mechanical Engineering	Theory - Core	3	-	1	10	20	5	5	-	60	4
ME30118	Heat Transfer	Theory – Core / MD	3	-	1	10	20	5	5	-	60	4
ME30114	Theory of Machines	Theory – Core	3	-	-	15	20	5	-	-	60	3
ME31120	Production Technology	Theory – MD	2	-	-	15	20	5	-	-	60	2
ME30314	Theory of Machines	Lab – Core	-	2	-	-	-	-	-	70	30	1
ME30318	Heat Transfer	Lab – Core / MD	-	2	-	-	-	-	-	70	30	1
ME33326	Computational Methods in Mechanical Engineering	Lab – PD	-	2	-	-	-	-	-	70	30	1
ME 30408	Comprehensive Viva Voce	Oral	-	-	-	-	-	-	-	-	100	2
<b>TOTAL</b>			<b>11</b>	<b>6</b>	<b>2</b>							<b>18</b>

**T.Y. B.Tech -Mechanical Engineering Structure with effect from Academic Year 2016-17****Semester I – Irrespective of Module**

Code	Subject	Type	Teaching Scheme			Assessment Scheme						Credits
			L	P	Tut.	ISA				ESA		
						Test 1	Test 2	HA	Tut.	CA	ESE	
ME 30111	Mechanical Design	Theory – Core	3	-	-	15	20	5	-	-	60	3
ME30311	Mechanical Design	Lab – Core	-	2	-	-	-	-	-	70	30	1
ME 37301	Seminar	Seminar	-	4	-	-	-	-	-	70	30	2
ME 37405	Mini Project	Project	-	4	-	-	-	-	-	70	30	2
<b>TOTAL</b>			<b>3</b>	<b>10</b>	<b>-</b>							<b>8</b>

**T.Y. B.Tech -Mechanical Engineering Structure with effect from Academic Year 2016-17****Semester II – Irrespective of Module**

Code	Subject	Type	Teaching Scheme			Assessment Scheme						Credits
			L	P	Tut.	ISA					ESA	
						Test 1	Test 2	HA	Tut.	CA	ESE	
ME 30112	Design of Machine Elements	Theory – Core	3	-	-	15	20	5	-	-	60	3
ME30312	Design of Machine Elements Lab	Lab – Core	-	2	-	-	-	-	-	70	30	1
ME 37302	Major Project-Stage I	Project	-	4	-	-	-	-	-	70	30	2
<b>TOTAL</b>			<b>3</b>	<b>6</b>	<b>-</b>							<b>6</b>



# **MODULE – VI**

**ME30116: COMPUTATIONAL METHODS IN MECHANICAL  
ENGINEERING**

Credits: 03

Teaching Scheme: 3 Hours / Week

**Unit 1: Numerical Solution of Algebraic and Transcendental Equations (7 Hrs)****Part A:** Bisection Method, Regula-Falsi Method, Newton-Raphson Method**Errors and approximations:**

Types of Errors, Absolute, Relative, Algorithmic, Truncation, Round off Errors, Error Propagation, Concept of Convergence, Relevance to Numerical Methods, Direct and Iterative Methods.

**Part B:** Modified Newton Raphson Method, Secant Method, and Successive Approximation Method.**Unit 2: Solution of Linear Simultaneous Equations (7 Hours)****Part A:** Homogeneous/Non-homogeneous systems, Gauss Elimination, Gauss-Jordan, Gauss-Seidel Methods**Part B:** Matrix Inversion Method, LU- Decomposition Method.**Unit 3: Interpolation, Curve Fitting and Numerical integration (10 Hours)****Part A: Interpolation:** Quadratic and cubic splines method**Curve Fitting:** Using least square criteria linear regression, Geometric curve, Exponential curve, polynomial of  $m^{\text{th}}$  degree**Numerical integration:** Trapezoidal Rule, Simpson  $1/3^{\text{rd}}$  and  $3/8^{\text{th}}$  Rule, Weddle's Rule, Gauss Quadrature Two Point Formula, Double Integration**Part B:** Central difference methods of interpolation, multiple linear regressions, Gauss Quadrature Three Point Formula**Unit 4: Numerical Differentiation and Solution of ODE's (8 Hours)****Part A: Numerical Differentiation:** Forward and Backward Difference Methods**Numerical Solution of Ordinary Differential Equation**

Taylor Series Method, Euler Method, Modified Euler Method, RungeKutta 2<sup>nd</sup> and 4<sup>th</sup> order method, Predictor-Corrector Methods – Milne’s Method

**Part B:** Numerical Differentiation using Central methods, RungeKutta higher order methods.

### **Unit 5: Numerical Solution of Partial Differential Equation(8 Hours)**

**Part A:** Finite Difference Method, Laplace’s Equation. Poisson’s Equation, One and Two Dimensional Heat Equations, Wave Equation

**Part B:** Finite Element Method and applications in 1D

#### **Text Books:**

1. Chapra S.C. and Canal R. P., Numerical Methods for Engineers, 5<sup>th</sup> Ed., Tata McGraw Hill Pub. Co. Ltd., New Delhi
2. Balagurusamy E, Numerical Methods, Tata McGraw Hill Pub. Co. Ltd., New Delhi
3. Veerarajan T., Ramchandran T., Theory and Problems in Numerical Methods with programs in C and C++, Tata McGraw Hill Co. Ltd. New Delhi

#### **Reference Books:**

1. Jain M. K., Iyengar S. R. K. and Jain R. K., Numerical Methods for Scientific and Engineering Computations, 5th Ed., New Age International Ltd, New Delhi
2. Schilling R. J. and Harries S. L., Applied Numerical Methods for Engineers using MATLAB and C, Thomson Asia Pvt. Ltd., Singapore
3. Gourdin A., Boumahrat M., Applied Numerical Methods, Prentice Hall of India Ltd, New Delhi

#### **Course Outcomes:**

The student will be able to –

1. Formulate engineering problems into Mathematical equations and find the solution
2. Apply various numerical methods like Newton Raphson, Bisection, and Regula Falsi to find the roots of an equation.
3. Apply numerical methods like Gauss Elimination, Gauss Seidel, and Gauss Jordan to find the solution of Linear Simultaneous equation.
4. Interpret experimental data by using Interpolation and Curve Fitting techniques like Quadratic, cubic splines and least square criteria, linear regression, Geometric curve, Exponential curve
5. Get approximate solutions of ODE’s by using Numerical approach.
6. Get approximate solutions of PDE's and develop understanding of FEM.

**ME30216: COMPUTATIONAL METHODS IN MECHANICAL  
ENGINEERING**

**Credits:** 01

**Teaching Scheme:** - Tutorial 1 Hr/Week

1. A case study problem to find root of an equation by a root bracketing method.
2. A case study problem to find root of an equation by an open method.
3. A case study problem to solve a set of linear simultaneous equation by direct method.
4. A case study problem to solve a set of linear simultaneous equation by an iterative method.
5. A case study problem to interpolate on a given set of data points.
6. A case study problem to fit a geometric curve on a given data.
7. A case study problem to do numerical integration.
8. A case study problem to do numerical differentiation.
9. A case study problem to solve ODE's by using single step methods.
10. A case study problem to solve ODE's by using Multi step approach
11. A case study problem to solve an Elliptic PDE.
12. A case study problem to solve a Parabolic PDE.

**Text Books**

1. Chapra S.C. and Canal R. P., Numerical Methods for Engineers, 5<sup>th</sup> Ed., Tata McGraw Hill Pub. Co. Ltd., New Delhi
2. Balagurusamy E, Numerical Methods, Tata McGraw Hill Pub. Co. Ltd., New Delhi
3. Veerarajan T., Ramchandran T., Theory and Problems in Numerical Methods with programs in C and C++, Tata McGraw Hill Co. Ltd. New Delhi

**Reference Books**

1. Jain M. K., Iyengar S. R. K. and Jain R. K., Numerical Methods for Scientific and Engineering Computations, 5th Ed., New Age International Ltd, New Delhi
2. Schilling R. J. and Harries S. L., Applied Numerical Methods for Engineers using MATLAB and C, Thomson Asia Pvt. Ltd., Singapore
3. Gourdin A., Boumahrat M., Applied Numerical Methods, Prentice Hall of India Ltd, New Delhi.

**Course Outcome:**

The student will be able to –

1. formulate wide range of engineering problems
2. interpret experimental data.
3. get approximate solution to engineering problems by using numerical methods.

**ME30118: Heat Transfer****Credits: 03****Teaching Scheme: 03 Hours / Week****Unit 1: Introduction****(08 Hours)**

**Part A:** Applications of heat transfer in engineering field. Modes of heat transfer, Fourier's law of heat conduction, Newton's law of cooling, Stefan-Boltzmann's law of radiation. Significance of thermal conductivity. Variation in thermal conductivity with temperature for metals, Non metallic solids, gases and liquids. Variable thermal conductivity (One-dimensional problems).

Three dimensional heat conduction equation in Cartesian coordinate for anisotropic material for unsteady state condition, and reduction to Fourier equation, Laplace equation and Poisson's equation.

Part B: Thermal diffusivity, Three dimensional heat conduction equation in cylindrical and spherical co-ordinates.

**Unit 2: One Dimensional Steady State Heat Conduction****(08 Hours)**

Part A: One dimensional steady state heat conduction through a plane wall, cylindrical wall and sphere. Analogy between heat flow and electricity, heat conduction through a composite slab, cylinder and sphere, overall heat transfer coefficient.

One dimensional steady state heat conduction with heat generation: Conduction heat transfer through plane wall, solid cylinder, hollow cylinder and sphere with heat generation. Critical radius of insulation.

Part B: Practical problems involving heat generation, thermal contact resistance and economic thickness of insulation.

**Unit 3: Extended Surfaces****(08 Hours)**

Part A: Classification of fins. Derivation of differential equation for fins with constant cross section with different boundary conditions. Effectiveness and efficiency of a fin. Error in the measurement of temperature in a thermo-well. Introduction to unsteady state heat conduction.

Part B: System with negligible internal resistance. Biot and Fourier numbers. Criteria for neglecting internal temperature gradient.

**Unit 4: Convection****(08 Hours)**

Part A: Mechanism of convection, Classification of convection, Introduction to hydrodynamic and thermal boundary layer. Laminar and turbulent flow over and inside a surface.

Convective heat transfer coefficients and their order of magnitude, Dimensional analysis of free and forced convection. Physical significance of the dimensionless parameters; Nu, Re, Pr, Gr, St and Ra.

Natural convection: Physical mechanism, Definitions, Empirical correlations for free convection heat transfer over horizontal plate, vertical plate and cylinder.

Forced convection: Empirical correlation's for heat transfer in laminar and turbulent flow over a flat plate and in a circular pipe.

Part B: Concept of hydraulic diameter

### **Unit 5: Heat Exchanger Characteristics and Thermal Radiation (08 Hours)**

Part A: Classification of Heat Exchangers, LMTD and Effectiveness-NTU methods to study performance of heat exchangers.

Thermal Radiation: Heat exchange by radiation between two finite black surfaces. Radiation shape factor, use of shape factor charts.

Irradiation, radiosity, electrical network method of solving problems. Heat exchange between non-black bodies and Heat exchange between two infinitely parallel planes, cylinders and spheres. Radiation shields, Gas radiation, and solar radiation.

Part B: Compact Heat Exchanger, Heat sinks

#### **Text Books:**

1. Sachdeva R. C., Fundamentals of Engineering Heat and Mass Transfer”, Wiley Eastern Limited, 3<sup>rd</sup> Edition 1988.
2. Sukhatme S. P., “A text book on Heat Transfer”, Orient Longmans Ltd., New Delhi, 3rd Edition, 1989.
3. Ozisik M. N., “Heat Transfer- A Basic Approach”, McGraw Hill, I edition, 1985.

### **Reference Books**

1. Frank P. Incropera and David P. De Witt, “Fundamentals of Heat Transfer”, Wiley, Eastern Limited
2. J. P. Holman, “Heat Transfer”, McGraw Hill, 9th edition, 2004.
3. Gupta and Prakash, “Engineering Heat Transfer”, Nemchand and Brothers.

### **Course Outcomes:**

The student will be able to –

1. Students will be able to mathematically formulate and analyze heat transfer system by conduction mode.
2. Students will be able to apply the conduction heat transfer knowledge on fins which are used in various applications.
3. Students will be able to apply the knowledge of fluid flow and convection heat transfer to analyze the thermal system.
4. Students will be able to analyze radiative heat transfer system.
5. Students will be able to perform thermal design of various heat exchangers.



**ME30207: Heat Transfer**

**Credits: 01**

**Teaching Scheme: 01 Hours / Week**

**List of Tutorials:**

1. Solving numericals of basic conduction, convection and radiation heat transfer.
2. Solving numericals on one dimensional heat transfer for plane wall, cylinder and sphere.
3. Solving numericals on one dimensional heat transfer for composite wall, composite cylinder and composite sphere using electrical analogy.
4. Solving numericals on heat transfer for fins.
5. Solving numericals on unsteady state heat transfer for plane wall, cylinder and sphere.
6. Solving numericals on forced convection.
7. Solving numericals on free convection.
8. Solving numericals on heat exchangers.
9. Solving numericals on radiation.
10. Solving numericals on radiation.

**Text Books:**

1. Sachdeva R. C., Fundamentals of Engineering Heat and Mass Transfer”, Wiley Eastern Limited, 3<sup>rd</sup> Edition 1988.
2. Sukhatme S. P., “A text book on Heat Transfer”, Orient Longmans Ltd., New Delhi, 3rd Edition, 1989.
3. Ozisik M. N., “Heat Transfer- A Basic Approach”, McGraw Hill, I edition, 1985.

**Reference Books**

1. Frank P. Incropera and David P. De Witt, “Fundamentals of Heat Transfer”, Wiley, Eastern Limited

2. J. P. Holman, "Heat Transfer", McGraw Hill, 9th edition, 2004.
3. Gupta and Prakash, "Engineering Heat Transfer", Nemchand and Brothers.

**Course Outcomes:**

1. Students will be able to mathematically formulate and analyze heat transfer system by conduction mode.
2. Students will be able to apply the conduction heat transfer knowledge on fins which are used in various applications.
3. Students will be able to apply the knowledge of fluid flow and convection heat transfer to analyze the thermal system.
4. Students will be able to analyze radiative heat transfer system.
5. Students will be able to perform thermal design of various heat exchangers.

## ME30114 :: THEORY OF MACHINES

**Credits: 03**

**Teaching Scheme** Theory 3 Hrs/Week

### Unit I

**(8 Hrs)**

#### **Flywheels and Governors**

##### **Part A.**

##### **Flywheel:**

Turning moment Diagrams for a four stroke Cycle single and Multi cylinder Internal combustion engine, Fluctuation of energy, Coefficient of fluctuation of energy, Flywheels for engines and Punching machines.

##### **Governors:**

Centrifugal Governors, Load type and Spring loaded type, Sensitivity and stability of governors, Isochronism, Hunting, Effort and Power, Controlling force, Coefficient of insensitivity.

##### **Part B.**

Applications of traditional and modern Governors, Flywheel Dimensions, Fly press etc.

### Unit II

**(10 Hrs)**

#### **Spur Gears**

##### **Part A.**

Gears- Classification of gears,

Spur Gears-terminology of gearing, conjugate action, Involute and Cycloidal profile, path of contact, arc of contact, contact ratio, interference, undercutting,

Other Types of GearsHelical Gears: Normal and transverse module, Torque transmitted by helical gears on parallel shafts. Virtual number of teeth.

Bevel Gears, Geometry, Basic Rack, Standard proportions.

Spiral Gears- Spiral angle, shaft angle, Efficiency of spiral gears.

Worm and Worm Wheel: Terminology, geometrical relationships, applications and tooth forces. Torque transmitted.

##### **Part B.**

Methods to avoid interference and undercutting Rack shift, Effect of center distance variation, friction between gear teeth, internal gears.

**Unit III (8 Hrs)****Gear Trains****Part A.**

Types of gear trains, Velocity ratio, Tooth load, torque transmitted. Holding torque, Tabular method of problem solving

**Part B.**

Graphical, Analytical, Algebraic methods of Gear Train Problem Solving

Gearboxes, Typical industrial gearboxes like constant mesh, synchromesh, differential gearbox, Positively infinite variable speed drives, Cyclo-drives, harmonic drives.

**Unit IV****(10 Hrs)****Cams and Followers****Part A.**

Types of cams and followers, Analysis of standard motions to the follower, Determination of cam profiles for given follower motions, Jump phenomenon, Introduction to Advanced cam curves.

**Part B.**

Analysis of cams with specified contours- circular arc cam, tangent cam, eccentric cam, Kinematically equivalent system.

**Unit V****Introduction to Synthesis of Linkages****(4 Hrs)****Part A.**

Type, Number and Dimensional Synthesis, Function Generation, Path Generation and Rigid Body Guidance, Accuracy (Precision) points, Chebychev spacing of accuracy points, Structural error.

**Part B.**

Two and three-position synthesis of four-bar and slider-crank mechanisms for function generation and rigid body guidance using the Pole method. Frudenstein's theorem.

**Text Books**

1. John Uicker, Jr., Gordon R. Pennock and J. E. Shigley, “Theory of Machines and Mechanisms”, 3rd Edition, Oxford University Press.
2. S. S. Rattan, “Theory of Machines”, Tata McGraw-Hill Publication.
3. R. S. Khurmi, “Theory of Machines”, Khanna Publication.

**References:**

1. Hannah and Stephans, “Mechanics of Machines”, Edward Arnold Publications.
2. Beven T, “Theory of Machines”, Longman Publications.
3. Shigley J.E. and Uiker J.J., “Theory of Machines and Mechanisms”, International Edition, MacGraw Hill Inc.
4. Ballaney P.L., “Theory of Machines”, Khanna Publications.
5. Jagdish Lal, “Theory of Machines”, Metropolitan Book Co. Pvt. Ltd. N. Delhi.
6. Khurmi R.S. and Gupta J.K., “Theory of Machines”, Eurasia Publishing House Pvt. Ltd. N. Delhi.
7. A. Ghosh Malik, “Theory of Mechanisms and Machines” East-West Pvt. Ltd.
8. S.S. Rattan, “Theory of Machines”, Tata MacGraw Hill.
9. Dr. V.P. Singh, “Theory of Machines”, Dhanpatrai and sons.

**Course Outcomes:** On successful completion of the course, the student will be able to;

- Analyze various forces and torques acting on Mechanical component like Flywheels, Governors, cams, gears and gear trains etc.
- Analyze centrifugal governor and find its coefficient of insensitiveness and stability.
- Kinematic analysis of Geared systems & design Gear train for a particular application
- Design the profile of a cam to achieve a desired follower motion
- Kinematic synthesize planer mechanisms such as four bar mechanisms and its inversions by Algebraic method.

## ME30114 :: THEORY OF MACHINES LABORATORY

**Credits: 1**

**Teaching Scheme** Lab 2 Hrs/Week

### List of Practical's

The term work shall consist of following Experiments and students are expected to submit a journal containing these experiments and sheets along with assignments given in class.

1. To determine the characteristic curves for centrifugal governor and to find its coefficient of insensitiveness and stability.
2. To study the performance of a given flywheel for I.C. Engine and Punching Machine application.
3. To draw cam profiles for various type of follower motions. {4 Problems At least}  
[2 turns]
4. To study the cam with specified contours and verify the cam jump phenomenon.  
{2 Problems At least}[2 turns]
5. To draw the conjugate profile for any general form of gear tooth. {2 Problems At least}  
[2 turns]
6. To study the gear profile generation and study the effect of undercutting and rack shift for the involute profile.
7. To study the transmitted and holding torque of an epicyclic gear trains.
8. To study various types of industrial gear boxes such as; Differential, Constant mesh, Synchromesh and PIV gear box.
9. To study kinematic synthesis for two, three position for the four bar mechanism using graphical as well as numerical methods.
- 10.** Industry visit report based on the applications of systems like Flywheel, Governor, Cam-Follower, Gear etc.

### **Text Books**

1. John Uicker, Jr., Gordon R. Pennock and J. E. Shigley, "Theory of Machines and Mechanisms", 3rd Edition, Oxford University Press.
2. S. S. Rattan, "Theory of Machines", ,Tata McGraw-Hill Publication.
3. R. S. Khurmi, "Theory of Machines", , Khanna Publication.

**References:**

1. Hannah and Stephans, “ Mechanics of Machines”, Edward Arnold Publications.
2. Beven T, “Theory of Machines”, Longman Publications.
3. Shigley J.E. and Uiker J.J., “Theory of Machines and Mechanisms”, International Edition, MacGraw Hill Inc.
4. Ballaney P.L., “Theory of Machines”, Khanna Publications.
5. Jagdish Lal, “Theory of Machines”, Metropolitan Book Co. Pvt. Ltd. N. Delhi.
6. Khurmi R.S. and Gupta J.K., “Theory of Machines”, Eurasia Publishing House Pvt. Ltd. N. Delhi.
7. A. Ghosh Malik, “Theory of Mechanisms and Machines” East-West Pvt. Ltd.
8. S.S. Rattan, “Theory of Machines”, Tata MacGraw Hill.
9. Dr. V.P. Singh, “Theory of Machines”, Dhanpatrai and sons

**Course Outcomes:** On successful completion of the course, the student will be able to

- Determine the characteristic curves for centrifugal governor and find its coefficient of insensitiveness and stability.
- Draw cycloid & involute profile for given standard gear tooth system
- Draw the conjugate profile for any general form of gear tooth & study the effect of undercutting and rack shift for the involute profile.
- Draw cam profiles for various type of follower motions
- kinematic synthesis of planer mechanisms Graphically for two, three position such as four bar mechanisms and its inversions.

## ME31120 Production Technology

**Credits:02**

**Teaching Scheme: 02 Hours / Week**

### **Unit 1: Jigs and Fixtures**

**(04 Hours)**

**Part A:** Introduction to jig & fixture, Classification of jig & fixtures. Principle of location, types of locators. Principle of guiding elements Types of guiding elements, Principle of clamping elements,

Types of clamps, Types of Jigs & Fixtures.

[Practical design problem on Drill Jig and milling Fixture]

**Part B:** General guide lines & procedures for design of jig & fixtures, Bodies, bases & frame,

### **Unit 2: Theory of Metal Cutting**

**(06 Hours)**

**Part A:** Determination of shear angle, chip reduction factor, velocity relationship, Merchant force circle, estimation of cutting forces, Tool wear, Tool life, modified Taylor's equation, Tool dynamometer.

**Part B:** Mechanics of chips formation, types of chips,

### **Unit 3: Cutting Tool Design**

**(06 Hours)**

**Part A:** Tool materials, design of single point cutting tool, form tool, drill, reamer, broach & plain milling cutter.

**Part B:** Nomenclature of drill, milling cutter, broach

### **Unit 4: Methods of Surface Improvements**

**(06 Hours)**

**Part A:** Corrosion Prevention Methods: Design and material selection, Surface Modification Techniques such as Electro deposition (Conventional electroplating, Electroless plating, Anodising), Diffusion coatings (Plasma nitriding, Aluminizing, Boronising, Chromizing), Vapour deposition (conventional PVD and CVD, Diamond like coating, Electron beam PVD), Thermal Spray Coatings, Ion implantation etc.

**Part B:** Mechanism of corrosion, Types of corrosion, atmosphere control, electroplating, Inhibitors, Cathodic and anodic protection, Coatings etc.



**Unit 5: CNC Machines and Non Conventional Machining (06 Hours)**

Part A: CNC Machining Centres, CNC Turning Centres, Machine Control Unit, Automatic Tool Changers, EDM, ECM, EBM, Ultrasonic Machining, Laser beam machining

Part B: Abrasive Jet machining, Plasma Arc Machining

**Text Books: (As per IEEE format)**

1. P. N. Rao, “CAD/CAM Principles and Applications”;2002, tata McGraw Hill Publishing Company Limited
2. P.N.Rao, *Manufacturing Technology Volume II*, 2013, McGraw Hill Education (India) Private limited
3. Smith W.F.: *Principles of Material Science and Engineering: McGraw Hill Education (India) Private limited*
4. P.C.Sharma, *A text Book of production Engineering, 2010S. Chand & Company Pvt. Limited*

**Reference Books:**

- 1.Dolalson, Lecain and Goold, *Tool design, , Tata McGraw Hill Publishing Company Limited*
2. M.H.A. Kempster, *Introduction to Jigs and fixtures design*
3. Tool Engineering Handbook, A.S.T.M.E.

**Course Outcomes:**

1. Students will be able to calculate the Power requirement for machining operations on Lathe and calculate the Tool life of single point cutting tool.
2. Students will be able to design Drill Jigs and Fixtures for manufacturing of various components
3. Students will be able to implement machining processes on CNC machine tools.
4. Students will be able to suggest preventive methods for protection from corrosion.

## **ME30307: Heat Transfer Laboratory**

**Credits: 01**

**Teaching Scheme: 02 Hours / Week**

### **List of Practicals:**

1. Variation of thermal conductivity w.r.t. temperature in metal rod
2. Determination of thermal conductivity of insulating powder
3. Temperature distribution through a composite wall.
4. Temperature distribution along the length of a fin and determination of fin effectiveness and fin efficiency.
5. Natural convection heat transfer from a heated vertical cylinder.
6. Heat transfer in forced convection for internal flow in a pipe.
7. Determination of emissivity of a metal surface.
8. Determination of Stefan-Boltzmann constant.
9. Performance of a parallel and counter flow heat exchanger.
10. Determination of critical Heat Flux
11. Validation of Dittus-Boelter Equation

### **Text Books:**

1. Sachdeva R. C., 'Fundamentals of Engineering Heat and Mass Transfer', Wiley Eastern Limited, 3<sup>rd</sup> Edition 1988.
2. Sukhatme S. P., 'A text book on Heat Transfer', Orient Longmans Ltd., New Delhi, 3<sup>rd</sup> Edition, 1989.
3. Ozisik M. N., 'Heat Transfer- A Basic Approach', McGraw Hill, I edition, 1985.

### **Reference Books**

1. Frank P. Incropera and David P. De Witt, 'Fundamentals of Heat Transfer', Wiley, Eastern Limited
2. J. P. Holman, 'Heat Transfer', McGraw Hill, 9th edition, 2004.

3. Gupta and Prakash, “Engineering Heat Transfer”, Nemchand and Brothers.

**Course Outcomes:**

1. Students will be able to understand various measurement instruments, measurement techniques in thermal systems.
2. Students will be able to convert the crude data in to usable data.
3. Students will get the physical significance of various correlations available in literature.

**ME33326: COMPUTATIONAL METHODS IN MECHANICAL  
ENGINEERING**

**Credits:01**

**Teaching Scheme: 2 Hours / Week**

**List of Practicals:**

Programming assignments with applications in Mechanical Engineering on following topics using C / C++ and MATLAB OR any other equivalent Software;

1. Algebraic and Transcendental equations
2. Linear simultaneous equations(2 practical turns)
3. Interpolation(2 practical turns)
4. Curve Fitting
5. Numerical integration
6. Numerical Differentiation
7. Ordinary Differential Equation
8. Partial Differential Equation (2 practical turns)

**Note:**

Each lab report shall consist of:

- 1) Manual solution of the given problems.
- 2) Flow chart of the Numerical methods.
- 3) Algorithm of the Numerical methods.
- 4) Matlab Program & solution printout.

**Text Books:**

1. Chapra S.C. and Canal R. P., Numerical Methods for Engineers, 5<sup>th</sup> Ed., Tata McGraw Hill Pub. Co. Ltd., New Delhi
2. Balagurusamy E, Numerical Methods, Tata McGraw Hill Pub. Co. Ltd., New Delhi
3. Veerarajan T., Ramchandran T., Theory and Problems in Numerical Methods with programs in C and C++, Tata McGraw Hill Co. Ltd. New Delhi .

**Reference Books:**

- 1) Jain M. K., Iyengar S. R. K. and Jain R. K., Numerical Methods for Scientific and Engineering Computations, 5th Ed., New Age International Ltd, New Delhi
- 2) Schilling R. J. and Harries S. L., Applied Numerical Methods for Engineers using MATLAB and C, Thomson Asia Pvt. Ltd., Singapore
- 3) Gourdin A., Boumahrat M., Applied Numerical Methods, Prentice Hall of India Ltd, New Delhi

**Course Outcomes:**

The student will be able to –

1. write algorithm for the numerical methods.
2. write program with numerical packages like MATLAB
3. Students will be able to use MATLAB for graphical representation of the solution of PDE's.

**ME 30408:: Comprehensive Viva Voce**

Credits: 02

Teaching Scheme: Nil

The CVV will be conducted on the basis of following Lab Courses –

- Computational Methods in Mechanical
  - Heat Transfer
  - Theory of Machines
  - Mechanical Design (during Sem I)
- OR
- Design of Machine Elements (during Sem II)

**ME30111: MECHANICAL DESIGN****Credits: 03****Teaching Scheme** Theory 3 Hrs/Week**Unit I Design Against static Load (8 Hrs)****Part A:**

Design Process: Machine Design, Traditional design methods, Basic procedure of Machine Design, Use of standards in design, Selection of preferred sizes

Factor of safety, Service factor, Modes of Failure,

Theories of failure: Maximum Normal Stress Theory, Maximum Shear stress Theory, Distortion Energy Theory. Design of simple machine parts - Cotter joint, Knuckle joint and Levers, Eccentric axial loading, Stresses in curved beams.

**Part B:**

Sources of Design data , Design Synthesis, Creativity in design. Introduction to thermal and residual stresses.

**Unit II Shafts, Keys and couplings (8 Hrs)****Part A:**

Transmission shaft, Shaft design on strength basis, Shaft design on torsional rigidity basis, A.S.M.E. code for shaft design, design of Hollow shaft on strength basis, design of Hollow shaft on torsional rigidity basis, Design of square and flat Key, Design of splined shaft ,

Design of Muff ,Flange Couplings.

**Part B:**

Design of shaft on the basis of lateral rigidity – Castigliano’s theorem.

Design of saddle, sunk, feather and Woodruff keys , Design of multiflex flexible coupling, Critical speed of shaft. Selection of couplings from manufacturing catalogue.

**Unit III Threaded joints & Power screws (8 Hrs)****Part A:****Threaded joints**

Basic types of screw Fastening, Bolts under tension, Eccentrically loaded bolted joint in shear, Eccentric load perpendicular to axis of bolt, Eccentric load on circular base, Torque requirement for bolt tightening, Bolts of uniform strength.

**Power screws:** Forms of threads, Multiple threaded screws, Terminology of Power screws, Torque analysis with square, trapezoidal and Acme threads, Self locking screw, Efficiency of Square Threaded Screws, Efficiency of Self-Locking Screws, Collar friction torque, Design of screw and Nut, Design of Screw jack and C-Clamp.

**Part B:**

Dimensions of standard fasteners, Design of cylinder head bolts and turn buckle.

Differential and compound Screws, Recirculating Ball Screws.

## Unit IV Welded, Riveted Joints and Design for Fluctuating Loads

(10 Hrs)

### Part A:

**Welded Joints:** Stresses in butt and fillet welds, Strength of butt parallel and transverse fillet welds, Axially loaded unsymmetrical welded joint, Eccentric load in plane of welds, Welded joint subjected to bending and torsional moments.

### Riveted Joints:

Types of failure, strength equation, Efficiency of joint

**Design for Fluctuating Loads:** Stress concentration – causes and remedies, Fluctuating stresses, Fatigue failure, S-N curve, Endurance limit, Low cycle and high cycle fatigue, Notch sensitivity, Endurance strength modifying factors, Reversed stresses, Design for finite and infinite life, Soderberg and Goodman diagrams and Fatigue design of shaft under combined stresses.

### Part B:

Modified Goodman diagram, Cumulative damage in fatigue failure.

## Unit V Mechanical Springs ( 6 Hrs)

### Part A:

Mechanical Springs: Types, Applications and materials of springs, Stress and deflection equations for helical Springs, Style of ends, Design of helical springs, Design against Fluctuating Load, springs in series and Parallel, Concentric helical springs.

### Part B:

Helical torsion Spring, Surge in spring, Multi-leaf Spring, Nipping of leaf Springs, Shot peening, Belleville spring.

### Text Books

1. Bhandari V. B. “Design of Machine Elements”, 3rd Edition, Tata McGraw Hill Education Private Ltd, New Delhi
2. Sharma C. S., Purohit Kamlesh “Design of Machine Elements”, , Prentice Hall of India Pvt. Ltd. New Delhi.
3. Khurmi R. S. and Gupta J. K. “A text book of Machine Design”, S Chand and Co. Ltd., New Delhi

### Reference Books

1. Robert Juvinall, Kurt Marshek, “Machine Component Design”, fifth edition, Wiley India
2. Spotts M. F. and Shoup T. E. “Design of Machine Elements”, Prentice Hall Int
3. Shigley J. E. and Mischke C. R. , “Mechanical Engineering Design”, . 6th Edition, Tata McGraw Hill Pub. Co. Ltd., Delhi
4. Kannaiyah P. “Machine Design”, , SCITECH Publication Pvt. Ltd. , Chennai
5. Dr. P C Sharma & Dr. D K Aggarwal, “Machine Design”, 12<sup>th</sup> Edition, S K Kataria & sons, New Delhi
6. “Design Data”, P.S.G. College of Technology, Coimbatore



**Course Outcomes:** On successful completion of the course, the student will be able to

- Analyze the stress and strain on mechanical components and identify failure modes for mechanical parts
- Select material & derive specification for simple mechanical components like Cotter joint, knuckle joint, shaft, couplings, springs etc.
- Design lifting device Screw jack & clamping device C-Clamp
- Design mechanical component for fluctuating load
- Design mechanical joints like welded joint, threaded joint, Riveted joint

**ME30311: MECHANICAL DESIGN (LAB)****Credits: 1****Teaching Scheme: laboratory 2 Hours / Week****List of Practicals**

Practical includes **Three** design projects based on syllabus of the subject. Each design project shall consist of two half imperial size sheets: one involves assemble drawing with partlist and overall dimensions and other sheet involving individual component drawings. Manufacturing tolerances , dimensional tolerances and surface finish symbols should be specified on the drawings. A design report which includes all the design calculations should be submitted in the separate file.

Probable topics of the projects based on the use of standards are enlisted below.

1. Design of Cotter joint/ Knuckle Joint / Levers
2. Design of Couplings
3. Design of Screw Jack/ C-Clamp
4. Design of springs

Industrial visit report based on the systems like shafting, keys, couplings, bolted /welded joints, springs etc.

**Recommendation** : At least one project drawing should be done using CAD software.

**Text Books**

1. Bhandari V. B. “Design of Machine Elements”, 3rd Edition, Tata McGraw Hill Education Private Ltd, New Delhi
2. Sharma C. S., PurohitKamlesh “Design of Machine Elements” , Prentice Hall of India Pvt. Ltd. New Delhi.
3. Khurmi R. S. and Gupta J. K. “A text book of Machine Design”, S Chand and Co. Ltd., New Delhi

## Reference Books

1. Robert Juvinall, Kurt Marshek, "Machine Component Design", fifth edition, Wiley India
2. Spotts M. F. and Shoup T. E. "Design of Machine Elements", Prentice Hall Int
3. Shigley J. E. and Mischke C. R., "Mechanical Engineering Design", 6th Edition, Tata McGraw Hill Pub. Co. Ltd., Delhi
4. Kannaiah P. "Machine Design", SCITECH Publication Pvt. Ltd., Chennai
5. Dr. P C Sharma & Dr. D K Aggarwal, "Machine Design", 12<sup>th</sup> Edition, S K Kataria & Sons, New Delhi
6. "Design Data", P.S.G. College of Technology, Coimbatore

**Course Outcomes:** On successful completion of the course, the student will be able to

- Select the suitable material from the design data book and derive specification for designing simple mechanical components like Cotter joint, knuckle joint, shaft, couplings, springs etc
- Decide the fits of different mechanical components of the system relative to the other components of the system
- Select the suitable material from the design data book and derive specification for lifting device screw Jack & clamping device C-clamp
- Represent the designed component in the form of engineering drawings (Parts and Assembly Drawing) in order to communicate the manufacturing requirements of the component to the manufacturer.

## ME30112: DESIGN OF MACHINE ELEMENTS

**Credits:** 03

**Teaching Scheme:** - Theory 3 Hrs/Week

**Prerequisites:** Mechanical Design

### **Unit I Belts , Chain and Rope drives (6 Hrs)**

**Part A:**

Types of belts, belt construction, geometric relationships, analysis of belt tensions, condition for maximum power, characteristics of belt drives, Belt tensioning methods, Chain drives, roller chain, power rating of roller chains, sprocket wheel, and design of chain drive.

**Part B:**

Rope drives, Construction of wire ropes, Lay of wire ropes, Stresses in wire rope, Selection of wire ropes, Rope drum construction and design. Geometric relationships, polygonal effect in Chains, chain lubrication, silent chain.

### **Unit II Friction Clutches and Brakes (9 Hrs)**

**Part A:**

**Clutch:**

Classification and selection of friction clutches, Torque transmitting capacities and design of single plate, multi-plate, Cone and Centrifugal clutches

**Brakes:**

Energy absorbed by brake, Block brake, Band Brake, Internal expanding shoe brake, Temperature rise in brake operation. Design of Disk brake.

**Part B:**

Types of friction materials, their advantages, limitations and selection criteria, Concept of temperature rise in clutch operation.

### **Unit III Rolling and Sliding Contact Bearing (8 Hrs)**

**Part A:**

**Rolling contact bearings :**

Types of rolling contact Bearings, Static and dynamic load carrying capacities, Stribeck's equation, Equivalent bearing load, Load-life relationship, Selection of bearing life, Taper roller bearing, Design for cyclic loads and speed, Bearing with probability of survival other than 90%.

**Sliding Contact Bearing :**

Comparison of rolling and sliding contact bearing, Hydrodynamic journal bearing: Reynold's equation, Raimondi and Boyd method, temperature rise, Bearing design – selection of parameters.

**Part B:**

Bearing materials, Types of lubricants , Bearing failure causes and remedies, Hydrostatic Bearing: Viscous flow through rectangular slot, hydrostatic step bearing,

energy losses in hydrostatic bearing

#### **Unit IV Spur Gear**

**(8 Hrs)**

##### **Part A:**

Number of teeth and face width, Types of gear tooth failure, Desirable properties and selection of gear material, Constructional details of gear wheel, Force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by velocity factor and Buckingham's equation.

##### **Part B:**

Classification of gears, Selection of types of gears, Standard systems of gear tooth. Methods of gear lubrication, Introduction to addendum modification and its advantages

#### **Unit V Helical and Bevel Gears**

**( 9 Hrs)**

##### **Part A:**

##### **Helical Gears:**

Transverse and normal module, Virtual no of teeth, Force analysis, Beam and wear strengths, Effective load on gear tooth, Estimation of dynamic load by velocity factor and Buckingham's equation, Design of helical gears.

##### **Bevel Gears:**

Straight tooth bevel gear terminology and geometric relationship, Formative number of teeth, Force analysis, Design criteria of bevel gears, Beam and wear strengths, Dynamic tooth load by Velocity factor and Buckingham's equation, Effective load, Design of straight tooth bevel gears.

##### **Part B:**

Selection of materials for bevel gears, Introduction to spiral bevel gears and hypoid gears and comparison with straight tooth bevel gears, Lubrication and mounting of bevel gears, Bearing reactions, Types of failures in bevel gears.

##### **Text Books**

1. Bhandari V. B. "Design of Machine Elements", 3rd Edition, Tata McGraw Hill Education Private Ltd, New Delhi
2. Sharma C. S., Purohit Kamlesh "Design of Machine Elements", , Prentice Hall of India Pvt. Ltd. New Delhi.
3. Khurmi R. S. and Gupta J. K. "A text book of Machine Design", S Chand and Co. Ltd., New Delhi

##### **Reference Books**

1. Robert juvinall ,Kurt marshek, "Machine component Design", fifth edition, Wiley India
2. Spotts M. F. and Shoup T. E. "Design of Machine Elements", Prentice Hall Int
3. Shigley J. E. and Mischke C. R, "Mechanical Engineering Design", . 6th Edition, Tata McGraw Hill Pub. Co. Ltd., Delhi
4. Kannaiah P. "Machine Design", , SCITECH Publication Pvt. Ltd. ,Chennai
- 5 . Dr. P C Sharma & Dr.D K Aggarwal, "Machine Design", 12<sup>th</sup> Edition, S K Kataria & sons, New Delhi
6. "Design Data", P.S.G. College of Technology, Coimbatore

**Course Outcomes:** On successful completion of the course, the student will be able to

- Decide Power transmission system for a particular application
- Design drive train such as Belt,Rope,Chain drive
- Derive the design specifications for clutch & brake based on principle of uniform wear and pressure theory
- Select the material and derive the design specifications for Spur, Helical & Bevel gear
- Select the standard components like bearings, belts and chains from the manufacturer's catalog

**ME30312: DESIGN OF MACHINE ELEMENTS (LAB)****Credits: 1****Teaching Scheme: laboratory 2 Hours / Week****List of Practicals**

1. Practical assignment on selection of flat / Vee Belt from manufacturer's catalog.
2. Practical assignment on selection of chain drive from manufacturer's catalog.
3. Practical assignment on selection of rolling contact bearing from manufacturer's catalog.
4. Hydrodynamic journal bearing Test
5. **“ONE” design project:**

The design project shall consist of two imperial size sheets – one involving assembly drawing with a part list and overall dimensions and the other sheet involving drawing of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified so as to make it working drawing. A design report giving all necessary calculations of the design of the components and assembly should be submitted in a separate file.

Design projects should include selection of prime mover and design of mechanical systems comprising of machine elements: i) spur gears, helical and or bevel gears **OR** ii) Friction Clutches or Brakes.

- Industrial visit report based on the systems like Belt/Rope /Chain drives, friction clutches, brakes, Bearings, Gears etc.

**Text Books**

1. Bhandari V. B. “Design of Machine Elements”, 3rd Edition, Tata McGraw Hill Education Private Ltd, New Delhi
2. Sharma C. S., PurohitKamlesh “Design of Machine Elements”, , Prentice Hall of India Pvt. Ltd. New Delhi.
3. Khurmi R. S. and Gupta J. K. “A text book of Machine Design”, S Chand and Co. Ltd., New Delhi

## Reference Books

1. Robert juvinall ,Kurt marshek, “Machine component Design”,fifthedition,Wiley India
2. Spotts M. F. and Shoup T. E. “Design of Machine Elements”, Prentice Hall Int
3. Shigley J. E. and Mischke C. R ,“Mechanical Engineering Design”,. 6th Edition, Tata McGraw Hill Pub. Co. Ltd., Delhi
4. Kannaiah P. “Machine Design”, , SCITECH Publication Pvt. Ltd. ,Chennai
- 5 . Dr. P C Sharma &Dr.D K Aggarwal, “Machine Design”, 12<sup>th</sup> Edition, S K Kataria& sons, New Delhi
6. “Design Data”, P.S.G. College of Technology, Coimbatore

**Course Outcomes:** On successful completion of the course, the student will be able to

- Select the material from the design data book and derive the design specifications for machine components like belt,rope,chain drive, Bearing
- Decide the layout of a mechanical system like gear-box and decide the fits of different mechanical components of the system relative to the other components of the system.
- Represent the designed component, individually and as a part of the mechanical assembly like a gear box, in the form of engineering drawings in order to communicate the manufacturing requirements of the components to the manufacturer
- Measure pressure distribution & frictional torque in hydrodynamic journal bearing



**ME37302:: PROJECT STAGE-1****Credits: 02****Teaching Scheme:4 Hours / Week**

The project work could be of the following nature:

Design/development and Fabrication of models, machines, and prototypes based on new ideas, robotic and automation systems, Experimental set ups, test rigs/ equipment's,

Thermal Systems Energy audit/conservation studies

Extensive computational analysis of problems relevant to mechanical engineering,

CAD/CAM/CAE

Modeling/simulation of product(s), mechanism(s) or system(s) and its validation or comparison with available bench marks / results

The project work shall be taken up individually or in a group consisting of not more than 4 students. A report containing maximum 30 pages shall be submitted based on the background, need and scope of the project, project specifications, activities involved in the project and activity plan, study of literature and basic theory, and work completed (if any).

**Guidelines:**

- Report shall be typed or printed.
- Project title and approval sheets shall be attached at the beginning of the report followed by index and synopsis of the project.
- References shall be mentioned at the end followed by appendices (if any).
- When a group of students is doing a project, names of all the students shall be included on every certified report copy.

Each group of students shall submit two copies of reports to the institute and one copy shall be prepared for each individual student.

**Course Outcomes:**

The student will be able to –

- 1) Student will be able to identify and plan the project problem.
- 2) Student will be able to formulate the project problem.
- 3) Student will be able to conduct the literature survey of the related topic.

**ME 37301: Seminar****Credits: 02****Teaching Scheme: 1 Hours / Week****Guidelines:**

The seminar topic may be

- Mechanical Engineering
- Based on Interdisciplinary subjects.
- Recent trends in engineering field.

The topic should be based on recent research paper published in International Conference / engineering journals / article published in print media.

Each student should have a different seminar topic and its presentation. In case more than one student is working on the same topic, then their scope of seminar must be distinct.

**Instructions for Seminar Report writing**

1. Prepare minimum one copy of manuscript of Seminar report for the submission. The report should be printed on both sides of the paper, except the cover page, front page and Certificate.
2. The manuscript of the Seminar report should be preferably 15-20 pages.
3. The Seminar report must be spiral bound.
4. Entire report should be documented as one chapter. Following will be the order of the report.
  - Cover page and front page as per the standard specimen (**as described by the Department**) on separate sheet.
  - Certificate from the institute as per the standard specimen (**as described by the Department**).
  - Acknowledgement
  - List of Figures
  - List of Tables
  - Nomenclature (**symbols and the abbreviations** used in the manuscript should be included in Nomenclature section)
  - Contents
  - Abstract (A brief abstract of the report not more than **250 words**. The heading of abstract i.e. word “Abstract” should be **bold, Times New Roman, 12 pt** and should be typed at the **centre**. The contents of abstract should be typed on new line without space between heading and contents. Try to include one or two sentences each on **motive, method, key-results** and **conclusions** in the Abstract)
  - Sections: Introduction, Theory / Experimental details, Methodology, Experimental / Numerical scheme, Results and Discussion, Conclusions.
  - References
5. The main part of manuscript should be Times New Roman 12 pt. and justified. Use 1.5 line spacing.

6. Use the paper size **8.5'' × 11''** or **A4 (210 × 197 mm)**. Follow the margins given below.

Margin Location	Paper 8.5''×11''	Paper A4 (210mm×197mm)
Top	1''	25.4 mm
Left	1.5''	37 mm
Bottom	1.25''	32 mm
Right	1''	25.4 mm

7. All paragraphs should be 1.5 line spaced with a one blank line between each paragraph. Each paragraph should begin without any indentation.
8. Section titles should be bold with 12 pt and Title Case (the first letter is to be capitalized) and should be left aligned.
9. Sub-Section headings should be aligning at the left with 12 pt, italic and Title Case (the first letter is to be capitalized).
10. All section headings and subheadings should be numbered. For sections use numbers **1, 2, 3, ....** and for subheadings **1.1, 1.2, ....** etc and section subheadings **2.1.1, 2.1.2, ....** etc.
11. Number equations consecutively. Equation numbers, within parentheses, are to position to right, for eg.

$$a + b = \gamma \quad (1)$$

12. Illustrations (charts, drawings, photographs, figures) are to be in the text. Figure No. and figure captions should be at bottom of the figure with **12 pt**. Table No. and Table captions should be at the top of the Table with **12 pt**.
13. Page number should be given in the footer with Times New Roman 10 Pt, centrally aligned. **Cover page, front page and Certificate should not be numbered.**
14. **References** should be either in order as they appear in the manuscript or in alphabetical order by last name of first author. References should be given in the body of the text and well spread. No verbatim copy or excessive text from only one or two references. If **figures** and **tables** are taken from any reference then indicate source of it. Referencing style that has to be followed in the manuscript are given below.

#### **Reference Books:**

Collier, G. J. and Thome, J. R., Convective boiling and condensation, 3rd ed., Oxford University Press, UK, 1996, pp. 110 – 112.

#### **Papers from Journal or Transactions:**

Jung, D. S. and Radermacher, R., Transport properties and surface tension of pure and mixed refrigerants, *ASHRAE Trans*, 1991, 97 (1), pp. 90 – 98.

Bansal, P. K., Rupasinghe, A. S. and Jain, A. S., An empirical correction for sizing capillary tubes, *Int. Journal of Refrigeration*, 1996, 19 (8), pp.497 – 505.

#### **Papers from Conference Proceedings**

Colbourne, D. and Ritter, T. J., *Quantitative assessment of flammable refrigerants in room air conditioners*, Proc. of the Sixteenth International Compressor Engineering Conference and Ninth International Refrigeration and Air Conditioning Conference, Purdue University, West Lafayette, Indiana, USA, 2002, pp. 34 – 40.

### **Reports, Handbooks etc.**

United Nations Environmental Programme, Report of the Refrigeration, Air Conditioning and Heat Pumps, Technical Option Committee, 2002, Assessment - 2002. ASHRAE Handbook: Refrigeration, 1994 (Chapter 44)

### **Patent**

Patent no, Country (in parenthesis), date of application, title, year.

### **Internet**

www.(Site) [Give full length URL]

### **Seminar Evaluation Scheme:**

1	Attendance during Semester	10
2	Attendance during Seminar presentation self and peer	10
3	Relevance of Seminar Topic	10
4	Timely abstract submission	10
5	Literature review	10
6	Technical Content	10
7	Presentation	25
8	Answers to the examiner's Queries	15
Total		100

### **Course Outcomes:**

The student will be able to –

1. Review research papers, periodicals and magazines
2. Discuss the recent developments in the field of mechanical engineering
3. Develop skills of technical report writing and presentation.