GOVERNMENT COLLEGE OF ENGINEERING, JALGAON
Department of Mechanical Engineering

Scheme for Semester V B. Tech. (Mechanical Engineering with Multidisciplinary Minor) with effect from academic year 2023-24 (As per NEP 2020)

Course Code	Proposed Course Domain	Category	Teaching Scheme				Evaluation Scheme						Credit
							Theory			Practical		Total	
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE		
ME301N	Design of Machine Elements	PCC	3	…	…	3	30	10	60	…	…	100	3
ME302N	Dynamics of Machines	PCC	3	…	…	3	30	10	60	…	…	100	3
ME303N	Heat and Mass Transfer	PCC	3	…	…	3	30	10	60	…	…	100	3
ME304N	Design of Machine Elements Lab	PCC	…	…	2	2	…	…	…	30	20	50	1
ME305N	Dynamics of Machines Lab	PCC	…	…	2	2	…	…	…	30	20	50	1
ME306N	Heat and Mass Transfer Lab	PCC	…	…	2	2	…	…	…	30	20	50	1
ME307N	Professional Elective- I	PEC	3	…	…	3	30	10	60	…	…	100	3
ME308N	Professional Elective- I Lab	PEC	…	…	2	2	…	…	…	30	20	50	1
XXMYYYN	Multi Disciplinary Minor-III	MDM-III (MDC)	4	**...**	…	4	30	10	60	…	…	100	4
ME310N	Open Elective-III	OE-III	2	…	…	2	30	10	60	…	…	100	2
Total			**18**	**0**	**8**	**26**	**180**	**60**	**360**	**120**	**80**	**800**	**22**
ME311N	Advanced Mechanisms	DHC-I	3	…	…	3	30	10	60	…	…	100	3
ME312N	Advanced Mechanisms Lab	DHC-II	…	…	2	2	…	…	…	30	20	50	1

L : Lecture **P: Practical** **MSE: Mid Semester Examination**

ISA :Internal Sessional Assessment **ESE: End Semester Examination** **ICA : Internal Continuous Assessment**

DHC: Departmental Honors Course

Program Elective Course- I	**Open Elective-III**
A. Production Technology	X.Power Station Engineering
B. Internal Combustion Engine	Y. Operation Research
C. Computer Integrated Manufacturing	

ME301N DESIGN OF MACHINE ELEMENTS

Teaching Scheme : 03L

Evaluation Scheme : 30 MSE +10 ISA +60 ESE **Credit:** 03

Duration of ESE : 04 Hrs **Total Marks:** 100

COURSE DESCRIPTION

This course introduces undergraduate students to different parts of machines, failure criteria and conventional design procedures.

DESIRABLE AWARENESS/SKILLS

Fundamental knowledge of computer, engineering drawing and deA sound knowledge of Mathematics, Engineering Mechanics, SOM, TOM and Machine Drawing are required.

COURSE OUTCOMES

On successful completion of this course student shall be able to:

1. Understand the stresses and strains induced in various machine element.
2. Design a machine component using theories of dynamic failure.
3. Understand component behavior subjected to loads and identify the failure criteria.
4. Design different machine components as cotter joint, power transmitting elements, temporary, permanent joint as well as energy storing and releasing element.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2								1			1	1	
2	2	1		1	1								1	1	
3	2	3	3										1	1	
4	1	1		1	1								1	1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Basic and Design of Simple Machine Elements (8 Hrs)

Introduction of Machine Design, Basic steps of Machine Design, technical design aspect of designing, Requisites of design engineer, Design of machine elements, Sources of design data, Use of standards in design, Selection of preferred sizes, Maximum principal stress Theory, Maximum shear stress theory, Maximum principal strain Theory, Maximum strain energy Theory, Maximum Distortion energy Theory. Stress Concentration _ Causes & Remedies. Design of

Simple machine Components_ Knuckle joint & Cotter joint, (Numerical on all theories of failure and design of simple machine Components)

Design of Shaft and Keys (8 Hrs)

*Shafts: -Material, Design on the basis of strength considering shaft subjected to:-*Twisting moment only, bending moment only, combine twisting and bending moment, axial load in addition to twisting and bending. Design on the basis of rigidity:-A.S.M.E.codefor shaft design, *Keys:-* Classification of keys, Design considerations in parallel and tapered sunk keys, Design of square, flat and Kennedy keys, Splines.

Design of Joints and Fasteners (8 Hrs)

Threaded Joints: -Different Forms of Threads, Bolts of uniform strength, Locking devices, I.S.O. metric screw threads, Stresses in threaded joint,eccentrically loaded bolted joint,Torque requirement for bolt tightening design of Power Screw Jack. Welded Joints:- Types of welding and joints, strength of transverse and parallel fillet welded section, (numerical will be exercise on all above cases).

Design of Elastic member and Energy storing device (8 Hrs)

Spring:-Types, Applications and materials of springs, Stress and deflection equations for helical spring, Style of ends, Wahl's stress factor, Design of helical compression springs, Springs in series and parallel, Concentric helical springs, leaf spring, Shot peening.

Design of Dynamic loading (8 Hrs)

Design for Fluctuating Loads: Stress concentration-causes and remedies, fluctuating stresses, Fatigue failure, Endurance limit, Notch sensitivity, Reversed stresses, Solderberg and Goodman diagrams, Fatigue design of components under combined stresses such as shafts, bolts and springs.

Text Book:

1. Mechanical Engineering Design, Shigley J.E. and Mischke C.R., 8thedition, 2008 Tata McGraw Hill Publication Co. Ltd.
2. Designof Machine Elements, Spotts M.F. and Shoup T.E., 7th edition,1998Prentice Hall International.

Reference Book:

1. Design of Machine Elements, Bhandari V.B., 3rd edition,2010,Tata McGraw Hill Publication Co. Ltd.
2. Machine Components Design, Willium C. Orthwein, 2006, West Publishing Co. and Jaico Publications House.
3. Design Data, P.S.G. College of Technology, Coimbatore.
4. Fundamentals of Machine Components Design, Juvinal R.C., 3rd edition 2003, John Wiley and Sons.
5. heory and Problems of Machine Design, Hall A.S., Holowenko A.R. and Laughlin H.G, 1930
6. Mechanical Analysis and Design, A. H. Burr and J. B. Cheatham, 4th edition,1985., Prentice Hall.

ME302N DYNAMICS OF MACHINES

Teaching Scheme: 03L, **Total:** 03 **Credit:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:**100
Duration of ESE: 03Hrs

COURSE DESCRIPTION:

The objective is to introduce some of the components mainly used in IC Engines and make analysis of various forces involved. Subjects deals with topics like inertia forces in slider crank mechanism; IC Engine components & the analysis like governors is introduced. It also deals with balancing of rotating & reciprocating parts. Studies are made about balancing of multi cylinder engines, Radial engines etc. study of primary & secondary forces are considered while balancing. Finally, they are introduced to the topic of vibrations. The study deals with linear, longitudinal, & torsional vibrations. The idea is to introduce the concept of natural frequency and the importance of resonance and critical speeds.

COURSE OUTCOMES: At the end of completion of the course, the student will be able to:

1. Analyse dynamic forces in four-bar and slider-crank mechanisms.
2. Evaluate the performance characteristics of governors and flywheels in regulating engine stability
3. Analyze static and dynamic balancing techniques for rotating and reciprocating systems.
4. Determine critical speed, vibration isolation, and transmissibility for mechanical
5. Examine free and forced vibrations in single-degree-of-freedom systems, including damping effects systems.

RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2		3	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	3		1		1	-	-	-	-	-	-	-	-	-	1
CO 4	3	-	-	2	-	-	-	-	-	-	-	-	-	1	-
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Dynamic Force Analysis (6hr)

D'Alembert's Principle, Dynamic analysis of four –link mechanism, Dynamic analysis of slider- crank mechanism, Engine force analysis, Equivalent dynamical system, and Graphical method for equivalent dynamical system

Governor and Flywheel (7hr)

Introduction, Types of Governors, Sensitiveness of governor, hunting of governor, controlling force, Stability, Isochronism, power of Governor, effort of governor. Turning moment diagram for Single Cylinder, double acting Steam engine, 4-Stroke Cycle I.C. engine, multicylinder engine, Fluctuation of energy, energy stored in flywheel**.**

Balancing (7hr)

Introduction, Static balancing, Dynamic balancing, transferring of a Force from one plane to another, Balancing of Several Masses in Different planes, Primary & Secondary Balancing of Reciprocating Mass, balancing a locomotive, effect of Partial Balancing, Balancing of In line Engines and V Engines.

Fundamentals of Vibration (8hr)

Introduction, Definitions, Vector method of representing Harmonic Motions, Addition of two simple Harmonic motion of the same frequency. Undamped Free Vibrations of Single Degree of Freedom Systems**: -** Introduction, Derivations of differential equations, solution of differential equation, Torsional vibrations, Equivalent stiffness of spring combinations, Energy method. Damped Free Vibrations of Single Degree of Freedom Systems: - Introduction, Different types of damping, Free vibrations with viscous damping, Logarithmic Decrement, Viscous dampers, Coulomb damping, Structural damping, Interfacial damping.

Forced Vibrations of Single Degree of Freedom Systems (8hr)

Introduction, forced vibrations with constant Harmonic excitation, forced vibration with rotating and reciprocating unbalance, forced vibrations due to excitation of the support, Critical speed of a light shaft having a single disc without damping, critical speed of a light shaft having a single disc with damping, Vibration, isolation and transmissibility, vibration measuring instruments. Two Degrees of Freedom Systems: Introduction, Principal modes of vibration, undamped dynamic vibration absorber.

Text books:

1) S.S. Rattan, "Theory of Machines" Fifth edition, McGraw Hill 2019

2) G.K. Groover, "Mechanical Vibrations", eight edition 2009

3) Rao V. Dukkipati, Srinivas, PHI, "Mechanical Vibrations" PHI Learning Pvt. Ltd., 2012

Reference books:

1) T. Bevan ,"Theory of Machines",Third edition, CBH publisher,2005

2) by A. Ghosh and A.K. Mallik. ,"Theory of Mechanisms and Machines"

3)S.S. Rao." Mechanical Vibration"

ME303N HEAT AND MASS TRANSFER

Teaching Scheme : 03 L + 00 T; Total: 03 hours/week **Credits** : 03
Evaluation Scheme : 10 ISA + 30 MSE + 60 ESE **Total Marks** : 100
ESE Duration : 3 Hrs.

COURSE DESCRIPTION

The basic concepts of heat and mass transfer through various medium, such as conduction, convection, and radiation, are studied in this courses. Other topics covered include steady-state and transient heat transfer, heat exchangers, mass diffusion, and applications in mechanical, chemical, and aerospace engineering. In essence, this course teach students how to analyze and design systems that involve heat and mass transfer processes.

DESIRABLE AWARENESS / SKILLS

Knowledge of Engineering Thermodynamics and Fluid Mechanics.

COURSE OUTCOMES

On the successful completion of this course; student shall be able to -

1. Analyze & apply the modes of heat transfer equations for one dimensional thermal system.
2. Design a thermal system considering fins, transient heat conduction.
3. Evaluate the heat transfer rate in natural and forced convection .
4. Interpret heat transfer by radiation between objects with simple geometries, for black and grey surfaces.
5. Analyze different heat exchangers and quantify their performance .
6. Ability to analyze the rate of mass transfer using fick's law of diffusion and understands mass diffusion in different coordinate systems.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3				1								2		1
2	2	2			2								2		1
3	2	2			2								2		1
4	2	2			1								2		1
5	3				1								2		2
6	2				1								2		

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Introduction to Heat Transfer (08 Hrs)

Different Modes and Laws of heat transfer, heat conduction equation in Cartesian coordinates and its simplified equations, electrical analogy, Critical radius of insulation.

steady state heat conduction without and with heat generation: Heat conduction without heat generation in plane wall, composite wall. Heat conduction with heat generation in Plane wall, Cylinder and Sphere with different boundary conditions.

Extended Surfaces (04 Hrs)

Heat transfer through extended surfaces: Types of fins and its applications, Governing Equation for constant cross sectional area fins, Solution for infinitely long fin , adequately long fin with insulated end tip and short fins Fin Efficiency & Effectiveness of fins, estimation of error in Temperature measurement by thermometer.

Convection, Boiling and Condensation (08 Hrs)

Forced Convection: Physical significance of non-dimensional numbers, Empirical correlations for flat plate, pipe flow, and flow across cylinders, spheres, tube banks.

Free Convection: Physical significance of non-dimensional numbers, Free convection from a vertical, horizontal surface, cylinder and sphere. Mixed Convection

Boiling and Condensation: Types of boiling, Regimes of pool boiling, Film wise condensation, Drop wise condensation , Critical heat flux. (No Numerical treatment on boiling and condensation)

Radiation (08 Hrs)

Radiation concept and its laws, Concept of black body, Intensity of radiation and solid angle; Radiation heat exchange between two black surfaces, view factor. Radiation heat exchange between grey surfaces, Electrical analogy for radiation, Radiation shields. [Numerical Treatment for Radiation shields only]

Heat Exchangers (08 Hrs)

Classification and applications of heat exchangers, Heat exchanger analysis – LMTD for parallel and counter flow heat exchangers, Effectiveness– NTU method for parallel and counter flow heat

exchangers, cross flow heat exchangers, LMTD correction factor, Heat Pipe, Introduction to electronic cooling - Active and passive methods of augmented heat transfer.

Mass Transfer **(04 Hrs)**

Physical origins, applications of mass transfer, Mixture Composition, Phase diagram, Fick's Law of Diffusion, Restrictive Conditions, Mass diffusion coefficient, Conservation of Species, The Mass Diffusion equation – Cartesian coordinates deviation, cylindrical coordinates and Spherical coordinates.[No numerical treatment for this chapter]

Text Books:

1. Franck P. Incropera, David P. DeWitt – Fundamentals of Heat and Mass Transfer,
2. Y. A. Cengel and A.J. Ghajar, Heat and Mass Transfer – Fundamentals and Applications, Tata McGraw Hill Education Private Limited.
3. S.P. Sukhatme, A Textbook on Heat Transfer, Universities Press.
4. R.C. Sachdeva, Fundamentals of Engineering Heat and Mass Transfer, New Age Science.
5. Joshi's Process Equipment Design, by V.V. Mahajani , S.B. Umarji ,Trinity Press

Reference Books

1. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.
2. M.M. Rathod, Engineering Heat and Mass Transfer, Third Edition, Laxmi Publications, New Delhi
3. V. M. Domkundwar, Heat Transfer, Dhanpat Rai & Co Ltd.
4. A.F. Mills, Basic Heat and Mass Transfer, Pearson.
5. S. P. Venkatesan, Heat Transfer, Ane Books Pvt. Ltd.
6. Holman, Fundamentals of Heat and Mass Transfer, McGraw – Hill publication.
7. M. Thirumaleshwar, Fundamentals of Heat and Mass Transfer, Pearson Education India.
8. B.K. Dutta, Heat Transfer-Principles and Applications, PHI.
9. C.P. Kothandaraman, S. V. Subramanyam, Heat and Mass Transfer Data Book, New Academic Science.
10. Process heat Transfer, D. Q. Kern, Wiley Publication

ME304N DESIGN OF MACHINE ELEMENTS LAB

Teaching Scheme : 02 P; Total: 02 hours/week **Credits :** 01
Evaluation Scheme: 30 ICA + 20 ESE **Total Marks :**50

COURSE DESCRIPTION

This course deals with the design exposure to different parts of machines elements, failure criteria and conventional design procedures.

DESIRABLE AWARENESS / SKILLS

Concepts and theory of the course ME301N Design of machine elements.

COURSE OUTCOMES

On the successful completion of this course; student shall be able to

1 Practically relate to concepts discussed in design of Machine Elements.
2 Understand procedure of machine design and develop an ability to apply it for simple component design.
3 Identify forces and moments in mechanical system components.
4 Analyze the stresses and strains induced in a machine element.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1		1	2				1					1		
2	2	1	3	1									2		
3	3	2	1	1											
4	2	2													

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Internal continuous assessment performance shall be based on theory course ME301N & consist of following Assignments and Project

1. Internal continuous assessment shall consist of "ONE" design project. The design project shall consist of assembly drawing with a part list and overall dimensions and the other sheet involving drawing of individual components using 3D CAD design software on A3 size paper. 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.

2. Design projects should include selection of prime mover and design of mechanical systems comprising of machine elements: Design data book shall be used extensively for the selection of the components.

3. Total five assignments (One on each unit - only Numerical)

Evaluation Methodology:

- **ICA –** It shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using the prescribed internal continuous assessment format.

- **ESE –** It shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners, out of which one examiner shall be external examiner.

ME305N DYNAMICS OF MACHINES LAB

Teaching Scheme: 02 P, Total:02 Hrs/Week **Credit:** 01

Evaluation Scheme: 30 ICA + 20 ESE **Total Marks:** 50

COURSE DESCRIPTION:

The objective of this course is to demonstrate the effects of various forces in balancing, governing and directing in a mechanism.

COURSE OUTCOMES: At the end of the course, the student shall be able to :

1. Analyze the dynamic forces in a four-bar mechanism, slider-crank mechanism.
2. Compare the performance of various types of gearboxes
3. Demonstrate the balancing methods for reciprocating mechanisms.
4. Analyze free vibrations of single and two-degree-of-freedom (DOF) systems
5. Assess the transmissibility of a single-degree-of-freedom system under forced vibration.

RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	1	3	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	-	-	-	3	-	-	-	-	-	-	-	-	-	1
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Minimum eight experiments shall be performed to cover entire curriculum of course ME 305N and shall be among as following,

List of Experiments:

1. Dynamic force analysis of four bar mechanism.
2. Dynamic force analysis of slider crank mechanism.
3. Performance characteristics of governors.
4. Performance characteristics of Gyroscope.
5. Study of different types of gear box.
6. Balancing of reciprocating mechanism.
7. Free vibration of single DOF & two DOF spring mass systems.
8. Damping determination through free vibration logarithmic decay of a simple damped system.
9. Dynamic vibration absorber.
10. Critical speed of shaft.
11. Transmissibility of single degree of freedom system.
12. Torsional vibration of bifilar or trifler pendulum.
13. To demonstrate flywheel and its effect on dynamic of system.

Guide lines for ICA: Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format (S 10)

Guide Lines for ESE: The End Semester Exam for this course shall be based on oral examination which covers content of syllabus and practical conducted, to judge the skills acquired by student.

ME306N HEAT TRANSFER LAB

Teaching Scheme : 02 P; Total: 02 hours/week **Credits** : 01
Evaluation Scheme : 30 ICA + 20 ESE **Total Marks** : 50

COURSE DESCRIPTION

This course introduces undergraduate students to Heat Transfer lab. The background required includes a sound knowledge of Mathematics, Engineering Thermodynamics, Applied thermodynamics and Fluid Mechanics of second year Level.

DESIRABLE AWARENESS / SKILLS

Concepts and theory of the course ME303N Heat and Mass Transfer

COURSE OUTCOMES

On completion of this course student should be able to:

1. Compute temperature distribution in steady - state and unsteady- state heat conduction
2. analyze heat transfer through extended surfaces.
3. interpret and analyze forced and free convection heat transfer
4. determine of radiation heat transfer to real life problems
5. Determine and predict performance of heat exchangers using LMTD and NTU methods

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs

(WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1		1	1								1		1
2	2	1		1	1								1		1
3	2	2	3		1								1		1
4	1	2		1	1								1		1
5	1	2			1								1		1

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

COURSE CONTENT

Minimum eight experiments shall be performed to cover entire curriculum of course ME303N. The list of experiments provided below is just a guideline.

List of Experiments

1. Determination of thermal conductivity of metal rod.
2. Determination of thermal conductivity of insulating powder.

3. Determination of thermal conductivity of composite wall.

4. Determination of heat transfer coefficient in forced convection.

5. Determination of heat transfer coefficient in natural convection.

6. Determination of temperature distribution, fin efficiency in natural and forced convection.

7. Determination of emissivity of a test surface.

8. Determination of Stefan Boltzmann constant

9. Study of pool boiling phenomenon and determination of critical heat flux

10. Study of heat transfer from a heat pipe.

11. Assignment to solve transient heat transfer problem using Heisler and Grober Charts.

12. Calibration of thermocouple

Evaluation Methodology:

- **ICA –** It shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using the prescribed internal continuous assessment format.

- **ESE –** It shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners, out of which one examiner shall be external examiner.

ME307NA PRODUCTION TECHNOLOGY

Teaching Scheme : 03L + 00T; Total: 03 hours/week **Credits** : 03
Evaluation Scheme :10 ISA + 30 MSE + 60 ESE **Total Marks** : 100

ESE Duration : 3 Hrs.

COURSE DESCRIPTION

This course provides students to imparting knowledge of production technology. The background required a sound knowledge of production systems, Thermal Aspects in the Machining, Gear Manufacturing and super finishing process, Production of Powder metallurgy process.CNC Technology.

DESIRABLE AWARENESS/SKILLS

Knowledge of basic Production Engineering and their basic concepts.

COURSE OUTCOMES

On the successful completion of this course; student shall be able to -

1. Develop knowledge of production technology.
2. Know the technology of gear manufacturing and super finishing process.
3. Know the Production of Powder metallurgy process.
4. Understand the unconventional Machining Processes.
5. Know basics and introduction to CNC machine programming.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs

(WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	2	-	-	-	-	-	-	-	-	-	1	-	1
2	1	1	-		1	-	-	-	-	-	-	-	-	-	1
3	1	1	-	2	-	-	-	-	-	-	1	-	-	-	1
4	-	1	1		-	-	-	-	-	-	-	-	-	2	-
5	2	-	1		-	-	-	-	-	-	-	-	-	2	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Gear Manufacturing and Super Finishing Processes (8Hrs)

Gear manufacturing: gear cutting process - forming and generations, gear cutting, milling, hobbing, gear shaping, shaving, lapping, grinding. Super finishing process: honning, lapping, burnishing and buffing processes with its working principle, advantages and disadvantages with its applications.

Thermal Aspects in Machining (8Hrs)

Sources of heat generation in machining and its effects, Temperature Measurement techniques in machining, types of cutting fluids, Functions of cutting fluid, Characteristics of cutting fluid, Application of cutting fluids, Economics of Metal Cutting Operations.

Powder Metallurgy (8Hrs)

Powder making methods. Powder compaction, Sintering, sintering mechanism. Applications of powder metallurgy, Powder Metallurgy Process. Applications such as Oil Impregnated Bearings and Cemented Carbides tipped tools. Limitations of Powder Metallurgy.

Unconventional Machining Processes. (8Hrs)

Principle,Mechanismofmaterialremoval,processparameters,advantages,disadvantages,limitations and applications for following machining processes: Ultra Sonic Machining (USM),Abrasive and Water Abrasive Jet Machining (AWJM), Electron Beam Machining (EBM), LaserBeam Machining (LBM), Plasma Arc Machining (PAM), Electro-Chemical Machining (ECM),Electric Discharge Machining(EDM).

CNC Technology (8Hrs)

Introduction and working of Numerical Control (NC), CNC, Distributed Numerical Control (DNC) machines. CNC axis and drives, introduction to automatic tool changer and automatic pallet changer, principles and block diagram of machining centers, advantages and applications.

Text Books

1. Manufacturing Engineering, M.S. Mahajan, 3rd edition 2008, Dhanpat Rai and sons, Delhi.
2. Manufacturing Technology-I &II, P C Sharma, 2nd edition 2008, S.Chand Publications
3. Element of Workshop Technology, Hajara, Volume I & II, Chaudhary and Bose S K,, 1st edition Asia Publishing House, 1997.
4. Production Engineering, P. C. Sharma, 11th edition 2008, S Chand Publishers
5. Manufacturing Technology Vol I & II, P. N. Rao, 3rd edition Tata McGraw Hill Publishers.2013.

Reference Books

1. Materials and Processes in Manufacturing, DeGarmo, Black Konser, 11th edition, Wiley,2011.or Materials and Processes in Manufacturing, DeGarmo, Black Kosher, edition 2005, Prentice Hall of India.
2. IntroductiontoManufacturingprocesses,ScheyJ.A.,3rdedition,TataMcGrawHill,1999.
3. ProcessesandMaterialsofManufacturing,LindbergA.,4thedition,PrenticeHall,1998.
4. Workshop Technology, Vol.I Raghuvanshi B.S.10th Edition, Dhanpat Rai andsons, Delhi,.2013.
5. Elements of WorkshopTechnology,Vol.IHazraChoudhary,edition2009,MediaPromoters

ME307NB INTERNAL COMBUSTION ENGINE

Teaching Scheme:03 L**, Total:**03 **Credits:**03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs**.**

COURSE DESCRIPTION:

This course provides the knowledge of Internal Combustion Engine. Course includes different engine cycles its performance analysis, various systems in IC Engine such as fuel feed, lubrication, cooling, ignition, supercharging and turbo charging, Fundamental of combustion in IC Engine, types and design of combustion chambers. Various emission control norms.

DESIRABLE AWARENESS/SKILLS:

Fundamental knowledge of Mathematics, Basic Engineering Thermodynamics, various ideal gas processes, Applied Thermodynamics.

COURSE OUTCOMES:

On completion of this course the student shall be able to:

1. Understanding the performance of I C Engine through thermodynamic cycles.
2. Fuel feed system for S I and C I Engines.
3. Various types of ignition, lubrication, cooling system used in I C Engines.
4. Understanding the combustion phenomena in S I and C I engines and factors influencing combustion chamber design.
5. Evaluate methods for improving the I C engine performance.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2								1			1	1	
2	2	1		1	1								1	1	
3	2	3	3										1	1	
4	1	1		1	1								1	1	
5	1	1		1									1	1	

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

COURSE CONTENT

Basic Concepts and Engine Cycles **(8 Hrs)**

Introduction: Classification of I.C. Engines, components and their functions. Thermal and volumetric efficiencies of engine, air fuel ratio, specific fuel consumption, numerical, Air Standard Cycles: Assumptions, Otto, Diesel, Dual Combustion cycle, derivation of their efficiency equation, work done and mean effective pressure, numerical on Air standard cycles, Comparison on the basis of heat input, compression ratio, maximum pressure and temperature, Actual cycle, Pumping losses, time losses.

Fuel Feed Systems **(8 Hrs)**

Charge, intake valve and manifold, valve timing diagram, valve overlap, choked flow, Carburetion: Requirement, Factors affecting carburation, simple carburetor, Air fuel ratio calculation, Solex carburetor, S. U. Carburetor, Fuel feeding systems in CI engines: Requirement, classification, fuel feed pump, jerk type injection fuel pump, distributor type pump, injection pump. Introduction to governor, Mechanical Governor, Pneumatic Governor, fuel injector and nozzles, Types of nozzles.

Ignition, Cooling and Lubrication System **(8 Hrs)**

Ignition systems: Requirement of ignition, battery ignition, magneto ignition, electronic ignition system, Firing order, Ignition timing, spark timing advance. Lubrication: Function of Lubrication, Mechanism of lubrication, Lubrication Systems, Properties of lubricants, Additives for Lubricants. Cooling systems: Requirement, need of cooling systems, types of cooling systems and comparison of cooling systems. Starting methods of engines: Supercharging, types of superchargers, effect of super charging, limitations and advantages of supercharging, and turbo charging of engines.

Combustion in S I and C I Engines **(8 Hrs)**

Homogeneous and heterogeneous mixtures, Combustion in S I engines: Stages in combustion, flame front propagation, factors influencing flame speed, detonation, factors affecting the detonation, pre-ignition, combustion chamber of S I engines, Combustion in C I engine: stages of combustion, factors affecting the delay period. Diesel knock, effect of engine variables on Diesel knock, comparison of knock in SI and CI engines, Combustion chamber for CI engines.

Engine Testing and Performance **(8 Hrs)**

Different methods for measurement of Friction Power, Indicated power, Brake power, numerical, heat balance sheet and efficiency calculations, numerical on performance of engines, BIS specification, and recent trends in internal combustion engines. Engine emission, air pollution due to engines, various EURO & BHARAT norms, Un burnt hydrocarbon emission in two stroke and CI engines, CO and NOx emission, particulates, EGR, emission control methods catalytic converters (Introductory), crank blow by losses.

TEXT BOOKS:

1. Internal Combustion Engines, V.Ganesan, 3rd edition 2007 Tata McGraw Hill, New Delhi.
2. Internal Combustion Engines, R. K. Rajput , 2nd edition 2007Laxmi Publications, New Delhi.
3. Internal Combustion Engines, Sharma R.P. and Mathur M.L., 2010 Dhanpatrai Publications, New Delhi.

REFERENCE BOOKS:

1. Fundamentals of Internal Combustion Engines,W.W.Pulkrabek, 2nd edition

2000, Prentice Hall of India (P) Ltd., New Delhi.
2. Internal Combustion Engines and Air Pollution, E.F. Obert, HarperandRow, New York.
3. Internal Combustion Engines, Ferguson C. R, 2nd edition. 2000 Johnes Wiley and sons, New York.
4. Internal combustion engine fundamentals, John Heywood, 1st edition, McGraw- Hill (1988) -USA.

ME307NC COMPUTER INTEGRATED MANUFACTURING

Teaching Scheme : 03L
Evaluation Scheme : 30 MSE +10 ISA +60 ESE **Credit:** 03
Duration of ESE : 03 Hrs **Total Marks:** 100

COURSE DESCRIPTION

This course introduces undergraduate students to use of computers in manufacturing in order to design and develop the products has found unprecedented applications. Computer integrated way of manufacturing provides benefits such as speed, flexibility, and better control. In this course, Computer Integrated Manufacturing (CIM) approaches are discussed. CAD/CAM tools and their within and between the production systems are presented. Data storage and handling is also the need of contemporary manufacturing systems. This is also catered using software tools. The course is reinforced with the laboratory demonstrations to add a practitioner's touch. Students would develop a basic CNC part program , design and develop a product and a production system after completing this course.

DESIRABLE AWARENESS/SKILLS

Fundamental knowledge of computer, engineering drawing and design.

COURSE OUTCOMES

On successful completion of this course student shall be able to:

1. Understand the basics of any software regarding Automation, CAD-CAM- CAE and CIM.
2. Familiarized with basic configurations and specification requirements of Robots and aware the various modes of 3D printing processes.
3. Distinguish different machine systems according to CAM.
4. Create basic part program for manufacturing of different machine components.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3		2	2		2			1		2	3	3	3	
2	2		1		2	3		1		2		2	2		3
3		1	2	2	3	2						2		2	2
4	3		2		2	1			2		2	3	3		

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

COURSE CONTENT

Introduction to CIM **(8Hrs)**

Introduction to CAD, CAM, CAD/CAM and CIM, Evolution of CIM, CIM wheel and cycle , Production concepts and mathematical models , CIM hardware and software , Major elements of CIM system, Three-step process for implementation of CIM, Computer networks for manufacturing, Role of CAD in Manufacturing, 2D & 3D CAD Models, Solid and Surface Modelling, CAD/CAM Data Exchange (STEP, IGES, DXF, etc.)

Computerized Process Planning and Control System **(8Hrs)**

Definition and significance of Computer Aided Process Planning, relationship between CAD, CAPP and CAM, benefits of CAPP, Production Planning and Control Systems, Retrieval and Generative Systems, typical activities of PPC System, computer integrated production management system, Material Requirement Planning, inputs to MRP system, working of MRP, outputs and benefits, Capacity Planning, Computer Aided Quality Control, Shop floor control.

Flexible Manufacturing Systems and Automation **(8Hrs)**

Flexible Manufacturing Systems (FMS):- Introduction & component of FMS, needs of FMS, general FMS consideration, objectives, types of flexibility, FMS layout and advantages, Control Systems in Manufacturing**:** Open-loop and Closed-loop Control, Fundamentals of Automation:-Types of Automation (Fixed, Programmable, Flexible), Levels of Automation, Automation Strategies,Programmable Logic Controllers (PLCs) and their Applications,Material Handling Systems:-Automated guided vehicles (AGVs), Need of AGV, Types of navigations AGV, Applications.

NC/CNC/DNC Machines **(8Hrs)**

Introduction to NC/CNC/DNC Machine, comparison, components and limitations of NC system,types of CNC machines, NC/CNC technology, applications, Specification and components, Construction Details, Controllers, Sensors and Actuators, Fundamentals of manual Part programming, G code and M code, absolute and incremental dimensioning Types of formats, Part Programming for CNC drilling, lathe and milling operations, subroutines, canned Cycles, parametric sub routines.

Robot technology and 3D printing **(8Hrs)**

Introduction to Robot Technology: - Robot Anatomy, Laws of Robot, human System and robotics, coordinate system, specifications of robot, different configurations of robots, power sources, actuators and transducers, robotic sensors, grippers, robot safety, applications, economic considerations of robotics system. Concepts of Computer Vision and Machine Intelligence, Introduction to 3D printing, classification, working, applications in manufacturing,

Text Books

1. hivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.
2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer

Reference Books

1. Alavudeen and Venkateshwaran, Computer Integrated ManufacturingII, PHI Learning Pvt. Ltd., New Delhi, 2013.
2. Gideon Halevi and Ronald D. Weill, Principles of Process PlanningII, Chapman Hall, 1995.
3. James A. Retrg, Herry W. Kraebber, Computer Integrated ManufacturingII, Pearson Education, Asia, 3rd Edition,2004.
4. Mikell P. Groover, Automation, Production system, and Computer Integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 4th Edition, 2014
5. Yoram Koren – "Robotics", McGraw Hill Publishing Co.,2007
6. Ibraim Zeid, "Mastering CAD/CAM" – Tata McGraw Hill Publishing Co. 2000

ME308NA PROUCTION TECHNOLOGY- LAB

Teaching Scheme : 02 P; Total: 02 hours/week **Credits :** 01
Evaluation Scheme : 30 ICA + 20 ESE **Total Marks :** 50

COURSE DESCRIPTION

This course deal with the practical exposure to provides students to imparting knowledge of production technology. The background required a sound knowledge of production systems, Thermal Aspects in the Machining, Gear Manufacturing, Production of Powder metallurgy process.

DESIRABLE AWARENESS / SKILLS

The students can understand practically concepts of machining, manufacturing and theory of the course ME307N Production Technology.

COURSE OUTCOMES

On successful completion of this course student shall be able to:-

1.Describe the Milling, lathe, Shaper, drilling and grinding machines for various mechanical engineering applications.

2.Explain metal removing for particular application.

3.Select CNC machine for particular application.

4.Use non-conventional machining processes for particular application

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs

(WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1		-	2	-	-	-	-	-	-	1	-	1	-	1
2		1	1	-	1	-	-	-	-	-	-	-	-	-	-
3	1	1	2	-	1	-	-	-	-	-	-	-	-	2	-
4		1	-	-	-	-	-	-	-	-	-	-	1	-	1

1- Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Internal continuous assessment consist of performance of following practical's,

1. **Machine Shop:** Study and demonstration of different operations to be carried on the milling machine, lathe, Shaper, drilling and grinding machines. One composite job on shaper, milling, drilling, grinding machine,Indexing, gearcutting,slotcutting, spline cutting etc.

2.Design and drawing:

1.Tool geometry of single point cutting tools.

2.Tool geometry of twist drill.

3.Tool geometry of plain Milling cutter.

3.CNC:

To study different elements of CNC machine, classification of CNC and write exercise on one program each for CNC lathe and CNC Milling.

4. Non-Conventional Machine:

To study different non- conventional machining processes. write assignments on any four non-conventional machining processes.

5. An Industrial visit to observe CNC machine and Non-conventional machining processes.

Evaluation Methodology:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal, sheet and Job) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.
- **ESE –** Oral will be based on content of syllabus and practical.

ME308NB INTERNAL COMBUSTION ENGINE LAB

TeachingScheme:02P, **Total:**02 Hrs/Week **Credit :** 01

Evaluation Scheme: 30 ICA + 20 ESE **Total Marks:** 50

COURSE DESCRIPTION:

This course provides the knowledge of Internal Combustion Engine. Course includes study of different engines, their performance analysis and various systems in IC Engine such as fuel feed, lubrication, cooling, ignition, supercharging and turbo charging. Trials on I C Engines.

DESIRABLE AWARENESS/SKILLS:

Fundamental knowledge of Mathematics, Basic Engineering Thermodynamics, various ideal gas processes, Applied Thermodynamics.

COURSE OUTCOMES:

On successful completion of this course student shall be able to:

1. Understanding the performance of I C Engine.
2. Fuel feed system for S I and C I Engines.
3. Various types of ignition, lubrication, cooling system used in I C Engines.
4. Understanding the working and various efficiencies of S I and C I engines and factors influencing their efficiency.
5. Evaluate methods for improving the I C engine performance.

RELEVANCE OF COURSE OUTCOMES (COS) WITH POS AND PSOS

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1			3							x		1		
2		2						1			x				
3	1				3						x				1
4						1			3		x		3		
5	2		1								x		1		

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Students shall Complete the following practical (Any Eight) and two assignments shall conduct on syllabus of ME 307N.

LIST OF EXPERIMENTS:

1. Study of cooling systems.
2. Study of lubrication systems.
3. Study of fuel pump and fuel injector.
4. Trial on a petrol engine and calculations of air/fuel ratio, volumetric, thermal and mechanical efficiency.
5. Trial on a Diesel engine and calculation of air/fuel ratio, volumetric, thermal and mechanical

efficiencies.

6. Morse test and determination of bsfc and isfc.
7. Study of combustion chambers of SI engines.
8. Study of combustion chambers of CI engines.
9. Study and analysis of exhaust emission from engine (PUC).
10. Visit to an automobile workshop (compulsory)

GUIDELINES FOR ICA:

Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted bystudent (Journal and sheet) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format **(S 10).**

GUIDELINES FOR ESE:

Oral examination based on content of theory syllabus and practical.

ME308NC COMPUTER INTEGRATED MANUFACTURING

Teaching Scheme: 02P, **Credit:** 01
Evaluation Scheme: 30 ICA+20 ESE **Total Marks:** 50

COURSE DESCRIPTION

This course deal with the practical exposure to CNC part programming on Lathe/Milling/Drilling operation. It exposes the students to the techniques of CNC programming and cutting tool path generation through CNC simulation software by using G-Codes and M-code.

DESIRABLE AWARENESS/SKILLS

Fundamental knowledge of computer, engineering drawing, G code and M code.

COURSE OUTCOMES

On the successful completion of this course; student shall be able to

1 Understand CNC part Program inCAD environment.
2 Perform various CNC operations.
3 Create simple CNC part program.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2		3		2							**3**	**3**		**1**
2	1	2			1				**1**		**2**			**2**	
3			1		2		**1**					**2**	**2**		

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

COURSE CONTENT

Minimum ten experiments shall be performed to cover entire curriculum of course ME307NC. The list of experiments provided below is just a guideline.

Group A. (Any Five)

List of Experiments

1. Create part programming for drilling on square plate
2. Create part programming for drilling operation on circular plate.
3. Create part programming for 2D profile cutting on rectangular plate.
4. Create part programming on lathe machine for turning operation
5. Create part programming on Lathe machine for Facing operation.

6. Create part programming on Lathe machine for taper turning operation.
7. Create part programming on Milling machine for spur gear or any other miscellaneous component.
8. Create 3D part program for any gear components on 3D printing machine.
9. Create 3D part program for any small components on 3D printing machine.
   (e.g Mobile stand, logo, Keychain etc.)

Group B.

Assignments:

1. Assignment on Introduction to CIM.
2. Assignment on Computerized Process Planning and Control System.
3. Assignment on Flexible Manufacturing Systems and Automation.
4. Assignment on NC/CNC/DNC Machines.
5. Assignment on Robot technology and 3D printing.

Evaluation Methodology:

- **ICA –** Internal continuous assessment should support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on performed practical and assignment based on each chapter. The performance shall be assessed experiment wise using internal continuous assessment format.

- **ESE/Oral –** It shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners, out of which one examiner shall be external examiner.

OPEN ELECTIVE-III
ME310NX POWER STATION ENGINEERING

Teaching Scheme: 02L, **Total:** 02 **Credit:** 02
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

COURSE DESCRIPTION:

Providing an overview of power plants and detailing the role of mechanical engineers in their operation and maintenance and applications of different types of power plants.

COURSE OUTCOMES: On completion of this course student should be able to:

1. Describe power generation systems like thermal power plant, hydraulic power plant, nuclear power plant, diesel power plant, solar power plant.
2. Explain the working of steam generators and turbines in thermal power plant.
3. Illustrate Water Treatment Plant & Circulation/Cooling Water System.
4. Demonstrate a comprehensive understanding of industrial safety and hazard management by identifying industrial hazards.

RELEVANCE OF COS / POS AND STRENGTH OF CO- RELATION:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3												3		
CO 2	3	2										2	2		2
CO 3	3		3		3										2
CO 4	3	2		2		3	3						3		2

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENTS:

Overview of Indian energy sector (8hr)

Energy sector scenario, Types of various power plants, Working and construction of Steam power plant, Hydro power plant, Gas power plant, Nuclear power plant, Diesel power plant, Solar power plant etc. Types of fuels used in steam power plant, Introduction of boilers, accessories and their mounting. Block diagram of various layouts, Internal cycles of processes in steam power Plant (Rankine cycle, reheat cycle), (No numerical treatment).

Coal to electricity (8hr)

Overall process flow in Thermal Power Plant, Brief description of maintenance equipment's and schemes of Thermal Power Plant. -site selection & layout considerations for thermal power plants Site, Introduction of various types of Turbines, Steam turbine operation start up procedures, Turbine rolling,

Types of Turbines rolling (cold rolling, warm rolling Hot rolling) TurbineEfficiency, (No numerical treatment) Turbine Condensing and Cooling Systems, Turbine Oil systems, Turbine Governors. Coal handling plants, Different modes of coal delivery, wagon tipplers, MGR system, Coal yard arrangement, Coal claiming, Crushers, Conveyors, Magnetic separators, Metal detectors, Types of ash, Bottom ash, Fly ash, Ash disposal process, Uses of ash in various fields. Fly ash disposal system.

Water Treatment Plant & Circulation/Cooling Water System. (8hr)

Impurities in Raw water, effects of contaminators water treatment methodologies, softening, demineralization, and layout of water treatment plant. Chlorinating and other chemical dozing, cleaning filters, air pumps.

Power Plant Safety (8hr)

Industrial Safety and hazards Industrial hazards, Accidents Causes and factors, cost of accidents, accident prevention, accident investigating, reporting and records. Fire Fighting Fundamentals of Fire, different classification and types of fire, different types of fire extinguishers for different classes of fire, firefighting systems in power plants. First Aid Basic of first aid, how injuries are caused in lifting, falls, first aid in case of electrical shock, artificial respiration.

Text book:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. R.K. Rajput, "Power Plant Engineering",Fifth Edition, Laxmi Publications Pvt Ltd2016.

References Books:

1. P. Sukhatme, J. K. Nayak "Solar Energy", Third Edition, 2008, Tata McGraw Hill Education Private Limited, New Delhi.
2. S. Rao, Dr. B. B. Parulekar "Energy Technology –Non conventional, Renewable &Convectional", Third Edition, 2010, Khanna Publishers, New Delhi.
3. Dr. H. S. Makunda , "Understanding Clean Energy & Fuels from Biomass", 2011, Wiley India.

OPEN ELECTIVE-III

ME310NY OPERATION RESEARCH

Teaching Scheme : 02 L + 00 T; Total: 02 hours/week **Credits** : 02
Evaluation Scheme : 10 ISA +30 MSE + 60 ESE **Total Marks** : 100
ESE Duration : 3 Hrs.

COURSE DESCRIPTION

This course introduces the fundamental concepts of mathematical modeling and optimization techniques used to solve complex decision making problems in various business and industries. Students will learn how to apply operation research techniques to solve real world problems in fields such as logistics, finance, healthcare, waiting lines etc.

DESIRABLE AWARENESS / SKILLS

The background expected familiar with Mathematics, linear relations equations and probability and statistics.

COURSE OUTCOMES

On the successful completion of this course; student shall be able to -

1. Develop knowledge of operational research and its model.
2. Apply and analyze mathematical optimization techniques such as linear programming, transportation and assignment models to various real life applications.
3. Give solution to complex decision making problems such as replacement and waiting lines.
4. Demonstrate cost effective strategies in various applications in industry

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3							1		1			1		
2		1	2										2		
3					3										1
4		2				3			2						

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

COURSE CONTENT

Introductions to Operation Research **(5Hrs)**

Scope, applications of operations research, phases and models of operations research, advantages and limitations of operations research and applications of operations research.

Linear Programming Problems **(5Hrs)**

Formulation of LPP, graphical method of solution, simplex method, artificial variable technique- Big M method.

Transportation and Assignment Model (7Hrs)

Mathematical formulation of TP, methods to obtain initial basic feasible solution, TP without degeneracy and with degeneracy, mathematical models of assignment problem, solution method of assignment problem, Hungarian method, maximization case, unbalanced restrictions on assignment, travelling salesman, and problem

Replacement and Queuing Theory (7Hrs)

Replacement and maintenance method- introduction, types of failure- gradual failure ,sudden failure replacement of items whose efficiency deteriorates with time, introduction to queuing theory, elements of queuing theory, characteristic of waiting lines, service discipline, service mechanism, terminology and notations for queuing system.

Inventory control (6Hrs)

Need and types of inventory, inventory associated costs, Economic Order Quantity (EOQ), classical EOQ model with uniform demand rate and infinite replenishment, EOQ model with multiple price breaks.

Text Books

1. Optimization Concepts and Applications in engineering, Belegundu, 2nd edition, Cambridge Uni. Press, India, 2018.
2. Operations Research, Hillier F.S., and Lieberman G.J., 8 th Edition, Mc. Tata McGraw Hill, India,2010.
3. Operation Research, Manohar Mahajan, Dhanpat Rai & Co.
4. Operations Research Principles and Practice, Ravindran, Phillips and Solberg, 2 nd Edition,Mc. WSE Willey, 2014.
5. Operations Research - An introduction, Hamdy A Taha, 3 rd edition, Pearson Education, 2009.

Reference Books

1. Quantities Techniques, L.C. Jhamb , Vol I and II, Everest Publication.
2. Operation Research, S.D. Sharma, Khanna Publication.
3. Operation Research, Problem and Solution, J. K. Sharma, Macmillan
4. Quantitative Techniques in Management, N. D. Vohra, TATA McGraw Hill.
5. Operation Research Principles and Practice, Ravindran, Wiley India Pvt. Ltd. New Delhi.

MEM363N FLUID MECHANICS (MDM-III)

Teaching Scheme : 04 L + 00 T; Total: 04 hours/week **Credits** : 03
Evaluation Scheme : 10 ISA + 30 MSE + 60 ESE **Total Marks** : 100
ESE Duration : 3 Hrs.

COURSE DESCRIPTION

The students learning this course will understand the basic concepts of hydrostatics, buoyancy and flotation, kinematics and dynamics of fluid motion, dimensional analysis and boundary layer theory.

DESIRABLE AWARENESS / SKILLS

Fundamental knowledge of mathematics, physics, chemistry and thermodynamics.

COURSE OUTCOMES

On successful completion of this course, students will be able to-

1. Use fluid properties in obtaining solution of processes / problems involving fluid flow.
2. Demonstrate bernoulli's equation for practical applications involving usage and design of Venturimeter, orifice meter etc.
3. Analyze the forces such as drag and lift on immersed bodies.
4. Apply the principle of dimensional analysis to practical problems.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO/PO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	-	2	-	-	-	-	-	-	-	-	-	-	1	-	1
CO 2	1	2	1		-	-	-	-	-	-	-	-	2	-	2
CO 3	-	2	-	1	-	-	-	-	-	-	-	-	1	-	-
CO 4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Fundamental Concepts of Fluid Mechanics (08 Hrs)

Definition of fluid, concept of continuum, density, specific weight, specific gravity, dynamic viscosity, kinematic viscosity, Newton's law of viscosity, types of fluid, rheological diagram, surface tension, capillarity, compressibility, vapour pressure.

Hydrostatics and Buoyancy and Flotation **(08 Hrs)**

Pascal's and hydrostatic law, total pressure and centre of pressure for vertical, horizontal inclined and curved surface, buoyancy and flotation, concept of Metacentric height and equilibrium of floating and submerged bodies.

Kinematics of Fluid Motion **(08 Hrs)**

Eulerian and Langragian approach of fluid flow, continuity equation, types of flows (one dimensional, two dimensional, three dimensional, steady flow, unsteady flow, uniform and non-uniform fluid flow, laminar flow, turbulent flow, compressible flow, incompressible flow, rotational flow, irrotational fluid flow) fluid flow field (stream, path and streak line), vorticity in two dimensional flow, stream function and velocity potential function. (no numerical treatment for this chapter)

Dimensional Analysis **(03 Hrs)**

Dimensional Analysis: Dimensions of physical quantities, dimensional homogeneity, Buckingham π theorem and important dimensionless numbers.

Fluid Dynamics and flow through pipe **(08 Hrs)**

Introduction to Navier-Stokes' momentum equation, Euler equation of motion, derivation of Bernoulli's equation along stream line, concept of HGL and TEL, application of Bernoulli's equation to venture meter, pitot tube, orifice meter. Energy losses through pipe-major and minor losses, Darcy-Weisbach equation, pipes in series, pipes in parallel and concept of equivalent pipe, Moody's diagram, Siphons, transmission of power through pipes. (No derivations for minor losses)

Boundary Layer and External Flows **(05 Hrs)**

Boundary layer formation for flow over flat plate, boundary layer thickness (displacement, momentum and energy) Separation of boundary layer and methods of Controlling the forces on immersed bodies lift and drag (no derivation on lift), flow around cylinder and aerofoil.

Text books

1. Fluid Mechanics, Dr. R.K. Bansal- 9th edition, Laxmi Publication (P) Ltd. New Delhi,2014.

2. Hydraulics and Fluid Mechanics, Modi P. N. and Seth S. M, 19th edition-Standard Book House, 2012.

3. Fluid Mechanics, Cengel and Cimbla, 3rd edition, TATA McGraw-Hill,2019.

4. Fluid Mechanics, Frank M White, 7th edition, TATA McGraw-Hill,2011.

Reference Books

1. Fluid Mechanics, Kundu, Cohen, Dowling-6th edition- Elsevier India,2000.

2. Fluid Mechanics, Chaim Gutfinger, David Pnueli-1st edition,Cambridge University press,1997.

3. Introduction to Fluid Mechanics, Edward Shaughnessy, Ira Katz James Schaffer-1st edition, OXFORD University Press,2003.

4. Fundamentals of Fluid Mechanics- Munson, Okiishi, Huebsch, Rothmayer 7th edition, John Wiley & Sons Inc, 2004.

ME311N ADVANCED MECHANISM (DHC-I)

Teaching Scheme	**:** 03L + 00T; Total: 03 hours/week	**Credits**	**:** 03
Evaluation Scheme	**:**10 ISA + 30 MSE + 60 ESE	**Total Marks**	**:** 100
ESE Duration	**:** 3 Hrs.		

COURSE DESCRIPTION

Course is designed in such a way that the students should understand the concept of various methods of mechanism synthesis for all the task of kinematic synthesis and apply the tool to develop mechanisms for various industrial application.

DESIRABLE AWARENESS/SKILLS

Knowledge of Kinematics of Mechanisms.

COURSE OUTCOMES

The Student should able to:

1. Analyze planar complex mechanisms.
2. Determine the inertia forces in simple planar mechanisms.
3. Synthesize four bar and slider-crank mechanisms.
4. Analyze simple spatial mechanisms such as RSSP etc.
5. Perform inverse kinematics of simple parallel mechanisms.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2								1			1	1	
2	2	1		1	1								1	1	
3	2	3	3										1	1	
4	1	1		1	1								1	1	
5	1	1		1									1	1	

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

COURSE CONTENT

Complex mechanisms: **(8 Hrs)**

Analysis, synthesis and tasks of kinematic synthesis, Types of planar, spherical and spatial mechanisms, Mobility or Degrees of freedom, Kutzbach and Gruebler's criteria,

Graphical Linkage Synthesis: **(8 Hrs)**

Limiting Conditions, Dimensional Synthesis- Three position Synthesis with specified Moving Pivots, Three position Synthesis with Alternate Moving Pivots, Three position Synthesis for more than three

Positions, Pole, Relative Pole, Function generation by Relative Pole Method, Inversion Method, Function Generation by Inversion Method.

Analytical linkage Synthesis: (8 Hrs)

Type, number and dimensional synthesis. Analytical approach using complex number modelling for motion, path, and function generation (three prescribed positions). Synthesis of four-bar and slider-crank mechanisms using Freudenstein's equation.

Spatial mechanisms: (8 Hrs)

Transformations describing planar finite displacements, planar finite transformations, identity transformation, rigid-body transformations, spatial transformations, Denavit - Hartenberg parameters, Kinematic analysis by matrix method, Kinematic analysis of spatial Revolute- Spherical-Spherical-Revolute mechanism.

Parallel mechanisms: (8 Hrs)

Types of Parallel mechanisms, Degrees of freedom, Position and Velocity analyses (inverse kinematics only) of planar 3-RRR manipulator and 6-SPS general Stewart - Gough platform.

Text Books

1. G. N. Sandor and A. G. Erdman, "Advanced Mechanism Design: Analysis and Synthesis", Vol. 2, Pearson Education 2005 (for Unit I to IV).
2. Lung-Wen Tsai, "Robot Analysis: The Mechanics of Serial and Parallel Manipulators", John Wiley & Sons, Inc., 1999 (Unit V).

Reference Books

1. Robert L. Norton, "Kinematics and Dynamics of Machinery", 3rd Edition in SI Units, Tata McGraw-Hill Education Pvt. Ltd, 2011.
2. J. E. Shigley and J. J. Uicker, "Theory of Machines and Mechanisms", 4th Edn., Oxford University Press, Intl. Version, 2015.
3. R. S. Hartenberg and J. Denavit, "Kinematic Synthesis of Linkages", McGraw-Hill., 1964.
4. A.S. Hall, "Kinematics and Linkage Design", Prentice Hall of India, 1964.

ME312N ADVANCED MECHANISM LAB (DHC-II)

Teaching Scheme:02P, **Total:** 02 **Credit:**01
Evaluation Scheme:30 ICA+ 20 ESE **Total Marks:** 50

COURSE DESCRIPTION:

This course is designed in such a way that the students should understand the concept of various methods of mechanism synthesis for all task of kinematic synthesis and apply the tools to develop mechanisms for various industrial application.

DESIRABLE AWARENESS/SKILLS:

Fundamental knowledge of engineering mechanics, Numeral methods and optimization

COURSE OUTCOMES:

The Student should able to:

1) Apply the various tools for mechanism synthesis for all task of kinematic synthesis.

2) Know the various tools for optimal mechanism synthesis for n-accuracy points.

3) Understand the principles of graphical and analytical methods of synthesis along with computer application.

4) Know the kinematics of spatial mechanisms.

RELEVANCE OF COS/ POS AND STRENGTH OF CO-RELATION:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1			1			3						1	1	-
2		3											2	-	-
3					1										1
4	3	1		2									1	2	

1-Weakly correlated 2–Moderately correlated 3–Strongly correlated

Students shall Complete the following practical (Any Eight) and two assignments shall conduct on syllabus.

List of Experiments:

1) Problems on Path Generation Problem (Graphical approach).
2) Problems on Motion Generation Problem (Graphical approach).
3) Problems on Function Generation Problem (Analytical approach).
4) Problems on Path Generation Problem (Analytical approach).
5) Problems on Motion Generation Problem (Analytical approach).
6) Problems on Function Generation Problem (Freudenstein Equation).
7) Complex number modeling for the mechanism synthesis problem. (Numerical).
8) Formulation for Optimal Synthesis of Function Generation Problem.
9) Formulation for Optimal Synthesis of Path Generation Problem.
10) Formulation for Optimal Synthesis of Motion Generation Problem.

Guidelines for ICA:

Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal and sheet) based on practical performed by him/her. The performance shall be assessed experiment wise on regular basis.

Guidelines for ESE:

Oral will be based on content of syllabus and practical.

GOVERNMENT COLLEGE OF ENGINEERING, JALGAON
Department of Mechanical Engineering

Scheme for Semester VI B. Tech. (Mechanical Engineering with Multidisciplinary Minor) with effect from academic year 2023-24 (As per NEP 2020)

Course Code	Proposed Course Domain	Category	Teaching Scheme				Evaluation Scheme						Credit
							Theory			Practical			
			L	T	P	Total	MSE	ISA	ESE	ICA	ESE	Total	
ME351N	Metrology and Quality control	PCC	2	…	…	2	30	10	60	…	…	100	2
ME352N	Turbo Machinery	PCC	3	…	…	3	30	10	60	…	…	100	3
ME353N	Mechanical Engineering Design	PCC	3	…	…	3	30	10	60	…	…	100	3
ME354N	Metrology and Quality control Lab	PCC	…	…	2	2	…	…	…	30	20	50	1
ME355N	Turbo Machinery Lab	PCC	…	…	2	2	…	…	…	30	20	50	1
ME356N	Program Elective Course- III	PEC	3	…	…	3	30	10	60	…	…	100	3
ME357N	Program Elective Course- IV	PEC	3	…	…	3	30	10	60	…	…	100	3
ME358N	Program Elective Course- III Lab	PEC	…	…	2	2	….	….	….	30	20	50	1
ME359N	Program Elective Course- IV Lab	PEC	…	…	2	2	….	….	….	30	20	50	1
XXMYYYN	Multi Disciplinary Minor-IV	MDM-IV (MDC)	2	…	…	2	30	10	60	…	…	100	2
ME360N	Parametric Modelling Courses (Any One CAD Course)	VSEC (EEMC)	…	…	4	4	…	….	….	30	20	50	2
			16	**0**	**12**	**28**	**180**	**60**	**360**	**150**	**100**	**850**	**22**
ME361N	Stress Analysis	DHC-III	3	…	…	3	30	10	60	…	…	100	3

Program Elective Course- III : **A.** Tool Engineering **B.** Computational Fluid Dynamics **C.** Product Design and Development
Program Elective Course- IV **: A.** Mechatronics **B.** Synthesis of Mechanism **C.** Cryogenic Engineering

Exit Option for B.Voc or B.Sc.(Engg/Tech): 8 credits in Skill based Vocational Courses/Internship/Apprentiship /Mini Project offered during summer vacation after Third Year (As per exit policy approved by Board of Studies (Mechanical Engineering) in its meeting held on 06 July, 2023).

Note: Students having CGPA more than 8.0, can register for additional 18 credits for departmental honors with research degree from semester-VII to earn the credits which will lead to honors with research degree in mechanical engineering/tech program with MDM

ME351N METROLOGY AND QUALITY CONTROL

Teaching Scheme : 02L + 00T; Total: 02 hours/week **Credits:** 02
Evaluation Scheme :10 ISA + 30 MSE + 60 ESE **Total Marks** : 100
ESE Duration : 3 Hrs.

COURSE DESCRIPTION

This course provides basics of metrology and quality control and its importance. It consists of standards of measurements and types standards, linear measuring instruments, machine tool metrology and measurement by light wave interference. It comprises of design of gauges, use of comparators, angular and surface finish measurement. The course involves measurement of screw thread also covers quality control and statistical quality control.

DESIRABLE AWARENESS/SKILLS

Fundamental knowledge of Engineering Graphics, Machine Drawing, Mathematics, Physics,Electrical and Electronics.

COURSE OUTCOMES

On the successful completion of this course; student shall be able to -

1. Identify techniques in measurement to minimize the errors.
2. Understand design of the limit gauges,comparators and angular measurment.
3. Explain methods and devices for measurement of length, angle, thread parameters, and geometric features of parts.
4. Apply gain knowledge in Quality control and SQC.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3							1					1	-	-
2		1	2										2	-	-
3					3								-	-	1
4		2				3			2				-	-	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Introduction (7Hrs)

Definition: Measurement, precision, accuracy, sensitivity, Linear Measurement:-Standards, line standards, end standards, classification of standards, precision measurement, precision measuring instruments and their characteristics, linear Measurements instruments- Calipers, micro meters, surface plates, angle plates, V - blocks,straight edges, height and depth gauges, bore gauges,slip gauges. Measurement by light wave interference:- Basic principle, sources of light, optical flats, fringe patterns.

Design of gauges, Comparators & Angular Measurement (7Hrs)

Design of gauges:- Types of gauges, Taylor's principle, problems on design of gauges, Comparators:- Characteristics, application, types, construction and working of different mechanical, optical, electrical, pneumatic comparators, Angle measurement:-Sine bars, Sine centers, Use of sine bar, angle gauges, autocollimator.

Metrology of Screw thread & Recent trend in metrology (7Hrs)

Metrology of screw threads:-Terminology, errors and their effects, thread gauges, measurement of elements of external and internal threads, Recent trend in engineering metrology:-precision instrument based on laser, probes, telemetric systems, Isometric viewing of surface defects,
Machine vision.

Quality Control & Statistical Quality Control (7Hrs)

Introduction to Quality:- factors controlling quality of design and conformance, Introduction to quality tools: Demings PDCA,PDSA cycles, difference between inspection, quality control and quality assurance, quality survey, Statistic concept:-Concept of variation, variable & attribute data, the frequency distribution, quantitative description of distribution, normal curve, concept of six sigma.

Text Books

1. EngineeringMetrology,R.K.Jain,KhannaPublishers,NewDelhi,2002
2.Statisticalqualitycontrol,M.Mahajan, DhanpatRai&Co.,NewDelhi,2002

Reference Books

1. Handbook to industrial metrology, ASTME, Prentice Hall Publication,
2. Handbook of quality control, G.M.Juran, McGraw Hill Publication
3. A textbook of Engineering Metrology, I.C.Gupta,2002,Khanna Publishers, New Delhi,
4. A text book of metrology, M.Mahajan, Dhanpat Rai & co., New Delhi, 2010.
5. Statistical quality control, M. Jeya Chandra, CRC Press,2001.
6. Statistical quality control, Douglas Montgomery, Wiley,2001.

ME352N TURBO MACHINERY

Teaching Scheme : 03 L + 00 T; Total: 03 hours/week **Credits** : 03
Evaluation Scheme : 10 ISA + 30 MSE + 60 ESE **Total Marks** : 100
ESE Duration : 3 Hrs.

COURSE DESCRIPTION

This course introduces undergraduate students to Turbo Machinery. The background required includes a sound knowledge to Mathematics, Engineering Thermodynamics, Applied Thermodynamics and Fluid Mechanics. The Course aims at imparting knowledge of Turbo Machinery.

DESIRABLE AWARENESS / SKILLS

Fundamental knowledge of Mathematics, Engineering Thermodynamics, Fluid Mechanics.

COURSE OUTCOMES

On the successful completion of this course; student shall be able to -

1. Apply thermodynamic concepts to analyze steam and gas turbines.
2. Analyze gas power plant and propulsion cycles.
3. Analyze impulse and reaction type of hydraulic turbines.
4. Deal with the basic design problems of turbo machine components.
5. Evaluate the performance of turbo machines.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	-	3	-	-	-	-	-	-	-	-	1	-	-
CO 2	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	-	-	-	-	3	-	-	-	-	-	-	-	-	-	1
CO 4	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-
CO 5	3	-	-	1	-	-	-	-	-	-	-	-	1	-	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Steam Turbines (08 Hrs)

Impulse turbine and Reaction turbine, constructional details, velocity diagrams, losses in turbines, efficiency calculation, degree of reaction, compounding of turbine, governing of turbines, common application of steam turbines. (Numerical on impulse and reaction turbines)

Gas Turbines **(08 Hrs)**

Fundamentals and classification of gas turbines. Joule's cycle and theoretical gas turbine, work ratio and pressure ratio calculation, actual gas turbine cycle. Regeneration, intercooling , reheating and its effect on performance. Closed cycle and semi closed cycles gas turbine plants. Common applications of gas turbines.

Jet Propulsion **(08 Hrs)**

Introduction to jet propulsion, types of jet engines. Thrust, Thrust power, and propulsive efficiency. Turbo jet, turbo Prop, turbo fan engines, pulse jet and ram jet engines. Common applications of various jet engines. Concept of rocket propulsion. (No numerical on chapter)

Hydraulic Turbines (Impulse Type) **(08 Hrs)**

Impulse momentum principle, impact analysis of jet on fixed and moving flat plate, impact analysis of jet on curved vanes, series of plates and vanes. Velocity triangles, work done and efficiency calculations. Heads and various efficiencies of hydraulic turbine. Main components and constructional features of pelton wheel turbine. Velocity diagrams and work done. Condition for maximum hydraulic efficiency. Calculation of number of buckets, jets, non-dimensional parameters (speed ratio, jet ratio).Governing of pelton wheel turbine.

Hydraulic Turbines (Reaction Type) **(08 Hrs)**

Reaction turbines: Main components and constructional features. Types of reaction turbine (Francis, Kaplan), velocity diagrams, unit quantities, specific speed, characteristic curves. Efficiency calculation for reaction turbine. Concept of draft tube, Phenomenon of cavitation and its effects on life of turbine. Governing mechanisms for reaction turbine. Selection of suitable reaction turbine.

Text Books:

1. Thermal Engineering, Domkundwar, 9th edition, DhanpatRai and Co Ltd. Delhi
2. Thermal Engineering, P L Ballaney, 4th edition, Khanna Publications, Delhi
3. Fluid Mechanics and Hydraulic Machines, Dr. R. K. Bansal, 10th edition, Laxmi publication Ltd, New Delhi

References Book:

1. Thermal Engineering, R K Rajput, 9th edition 2010, Laxmi Publication ltd, New Delhi

2. Hydraulic Machine, Dr. JagdishLal, 2nd edition, 1994, Metro Politan book co. pvt Ltd, Delhi.

3. Hydraulics & Fluid Machine, Dr. Modi Seth, 14th edition 2002, Standard book house, Delhi.

4. Steam & Gas turbine, R. Yadav, 7th edition 2000, Central Publications, Allahabad

5. Gas Turbine Theory & Jet Propulsion, J. K. Jain, 7th edition 2000, Khanna Publications, New Delhi.

ME353N MECHANICAL ENGINEERING DESIGN

Teaching Scheme : 03 L + 00 T; Total: 03 hours/week **Credits** : 03
Evaluation Scheme : 10 ISA +30 MSE + 60 ESE **Total Marks** : 100
ESE Duration : 3 Hrs.

COURSE DESCRIPTION

This course provides the knowledge of machine design. Course includes design of different types of gears such as spur gears, helical gears, bevel and worm gears. Students will study selection of bearings from manufacturer's catalogue and they also learn the design of anti-friction bearings.

DESIRABLE AWARENESS / SKILLS

The background expected familiar with Mathematics, Strength of Material, Theory of machine & Machine Drawing etc.

COURSE OUTCOMES

On the successful completion of this course; student shall be able to -

1. Identify different types of gears and bearings according to engineering applications.
2. Use the design principles involved in design of gears and bearings.
3. Use design data, codes and catalogues for various mechanical components.
4. Apply design concepts of hydrodynamic bearing and anti-friction bearing for different engineering applications.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1												1		
2	1	2	3	1	1			2					3		
3		1	1					3							
4	1	2	3	1	1			2	1	2	3	1	1		

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Spur Gears (8 Hrs)

Classification of gears, Selection of type of gears, Standard system of gear tooth, Number of teeth and face width, Type of gear tooth failure, Desirable properties and selection of gear material, Force analysis, Numerical treatment on force analysis. Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength equation, Estimation of module based on beam and wear strengths, Estimation of dynamic tooth load by velocity factor and Buckingham's equation. Note: - (Numerical treatment shall be exercise on all above cases).

Helical Gears **(8 Hrs)**

Transverse and normal module, Virtual number of teeth, Force analysis, Numerical treatment on 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. Note: - (Numerical treatment shall be exercise on all above cases).

Bevel Gears **(8 Hrs)**

Straight tooth bevel gear terminology and geometric relationship, Formative number of teeth, Force analysis, Numerical treatment on 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, Selection of material for bevel gears. Note: - (Numerical treatment shall be exercise on all above cases).

Worm Gear **(8 Hrs)**

Geometry and nomenclature, Force and efficiency analysis (Numerical treatment), Bending and surface fatigue strength, Worm gear thermal considerations Note: - (Numerical treatment shall be exercise on all above cases).

Anti-friction bearings **(8 Hrs)**

Sliding contact bearings: Working principle of hydrodynamic and hydrostatic bearing, Design of hydrodynamic and hydrostatic bearings (Exclude numerical). Rolling contact bearings: Classification, static and dynamic load carrying capacity, load-life relationship (Numerical treatment also), selection from manufacture's catalogue with numerical, comparison of sliding contact and rolling contact bearings.

Text Books

1. Bhandari V.B. – Machine Design data Book, 2nd edition, Tata Mc Graw Hill Publ. Co. Ltd
2. Shigley J.E. and Mischke C.R. – "Mechanical Engineering Design" Mc GrawHill Publ. Co. Ltd.
3. R. S. Khurmi, A text book of Machine Design, S. Chand publication.
4. R. B. Patil, A text book of Deign of machine elements, Vol. II, second revised ed. syllabus (2006), Technomax Publication, Pune.

Reference Books

1. Spott's M.F. and Shoup T.E. – "Design of Machine Elements", 8th edition 2006, Pearsons India.
2. Black P.H. and O. Eugene Adams – "Machine Design", McGraw Hill Book Co. Ltd.
3. Bhandari V.B. – "Design of Machine Elements" – Tata McGraw Hill Publ. Co. Ltd
4. Hall A.S., Holowenko A.R. and Laughlin H.G – "Theory and Problems of Machine Design"— Schaum"s outline series.

1.

ME354N METROLOGY AND QUALITY CONTROL LAB

Teaching Scheme : 02 P; Total: 02 hours/week **Credits** : 01
Evaluation Scheme : 30 ICA + 20 ESE **Total Marks** : 50

COURSE DESCRIPTION

It consists of standards of measurements and types standards, linear measuring instruments, machine tool metrology and measurement by light wave interference. It comprises of design of gauges, use of comparators, angular and surface finish measurement. The course involves measurement of screw thread also covers quality control and statistical quality control.

DESIRABLE AWARENESS / SKILLS

Concepts of linear, angular measurement and theory of the course ME351N Metrology and Quality Control.

COURSE OUTCOMES

On the successful completion of this course; student shall be able to

1. Understandprinciple,constructionandworkingofvariousmeasuringinstruments.
2. Handle & operate precision measuring instruments/ equipment's.
3. Calculationofleastcountofinstrument,takereadingusingtheinstrument
4. Interpret the observations & results.
5. Collection, analysis and recording of data.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1			3									1	-	-
2		1											2	-	-
3					3								-	-	1
4						1			2				-	-	-
5	3			1									1	-	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Minimum ten experiments shall be performed to cover entire curriculum of course ME351N. The list of experiments provided below is just a guideline.

List of Experiments

- Determination of linear/angular dimensions of part using precision & non Precision instrument.
- Machine tool alignment tests on any machine tool like Lathe, Drilling and Milling.
- Interferometer-Study of surfaces using optical flat.
- Surface finish measurement.
- Measurement of roundness /circularity using mechanical comparator.
- Measurement of screw parameters.
- Measurement of Gear parameters, gear tooth thickness, PCD
- Study and applications of tool maker's microscope
- Use of profile projector

- Study and use of control charts

Evaluation Methodology:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal and sheet) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.
- **ESE –** Oral will be based on content of syllabus and practical.

ME355N TURBO MACHINERY LAB

Teaching Scheme : 02 P; Total: 02 hours/week **Credits** : 01
Evaluation Scheme : 30 ICA + 20 ESE **Total Marks** : 50

COURSE DESCRIPTION

This course is designed in order that the students should understand and/or operate Turbo Machinery.

The background required includes that the student should study the contents of ME 352N

DESIRABLE AWARENESS / SKILLS

Fundamental knowledge of Mathematics, Engineering Thermodynamics, Fluid Mechanics

COURSE OUTCOMES

On completion of this course student should be able to:

1. understand and analyze performance of steam turbine.
2. understand and analyze performance of gas turbine.
3. operate impulse type hydraulic turbine.
4. operate reaction type hydraulic turbine.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO							PO						PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	1	-	-	3	-	-	-	-	-	-	-	-	1	-	-
CO 2	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-
CO 3	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
CO 4	1	-	1	-		1	-	-	1	-	-	-	-	-	-

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

COURSE CONTENT

Minimum eight experiments shall be performed to cover entire curriculum of course ME352N. The list of experiments provided below is just a guideline.

List of Experiments

1. Study of steam turbines.
2. Study of gas turbines.
3. Study of various jet propulsion engines.

4. Study of impulse type hydraulic turbines.
5. Study of reaction type hydraulic turbines.
6. Trial on Pelton Wheel.
7. Trial on Francis turbine.
8. Trial on Kaplan turbine.
9. Visit to steam turbine plant.
10. Visit to hydraulic power plant.

Evaluation Methodology:

- **ICA –** It shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using the prescribed internal continuous assessment format.

- **ESE –** It shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners, out of which one examiner shall be external examiner.

ME 356NA TOOL ENGINEERING

Teaching Scheme: 03L**, Total :** 03 Hrs/week **Credit:** 03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100

COURSE DESCRIPTION:

This course provides the basic knowledge of Tool Engineering. The course includes information of cutting tools, economics of tooling, Design of jigs and fixtures, Sheet metal working.

DESIRABLE AWARENESS/SKILLS:

Fundamental knowledge of Engineering Graphics, CAD , Metrology and Quality Control and Advanced machining processes.

COURSE OUTCOMES:

On successful completion of this course student shall be able to

1. Analyze single point cutting tool, drills, broach, reamer, milling cutters
2. Design of Circular and flat form tool.
3. Design of jigs and fixtures.
4. Design of press tools using CAD.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	3	x	x	x	x	x	x	1	x	x	3	x	2
2	2	1	2	1	x	x	x	x	x	x	x	x	3	x	2
3	3	3	3	x	x	x	x	x	x	x	x	x	3	x	x
4	3	2	2	1	x	x	x	x	x	x	x	x	3	x	3

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT:

Cutting tools: (8 Hrs)

Cutting tool standards and materials. Tool signature ORS & ASA methods. Tool standards: Single point cutting tool, drills, broach, reamer, milling cutters.Cutting tool materials, heat treatment of tools. Study of modern tool materials such as uncoated / coated carbides, Ceramics, cermets, cubic boron nitride, diamond etc., Advance tool materials, coating on tool, throwaway inserts.

Tool Design: (8 Hrs)

Desirable properties of tool material, Selection of tool grades and styles including specifications from commercial catalogues for different processes like turning, milling, drilling, grinding for different operations. Design of flat form tool and circular form tool. Geometry, nomenclature, types, selection

and applications of drills, reamers, milling cutters and broach. Design of cutting tools Single point cutting tool.

Economics of Tooling : **(8 Hrs)**

Problems encountered in the economics of tooling, fixed and variable cost, Depreciation and its types, Machine tool replacement, Return on investment, Mathematical analysis for

equipment selection, economics of small tool selection, Small tool replacement, break even point analysis. Economic lot size, Minimum cost analysis, Difference between economic batch quantity and break-even quantity.

Design of Jigs and fixtures: **(8 Hrs)**

Design of Jigs and fixtures for complicated parts . Indexing, locking and auxiliary elements. Bodies and bases or frames of Jigs and fixtures. Boring fixtures, broaching fixtures grinding fixtures, welding fixture , Pneumatics & Hydraulics for jig & fixtures, Concept of Modular Fixtures, Economics of Jigs and fixtures.

Press Tool Design: **(8 Hrs)**

Design of cutting die, bending and drawing die using CAD modeling and analysis.

TEXT BOOKS :

1. P H Joshi, “Jigs and Fixture”, Tata McGraw Hill, 2006.
2. P.C. Sharma, “A Text Book of Production Technology”, S. Chand, 2007
3. Ostergaard, “Basic Die Making”, MGH, New York, 1993.
4. P.H. Joshi, “Press Tool Design and Construction”, Wheeler Publishing, Delhi, 2000.

REFERENCE BOOKS:

1. Kempster, “Introduction to Jigs & Tool Design”, Viva Books Pvt. Ltd,1998.
2. Cyryll Donaldson, George H. Lecain, V.C. Goold, “Tool Design”, Tata Mcgraw Hill, 2002
3. Joshi, “Machine Tools Handbook : Design and Operation”, McGraw Hill, 2008
4. J.R.Paquin, Die Design Fundamental", Industrial Press, Inc. New York, NY, USA, 2005
5. Vukota Boljanovic,"Sheet Metal Stamping Dies: Die Design and Die-Making Practice", Industrial Press, Inc. New York, NY, USA
6. Oehler, “Hydrualic Presses”, Arnold Press, 1968. 6. Ghosh and Mallik,”Manufacturing Science”, East West Publications.

ME356NB COMPUTATIONAL FLUID DYNAMICS

Teaching Scheme: 03L**, Total:** 03 **Credit:** 03
Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:** 100
Duration of ESE: 03Hrs

COURSE DESCRIPTION

This course aims to introduce numerical modelling and its role in automotive field; it will enable the students to understand the various discretisation methods and solving methodologies and to create confidence to solve complex problems in the automotive field with the knowledge of Heat transfer and fluid dynamics. Further students can able to develop finite difference and finite volume discretized forms of the CFD equations and to formulate explicit & implicit algorithms for solving the Euler Equations & Navier Stokes Equations.

DESIRABLE AWARENESS / SKILLS

Knowledge of Heat Transfer, Fluid Dynamics and their concepts

COURSE OUTCOMES:

On completion of this course student should be able to:

1. Understand the concepts of Differential Equations, Discretisation, Transformation and FEA role in CFD.
2. Apply all theories, approaches and methodologies in solving engg. Problem by CFD.
3. Analyse the stability, accuracy, and convergence of different numerical methods (FDM, FVM, FEM) for solving PDEs
4. Develop and implement adaptive meshing techniques to improve solution accuracy.
5. Understand the principles of turbulence modelling and its applications in CFD.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	1	1	-
CO 2	3	2	2	-	2	-	-	-	-	-	-	-	2	2	-
CO 3	3	-	-	2	3	-	-	-	-	-	-	--	-	-	1
CO 4	3	-	-	-	-	-	-	-	-	-	-	1	-	1	-
CO 5	-	3	-	2	-	-	-	-	-	-	-	1	-	-	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENTS:

Introduction and Basic Concepts: - (8hr)

Introduction to CFD and Governing Equations, Overview of Computational Fluid Dynamics (CFD), Applications of CFD in engineering and science, Governing equations of fluid flow (Navier-Stokes equations), Conservation laws: Mass, momentum, and energy, Classification of partial differential equations (PDEs)

Numerical Methods and Discretization Techniques: - (8hr)

Finite Difference Method (FDM), Finite Volume Method (FVM), Finite Element Method (FEM), Time discretization: Explicit vs. implicit methods, Spatial discretization schemes (Upwind, Central, QUICK) Stability, accuracy, and convergence.

Grid Transformation: - (8hr)

Grid Generation and Boundary Conditions, structured vs. unstructured grids, Grid independence and quality assessment, Adaptive meshing techniques, Boundary conditions: Dirichlet, Neumann, Robin, Pressure-velocity coupling methods (SIMPLE, PISO, SIMPLER)

Turbulence and Advanced CFD Modelling: - (8hr)

Introduction to turbulence and its effects, Turbulence modelling approaches (DNS, LES, RANS), Common turbulence models (k-ε, k-ω, SST), Heat transfer modelling (conjugate heat transfer, radiation), Multiphase flow models (Eulerian-Lagrangian, Volume of Fluid).

CFD Applications and Hands-on Simulations: - (8hr)

Introduction to CFD software (ANSYS Fluent, Open FOAM, COMSOL), Setting up simple CFD problems, post-processing and visualization tools (Para View, Tec plot, MATLAB), Validation and verification of CFD results, Case studies in aerodynamics, combustion, biomedical flows, etc

Text book:

1.Sunil Kumar Chakrabartty, Manas Kumar Laha, Pradip Niyogi, "IntroductionTo Computational Fluid Dynamics" 1st Edition 2009, Pearson India.

2. S.C.Gupta , "Applied Computational Fluid Dynamics" 1st Edition 2019.

References:

1. John D Anderson, "Computational Fluid Dynamics the Basics with Applications", Indian edition 1995Jr., McGraw Hill Book Company.

2. H K Versteeg, W Malalasekera,"An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Indian edition 1995, Pearson Education Ltd.

3.Anil W Date, "Introduction to Computational Fluid Dynamics",Indian edition 1995 Cambridge University Press.

ME356NC PRODUCT DESIGN AND DEVELOPMENT

Teaching Scheme : 03L **Credits : 3**

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks : 100**

Duration of ESE : 03 hrs

COURSE DESCRIPTION

Introduction to the engineering design and structured design methods, Topics include mechanical design, process designs, specifications, concept generation, need selection, detailed design, simulation design for manufacturing and assembly design for product safety, Principles of life cycle engineering.

DESIRABLE AWARENESS

Product development and design, Process and methods including products specifications, Concept development, Engineering Drawing, Design for a prototype and manufacturing.

COURSE OUTCOMES:

After completion of the course, the students will be able to

1. Describe engineering design and development process.
2. Create 3D solid models of mechanical components using CAD software.
3. Demonstrate individual skills using selected manufacturing techniques
4. Employee engineering scientific and mathematical principles to executive design for concept to the finished product.

RELEVANCE OF POS AND STRENGTH OF CORRELATION:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1		2			1		3					1	1	
CO2		3		1			2			3					
CO3												3			
CO4		2		1		3									

COURSE CONTENT:

Design Fundamentals: (8 Hrs)

The importance of engineering design. Types of design, the design process Relevance of product life cycle issues in design. Designing to codes and standards. Social considerations in engineering design. Generic product development process. Various phases of product development. Planning for products, establishing markets, market segments. Relevance of market research.

Customer Oriented Design & Social Considerations: (8 Hrs)

Identification of customer needs. Customer requirements. Quality Function, deployment, product design specifications. Human Factors in Design, ergonomics and aesthetics. Societal consideration, Contracts, Productliability, Protecting intellectual property. Legal and ethical domains, Codes of ethics. Ethical conflicts, Environment responsible design. Future trends in interaction of engineering with society.

Material Selection Processing and Design: (8 Hrs)

Material Selection Process. Economics, Cost Vs Performance, Weighted property Index, Value Analysis. Role of Processing in Design. Classification of Manufacturing Process. Design for manufacture, Design for assembly, Design for casting, forging, Metal forming, machining and welding. Residual Stresses, fatigue, fracture and failure.

Design Methods: (8 Hrs)

Creativity and problem solving. Creative thinking methods, generating design concepts. Systematic methods for designing. Functional decomposition, physical decomposition, Functional representation. Morphological methods. TRIZ-axiomatic design. Decision making theory. Utility theory. Decision trees, concept evaluation methods.

Industrial Design Concepts: (8 Hrs)

Human factors design, user friendly design, design for serviceability, design for environment. Prototyping and testing cost evaluation. Categories of cost, overhead costs, activity based costing, methods of developing cost estimates. Manufacturing cost, value, analysis in costing.

TEXT BOOKS:

1. Product Design, Kevin Otto and Kristin wood, 2nd ed,Pearson Education Inc.
2. Product Design and Development, K.T.Ulrich and S.D.Eppinger, TMH, 2015
3. Product Development, Chitale & Gupta, 4th edition, TMH, 2016
4. The Mechanical Process Design, David Ullman, Mc Graw Hill Inc, 2008
5. Engineering Design Process, Yousef Haikand T M MShahin, 3rd ed, Cengage Learning,2012.

REFERENCE BOOKS:

1. Product Design & Process Engineering by Niebel & Deeper, McGraw Hill
2. Value Management by Heller, Addison Wasley
3. Value Engineering Ahow to Manual S.S.Iyer, Newage International Publishers
4. Value Engineering: A Systematic Approach by Arthur E.Mudge. McGraw Hill
5. New Product Development Tim Jones. Butterworth Heinmann, Oxford.
6. Value Engineering: A how to Manual S.S.Iyer, New Age International Publishers
7. Value Engineering: A Systematic Approach by Arthur E. Mudge- McGraw Hill
8. Assembly Automation and Product Design by Geoffrey Boothroyd, CRCTaylor & Francis.

ME357NA MECHATRONICS

Teaching Scheme : 03L + 00T; Total: 03 hours/week **Credits** : 03
Evaluation Scheme :10 ISA + 30 MSE + 60 ESE **Total Marks** : 100
ESE Duration : 3 Hrs.

COURSE DESCRIPTION

This course introduces to graduate students the basic mechatronics system components, and the design principles of using mechatronics to meet functionality requirements of products, processes and system.

DESIRABLE AWARENESS/SKILLS

Knowledge of Mechanical, Electronic, Instrumentation and measurement systems.

COURSE OUTCOMES

The Student should able to:
1. acquire the knowledge of basics of mechatronics and their scope.
2. acquire the knowledge of sensors and transducers.
3. Understand fundamental of hydraulic and electrical actuators.
4. acquire the knowledge of data acquisition system and control system.
5. develop the ability to analyze and design mechatronics syste

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2								1			1	1	
2	2	1		1	1								1	1	
3	2	3	3										1	1	
4	1	1		1	1								1	1	
5	1	1		1									1	1	

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

COURSE CONTENT

Introduction to Mechatronics: **(8 Hrs)**

Introduction Introduction to mechatronics, Mechatronics systems, Measurement systems, Multi discipline scenario.

Transducers and Sensors- **(8 Hrs)**

Introduction, Difference between transducer and sensor, Transducer types, Photoelectric transducers, photoemissive transducers, photoconductive transducers, photovoltaic transducers,Inductive transducers, Capacitive transducers, Pyroelectric transducers, Piezoelectric transducer, Half- effect transducer, Ionization transducers, Light Emitting diode, Optical encoder – incremental encoder,

absolute optical encoder, Bimetallic strip, Bourdon tube, Strain gauge, Load cell, Diaphragms, Mechanical switches, Flow transducers, Fibre optic transducers.

Signal Conditioning: **(8 Hrs)**

Introduction, Voltage divider, Rectification, Diode voltage stabilizer, Clipping and Clamping circuit

Operational Amplifier – **(8 Hrs)**

OPAMP circuits, Isolator, Instrumentation amplifier, Bridge circuit, Oscillator, 555 Timer, Analog to Digital conversion – digital to analog converter, counter based analog to digital converter, successive approximation, Galvanometer, Ammeter and Voltmeter, Cathode ray oscilloscope. X-Y recorders, Magnetic tape recorder. Data loggers – block diagram description, Data acquisition system.

Actuators and Microprocessor And Microcontroller: **(8 Hrs)**

Introduction, Actuator types and application areas, Electromechanical actuators, DC Motors – brushed DC motor, brushless, coreless, AC Motors – induction motors, synchronous motors, stepper motor, Fluid power actuators – pneumatic actuators, valves actuators, hydraulic actuators, comparison, Piezoelectric actuators – an illustration, piezoelectric motor.Stability of Systems: On/Off controller, Proportional Control, Integral control, Derivative Control; PI, PD and PID Controllers.

Text Books

1. A Text Book of "Mechatronics: A multi-disciplinary approach" by W Bolton, Fourth edition, Pearsoneducation,2008
2. 2. A Text Book of "Mechatronics" by HMT Ltd, Indian edition, Tata McGraw-Hill, New Delhi, reprint 2014
3. 3. A Text Book of "Mechatronics: Principles, Concepts and Applications" by N.P.Mahalik, First edition, Tata McGraw-Hill Education,2003
4. 4. A Text Book of "Mechatronics" by R.K.Rajput, Third edition, S. Chand Limited,2007

Reference Books

1. "Mechatronics" by M. D. SINGH, J. G. JOSHI Published by PHI Learning,2009
2. "Mechatronics Sourcebook" by N. C. Braga, First edition, Delmar Learning,2002
3. "Mechatronics System Design" by Shetty D, Kolk Ra, second edition, PWS Publications, Boston, 20

ME357NB SYNTHESIS OF MECHANISM

Teaching Scheme : 03L + 00T; Total: 03 hours/week **Credits** : 03
Evaluation Scheme :10 ISA + 30 MSE + 60 ESE **Total Marks** : 100
ESE Duration : 3 Hrs.

COURSE DESCRIPTION

This course introduces is to understand kinematics synthesis of mechanism, to learn various tools for the mechanism synthesis, It also makes the students conversant with concepts of Kinematic synthesis for Path generation, Motion generation and Function generation. The students synthesize and develop the suitable mechanisms for various applications.

DESIRABLE AWARENESS/SKILLS

Fundamental knowledge of engineering mechanics, Numeral methods and optimization**.**

COURSE OUTCOMES

On completion of this course student should be able to:
1. Apply the various tools for mechanism synthesis for all task of kinematic synthesis.
2. Know the tools for optimal mechanism synthesis for n- accuracy points.
3. Understand the principles of graphical and analytical methods of synthesis along with computer application.
4. Know and understand the kinematics of spatial mechanisms.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	-	2	-	-	3	-	-	-	-	-	1	2	-
2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	2	-	-	-	-	-	-	-	-	-	3
4	1	-	3	-	1	-	-	-	-	-	-	-	1	2	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Kinematic Synthesis (8Hrs)

Introduction ,Type, Number and Dimensional synthesis, Task of kinematic synthesis – function generation, path generation & motion generation problems with practical applications, Grashof's condition, limiting conditions, toggle positions, circuit and branches in linkages, concept of transmission angle, class I &class II chain, concept of transmission angle, Mobility, Grubler's criterion , Coupler curves, Cognate-Robert-Chebyshev theorem.

Graphical Approaches (8Hrs)

Accuracy (Precision) points, Mechanical error, Structural error, Chebyshev spacing, selection ofprecision points, Relative Pole techniques and inversion technique for all tasks of synthesis with three precision points , Dead centre problems, Burmester's curve.

Analytical Approaches **(8Hrs)**

Use of complex number method- Modelling linkages with dyads for the task of kinematicsynthesis for three precision points, Ground pivot specifications approach for three precisionpoints, Freudenstein's equation, Matrix method approach, computer approach for the aboveproblem.

Optimum Synthesis of a Planer Mechanisms **(8Hrs)**

Formulation for the task of kinematic synthesis, Identification of design variables, constraints, Formulation of objective function in terms of design variables, constrained and unconstrainedoptimal mechanism synthesis, Use Powell's search method and least square approximation forkinematic synthesis of mechanism problems.

Kinematics of spatial mechanisms: **(8Hrs)**

Introduction, degree of freedom, Matrix method, loop closure equation, kinematics of open chains, Numerical treatment.

Text Books

1.Theory of Machines and Mechanisms, J. E. Shigley and J. J. Uicker, McGraw-Hill.

2. Design of Machinery: An Introduction to the Synthesis and Analysis of Mechanisms andMachines, Robert L.Norton, Tata McGraw Hill.

3. Theory of Mechanisms and Machines, Ghosh and Malik, EWP

4. Optimisation for Engineering design(Algorithms and examples),Kalyanmoy Deb,PHI

Reference Books

1. Advanced Mechanism Design–Analysis and Synthesis - Vol. I and II, A.G.Erdman and G.N.Sandor, Prentice – Hall.

2. Kinematics and Mechanism Design, C.H. Suh and C.W. Radcliffe, John Wiley & Sons.

3. Kinematics and Linkage Design, Hall, A.S., Balt Publishers.

4. Kinematic Synthesis of Linkages, R.S. Hartenberg and J. Denavit, McGraw Hill.

ME357NC CRYOGENIC ENGINEERING

Teaching Scheme : 03L + 00T; Total: 03 hours/week **Credits** : 03
Evaluation Scheme :10 ISA + 30 MSE + 60 ESE **Total Marks** : 100
ESE Duration : 3 Hrs.

Course Description

This course covers the knowledge of evolution of low temperature science as well as the characteristics of low-temperature materials.

Desirable awareness/skills

Knowledge of Basic Science and Engineering Principles, Fluid Mechanics, Material Science.

Course Outcomes

The Student should able to:

1. To utilize basic knowledge to comprehend the characteristics of materials at low temperatures.
2. To apply the knowledge of low temperature production methods for different cryogenic systems.
3. To apply cryogenic refrigeration & liquefaction methods for industrial applications.
4. To use different cryogenic instrumentation and cryogenic insulation methods.

Relevance of COURSE OUTCOMES (COs) WITH POs AND PSOs (with strength of CO-PO relation)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3						2						3		2
2	3	2	3		2								2		3
3	3	3	2										2		2
4		2		2			2						3		1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Course Content

Introduction: (8 Hrs)

Cryogenic engineering, Properties of Cryogenic Fluids like Oxygen, Nitrogen, Argon, Neon, Florin, Helium, Hydrogen; Properties of Cryogenic Materials - mechanical, thermal, and electrical; Super conductivity; Hazards and prevention – physical hazard, chemical hazard, physiological hazard and preventions, Safety in cryogenic fluid handling, storage and use.

Applications of cryogenic systems: (8 Hrs)

Super conductive devices such as bearings, motors, cryotrons, magnets, D.C. transformers, tunnel diodes, space technology, space simulation, cryogenics in biology and medicine, food preservation and industrial applications, nuclear propulsions, chemical propulsions.

Cryogenic Refrigeration & Liquefaction: **(8 Hrs)**

Ideal isothermal and reversible isobaric source refrigeration cycles, Joule Thomson system, cascade or pre-cooled joule–Thomson refrigeration systems, COP, FOM

Liquefaction: **(8 Hrs)**

Introduction, Principle and Methods of production of low temperature thermodynamically ideal systems, Joule Thomson effect, liquefaction systems such as Linde Hampton, Precooled Linde Hampson, Claude System.

Cryogenic insulation: **(4 Hrs)**

Various types such as expanded foams, gas filled & fibrous insulation, vacuum insulation, evacuated powder & fibrous insulation, opacified powder insulation, multi-layer insulation, comparison of performance of various insulations.

Cryogenic System Requirements: **(4 Hrs)**

Cryogenics Heat Exchangers, Compressors, Expanders, Effect of various parameters in performance and system optimization, Storage equipment for cryogenic fluids, industrial storage and transfer of cryogenic fluids

Text Books

1. Cryogenic systems-Baron, McGraw-Hill book
2. Fundamentals of Cryogenic Engineering- Mamata Mukhopadhyay, PHI Learning Pvt. Ltd.

Reference Books

1. Cryogenic fundamentals-Haselden, Academic press New York
2. Cryogenic technology – M. Vance, Wiley Publications
3. Cryogenic Engineering, Revised and Expanded – Thomas Flynn, CRC Press
4. Cryogenic engineering – Russell B. Scott , Hassell Street Press

ME358NA TOOL ENGINEERING LAB

TeachingScheme:02P**, Total:**02 Hrs/week **Credit** : 01
Evaluation Scheme: 30 ICA + 20 ESE **Total Marks:** 50

COURSE DESCRIPTION:

This course provides the knowledge of Tool Engineering. Course includes information of cutting tools geometry, Various cutting tool materials, Economics of tooling, Design of jigs and fixtures, Sheet metal working and Limit gauges.

DESIRABLE AWARENESS/SKILLS:

Fundamental knowledge of Engineering Graphics, CAD, Metrology and Quality Control and advanced machining processes.

COURSE OUTCOMES:

On successful completion of this course student shall be able to:
1. design of circular and flat form tool.
2. mathematical analysis of equipment and tooling cost.
3. design the complicated jigs and fixtures.
4. design of press tool using cad.
5. design of go and nogo limit gauges.

RELEVANCE OF COURSE OUTCOMES (COS) WITH POS AND PSOS

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	x	x	3	x	x	x	x	x	x	x	x	1	x	x
2	x	2	x	x	x	x	x	1	x	x	x	x	x	x	x
3	1	x	x	x	3	x	x	x	x	x	x	x	x	x	1
4	x	x	x	x	x	1	x	x	3	x	x	x	3	x	x
5	2	x	1	x	x	x	x	x	x	x	x	x	1	x	x

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

Minimum eight experiments and five assignments shall be performed to cover entire curriculum of course ME 358NA and shall be among as following:

1) Draw a tool geometry of – a) Milling Cutter. b) Broaching tool.
2) Design of –a) Flat form tool. b) Circular form tool.
3) Assignment on Economics of Tooling.
4) Design of Drilling Jig.
5) Assignment on Boring, Grinding and Welding Fixture.
6) Design of Limit gauges.
7) Design of Cutting Die.
8) Design of Bending Die.
9) Design of Drawing die.

Guidelines for ICA:

Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by the student (Journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.

Guidelines for ESE:

The End Semester Exam for this course shall be based on oral examination which covers content of syllabus and practical conducted, to judge the skills acquired by student.

ME358NB COMPUTATIONAL FLUIDDYNAMICS LAB

Teaching Scheme : 02 P; Total: 02 hours/week **Credits** : 01
Evaluation Scheme : 30 ICA + 20 ESE **Total Marks** : 50

COURSE DESCRIPTION

This course aims to introduce numerical modelling and its role in automotive field; it will enable the students to understand the various discretization methods and solving methodologies and to create confidence to solve complex problems in the automotive field with the knowledge of Heat transfer and fluid dynamics. Further students can able to develop finite difference and finite volume discretized forms of the CFD equations and to formulate explicit & implicit algorithms for solving the Euler Equations & Navier Stokes Equations.

DESIRABLE AWARENESS/SKILLS

Knowledge of Heat Transfer, Fluid Dynamics and their concepts.

COURSE OUTCOMES: On the successful completion of this course; student shall be able to: -

1. Analyze fluid flow through pipes (typically incompressible fluid).
2. Analyze the flow over a flat plate to study boundary layer development.
3. Study the behavior of compressible fluids (like air) in a converging-diverging nozzle.
4. Analyze heat transfer due to fluid motion, typically in turbulent or laminar flow
5. Study the flow around a cylindrical object to understand drag, vortex shedding, and wake formation.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	-	-	-	2	-	-	-	-	-	-	-	-	1	-
2	3	2	2	-	-	-	-	-	-	-	-	-	-	1	-
3	3	-	-	-	2	-	-	-	-	-	-	-	2	-	-
4	3	-	-	1	-	-	-	-	-	-	-	-	-	-	1
5	3	-	-	-	1	-	-	-	-	-	-	-	-	1	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Minimum seven experiments shall be performed to cover entire curriculum ofME358NB Computational fluid dynamics lab. The list of experiments provided below is just a guideline.

List of Experiments

1. To perform numerical analysis on flow through pipe.
2. To perform numerical analysis on flat plate boundary layer.

3. To perform numerical analysis on compressible flow in nozzle.
4. To perform numerical analysis on convective heat transfer.
5. To perform numerical analysis on steady flow past a cylinder.
6. To perform numerical analysis on unsteady flow past a cylinder.
7. To perform numerical analysis on flow over an airfoil.
8. To perform numerical analysis on heat conduction through wall.

Major Equipment:

1.Compatiblecomputational facility.

2. Ansys software, Open foam Software

- **ICA –** It shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on practical performed by him/her. The performance shall be assessed experiment wise using the prescribed internal continuous assessment format.

- **ESE –** It shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners, out of which one examiner shall be external examiner.

ME358NC PRODUCT DESIGN & DEVELOPMENT LAB

TeachingScheme:02P**, Total:**02 Credit : 01
Evaluation Scheme: 30 ICA + 20 ESE

COURSE DESCRIPTION:

This course provides the knowledge of engineering design and structured design methods, Topics include mechanical design, process designs, specifications, concept generation, need selection, detailed design, simulation design for manufacturing and assembly design for product safety, Principles of life cycle engineering.

DESIRABLE AWARENESS/SKILLS:

Product development and design, Process and methods including products specifications, Concept development, Engineering Drawing, Design for a prototype and manufacturing.

COURSE OUTCOMES:

After completion of the course, the students will be able to

1. Describe engineering design and development process.
2. Create 3D solid models of mechanical components using CAD software.
3. Demonstrate individual skills using selected manufacturing techniques
4. Employee engineering scientific and mathematical principles to executive design for concept to the finished product.

RELEVANCE OF COURSE OUTCOMES (COS) WITH POS AND PSOS

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	x	x	3	x	x	x	x	x	x	x	x	1	x	x
2	x	2	x	x	x	x	x	1	x	x	x	x	x	x	x
3	1	x	x	x	3	x	x	x	x	x	x	x	x	x	1
4	x	x	x	x	x	1	x	x	3	x	x	x	3	x	x

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

Minimum seven experiments shall be performed to cover entire curriculum of course ME 358N (C) and shall be among as following:

1. Conduct a study on a life cycle of a specific product currently available in industry.

2. For a hypothetical product identify costumer needs, develop product Specifications, and consider ethical and societal impact in design.

3. Conduct a market Survey for a product.

4. Material Selection and manufacturing process for a Nut and Bolt.

5. Apply TRIZ to improve a Mechanical System.

6. Design and Testing of an Ergonomic and user-friendly hand tool.

7. Comparing Properties for Investments using a weighted Index.

8. Cost vs Performance Analysis for Engineering Design.

9. Study of Cost Evaluation, Categories of cost, and Overhead Cost

GUIDELINES FOR ICA:

Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by the student (Journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format.

GUIDELINES FOR ESE:

The End Semester Exam for this course shall be based on oral examination which covers content of syllabus and practical conducted, to judge the skills acquired by student.

ME359NA MECHATRONICS LAB

Teaching Scheme: 02P,**Total:**02 **Credit:** 01

Evaluation Scheme :30ICA+20ESE **Total Marks:** 50

COURSE OUTCOMES:

Upon the completion of this course the students will be able to

1. demonstratethefunctioningofmechatronicssystemwithvariouspneumatic,hydraulic and electrical systems.
2. demonstrate the functioning of control systems with the help of PLC and microcontrollers.

RELEVANCE OF COS/POS AND STRENGTH OF CO-RELATION:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1			3									1	-	-
CO2		1											2	-	-

1-Weaklycorrelated 2–Moderatelycorrelated 3–Stronglycorrelated

Minimum five experiments and three assignments shall be performed to cover entire curriculum of course ME357N.

Outline of Content: This course contains any five experiments and three assignments.

1) Study of Basic block diagram of Mechatronics system components.
2) Demonstration of motion/force transducers.
3) Demonstration of temperature/pressure transducers.
4) Demonstration of Bottle Filling Plant using PLC
5) Demonstration of hydraulic actuator/pneumatic actuator with PLC.
6) Demonstration of Lift control using PLC
7) Study of Micro processors and Microcontrollers
8) Demonstration of Industrial Robot Arm /Autonomous guided vehicle (VirtualLab)

Guidelines for ICA:

Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal) based on practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format (S10)

Guidelines for ESE:

Oral will be based on content of syllabus and practical.

ME359NB SYNTHESIS OF MECHANISM-LAB

Teaching Scheme : 02 P; Total: 02 hours/week **Credits** : 01
Evaluation Scheme : 30 ICA + 20 ESE **Total Marks** : 50

COURSE DESCRIPTION

This course is designed in such a way that the students should understand the concept of various methods of mechanism synthesis for all task of kinematic synthesis and apply the tools to develop mechanisms for various industrial application.

DESIRABLE AWARENESS / SKILLS

Concepts and theory of the course ME357N Synthesis of Mechanism.

COURSE OUTCOMES

On the successful completion of this course; student shall be able to

1) Apply the various tools for mechanism synthesis for all task of kinematic synthesis.
2) Know the various tools for optimal mechanism synthesis for n-accuracy points.
3) Understand the principles of graphical and analytical methods of synthesis along with computer application.
4) Know the kinematics of spatial mechanisms

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1		-	1	-	-	3	-	-	-	-	-	1	1	
2	-	3	-	-	-	-	-	-	-	-	-	-	2	-	-
3				-	1	-	-	-	-	-	-	-	-		1
4	3	1	-	2	-	-	-	-	-	-	-	-	1	2	-

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Students shall Complete the following practical **(Any Eight)** and two assignments shall conduct on syllabus.

List of Experiments

1.Problems on Path Generation Problem (Graphical approach).
2.Problems on Motion Generation Problem (Graphical approach).
3.Problems on Function Generation Problem (Analytical approach).
4.Problems on Path Generation Problem (Analytical approach).
5.Problems on Motion Generation Problem (Analytical approach).
6.Problems on Function Generation Problem (Freudenstein Equation).
7.Complex number modeling for the mechanism synthesis problem. (Numerical).
8.Formulation for Optimal Synthesis of Function Generation Problem.
9.Formulation for Optimal Synthesis of Path Generation
10.Problem.Formulation for Optimal Synthesis of Motion Generation Problem.

Evaluation Methodology:

- **ICA –** Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal and sheet) based on practical performed by him/her. The performance shall be assessed experiment wise on regular basis.
- **ESE –** It shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners, out of which one examiner shall be external examiner.

ME359NC CRYOGENIC ENGINEERING LAB

Teaching Scheme: 02P, **Total:** 02 **Credit:** 01
Evaluation Scheme: 30 ICA+20 ESE **Total Marks:** 50

COURSE DESCRIPTION

A "cryogenic engineering lab course" focuses on the practical application of cryogenic engineering principles. It involves hands-on experiments and laboratory work to study and understand low-temperature phenomena and technologies. These courses often cover topics like liquefaction, refrigeration, and the behavior of materials at cryogenic temperatures.

DESIRABLE AWARENESS / SKILLS

Concepts and theory of the course ME357NC Cryogenic Engineering.

COURSE OUTCOMES

On the successful completion of this course; student shall be able to

1. To provide the knowledge of evolution of low temperature science .
2. To provide knowledge on the properties of materials at low temperature.
3. To familiarize with various gas liquefaction and refrigeration systems and to provide design aspects of cryogenic storage and transfer lines

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1		-	1	-	-	3	-	-	-	-	-	1	1	
2	-	3	-	-	-	-	-	-	-	-	-	-	2	-	-
3				-	1	-	-	-	-	-	-	-	-		1

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlated

COURSE CONTENT

Minimum five experiments and three assignments shall be performed to cover entire curriculum of course ME357NC.

1. Study of cryogenic properties of hydrogen and helium.
2. Study of low temperature measurement instruments.
3. Study of flow measurement and quality measurement instrument.
4. Study of liquid level measurement.
5. Study of insulation used in cryogenic equipment.
6. Study of cryogenic application (superconductivity)
7. Study of cryogenic application in space technology.
8. Study of cryogenic application in bio medical and food preservation.
9. Study of safety while handling fluid.
10. Study of ideal liquefaction system.

Guidelines for ICA:

Internal Continuous Assessment shall support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (Journal) based on

practical performed by him/her. The performance shall be assessed experiment wise using internal continuous assessment format (S10)

Guidelines for ESE:

Oral will be based on content of syllabus and practical.

ME360N PARAMETRIC MODELLING COURSES

Teaching Scheme: 04P, **Credit:** 02
Evaluation Scheme: 30 ICA+20 ESE **Total Marks:** 50

COURSE DESCRIPTION

The primary objective of this lab is to provide hands-on experience in using any one Parametric software for product modelling, development and analysis.

DESIRABLE AWARENESS/SKILLS

Fundamental knowledge of computer and engineering drawing.

COURSE OUTCOMES

On the successful completion of this course student shall be able to …

1. Create2D sketch of individual component.
2. Create part model and assembly of any component
3. Create surface model of sheet metal work.
4. Create drafting of model as per requirement.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2		3		2							3	3	2	1
2	1	2			1				1		2		1	3	
3	2	1	1		2							2	2	1	
4	1			1			2			1				2	

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlated**

COURSE CONTENT

This course introduce to 3D CAD software includes Advantages of CAD packages, applications of CAD, the theory of CAD software consisting of basic operation of drafting packages, use of various commands for drawing, part modelling, assembling, drafting, transferring model files for any other format.

List of Experiments (Any 10)

1. Create any 2D sketch of component and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software.
2. Create 2D sketch of any Machine component and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software. (Oldham coupling, Universal coupling, Screw Jack)
3. Create any one-part model of machine component and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software. (Oldham coupling, Universal coupling)

4. Create Part Model of bench vise and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software.
5. Create part Model of screw jack and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software.
6. Create assembly of Oldham coupling/Universal coupling and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software.
7. Create assembly ofscrew jack and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software.
8. Create assembly of bench vice and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software.
9. Create Surface model of any one component and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software. (Door Handle, Tank, cylinder, pipe Y intersection)
10. Create Surface model of any one component and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software. (Jug, spoon, Axial Fan)
11. Create drafting of any one component and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software. (Oldham coupling/Universal Coupling)
12. Create drafting of any one component and plotted on A- 3 or A-4 sheet by using various commands of chosen 3D cad software. (Bench Vise, Screw jack)

Evaluation Methodology:

- **ICA –** Internal continuous assessment should support for regular performance of practical and its regular assessment. In addition; it shall be based on knowledge/skill acquired and record submitted by student (journal) based on performed practical. The performance shall be assessed experiment wise using internal continuous assessment format.

- **ESE/Oral –** It shall be based on performance in one of the experiments performed by student in the semester followed by sample questions to judge the depth of understanding/knowledge or skill acquired by the student. It shall be evaluated by two examiners, out of which one examiner shall be external examiner.

MEM 313N INTERNAL COMBUSTION ENGINE (MDM-IV)

Teaching Scheme:03 L**, Total:** 03 **Credits :** 03
Evaluation Scheme: 30 MSE+10 ISA + 60 ESE **Total Marks :** 100
Duration of ESE: 03Hrs**.**

COURSE DESCRIPTION:

This course provides the knowledge of Internal Combustion Engine. Course includes different engine cycles its performance analysis, various systems in IC Engine such as fuel feed, lubrication, cooling, ignition, supercharging and turbo charging, Fundamental of combustion in IC Engine, types and design of combustion chambers. Various emission control norms.

DESIRABLE AWARENESS/SKILLS:

Fundamental knowledge of Mathematics, Basic Engineering Thermodynamics, various ideal gas processes, Applied Thermodynamics.

COURSE OUTCOMES:

On completion of this course the student shall be able to:

1. Understanding the performance of I C Engine through thermodynamic cycles.
2. Fuel feed system for S I and C I Engines.
3. Various types of ignition, lubrication, cooling system used in I C Engines.
4. Understanding the combustion phenomena in S I and C I engines and factors influencing combustion chamber design.
5. Evaluate methods for improving the I C engine performance.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2								1			1	1	
2	2	1		1	1								1	1	
3	2	3	3										1	1	
4	1	1		1	1								1	1	
5	1	1		1									1	1	

1-Weakly correlated 2 – Moderately correlated 3 – Strongly correlate

COURSE CONTENT

Basic Concepts and Engine Cycles (8 Hrs)

Introduction: Classification of I.C. Engines, components and their functions. Thermal and volumetric efficiencies of engine, air fuel ratio, specific fuel consumption, numerical, Air Standard Cycles: Assumptions, Otto, Diesel, Dual Combustion cycle, derivation of their efficiency equation, work done and mean effective pressure, numerical on Air standard cycles,

Comparison on the basis of heat input, compression ratio, maximum pressure and temperature, Actual cycle, Pumping losses, time losses.

Fuel Feed Systems **(8 Hrs)**

Charge, intake valve and manifold, valve timing diagram, valve overlap, Carburetion: Requirement, Factors affecting carburation, simple carburetor, Air fuel ratio calculation, Simple carburetor. Fuel feeding systems in CI engines: Requirement, classification, fuel feed pump, distributor type pump, injection pump. Introduction to governor, Mechanical Governor, Pneumatic Governor, fuel injector and nozzles, Types of nozzles.

Cooling and Lubrication System **(8 Hrs)**

Need of Lubrication, Mechanism of lubrication, Lubrication Systems, Properties of lubricants, Additives for Lubricants. Cooling systems: Requirement, need of cooling systems, types of cooling systems and comparison of cooling systems. Starting methods of engines: Supercharging, types of superchargers, effect of super charging, limitations and advantages of supercharging, and turbo charging of engines.

Combustion in S I and C I Engines **(8 Hrs)**

Homogeneous and heterogeneous mixtures, Combustion in S I engines: Stages in combustion, flame front propagation, factors influencing flame speed, detonation, factors affecting the detonation, pre-ignition, combustion chamber of S I engines, Combustion in C I engine: stages of combustion, factors affecting the delay period. Diesel knock, effect of engine variables on Diesel knock, comparison of knock in SI and CI engines, Combustion chamber for CI engines.

Engine Testing and Performance **(8 Hrs)**

Different methods for measurement of Friction Power, Indicated power, Brake power, numerical, heat balance sheet and efficiency calculations, numerical on performance of engines, Engine emission, air pollution due to engines, various EURO & BHARAT norms, Un burnt hydrocarbon emission in two stroke and CI engines, CO and NOx emission, particulates, EGR, Introduction to emission control methods and catalytic converters.

TEXT BOOKS:

4. InternalCombustionEngines,V.Ganesan,3rd edition 2007TataMcGrawHill, New Delhi.
5. Internal Combustion Engines, R. K. Rajput , 2nd edition 2007Laxmi Publications, New Delhi.
6. Internal Combustion Engines, Sharma R.P. and Mathur M.L., 2010 Dhanpat rai Publications, New Delhi.

REFERENCE BOOKS:

5. Fundamentals of Internal Combustion Engines, W.W.Pulkrabek, 2nd edition 2000, Prentice Hall of India (P) Ltd., New Delhi.
6. Internal Combustion Engines and Air Pollution, E.F. Obert, Harperand Row, New York.
7. Internal Combustion Engines, Ferguson C. R, 2nd edition. 2000 Johnes Wiley and sons, New York.
8. Internal combustion engine fundamentals, John Heywood, 1st edition McGraw- Hill (1988) -USA.

ME361N- STRESS ANALYSIS (DHC-II)

Teaching Scheme:03 L**,Total:**03 **Credits:**03

Evaluation Scheme: 30 MSE + 10 ISA + 60 ESE **Total Marks:**100

Duration of ESE: 03Hrs**.**

COURSE DESCRIPTION

This course provides the analysis of stresses developed in structures and components and knowledge of Finite Element Analysis (FEA) for various practical applications (eg engineering components, composite structures, rotating disks, cracked geometries) in conjunction with relevant case studies will allow delegates to combine theoretical understanding with practical experience in order to develop their skills to model and analyse complex engineering problems.

DESIRABLE AWARENESS / SKILLS

Fundamental knowledge of Mathematics, Basic strength of materials, simple & complimentary stresses, various elastic constants, Basic knowledge of FEA.

COURSE OUTCOMES

On completion of this course the student shall be able to:

1. Develop a strong foundation on stress analysis and demonstrate the ability to analyze a range of structural problems.
2. Explain the fundamentals of Finite Element Analysis, be able to evaluate methodologies applied to the analysis of structural members (beams, plates, shells, struts), and critically evaluate the applicability and limitations of the methods and the ability to make use of original thought and judgment when approaching structural analysis.
3. Provide an in-depth explanation of current practice through case studies of engineering problems.
4. Use the most widely applied commercial finite element software package (ABAQUS).
5. Evaluate the importance of mesh sensitivity in finite element simulations.

RELEVANCE OF COURSE OUTCOMES (COs) WITH POs AND PSOs (WITH STRENGTH OF CO-RELATION)

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2								1			1	1	
2	2	1		1	1								1	1	
3	2	3	3										1	1	
4	1	1		1	1								1	1	
5	1	1		1									1	1	

1-Weakly correlated **2 – Moderately correlated** **3 – Strongly correlate**

COURSE CONTENT

Stress Analysis: **(8 Hrs)**

Introduction to stress analysis of components and structures, Ductile and brittle materials, Principle of complimentary stresses, Tensile data analysis, Material properties, Isotropic/kinematic hardening, Dynamic strain aging,

Complex stress and strain **(8 Hrs)**

Stress and strain transformation, Principal stresses, Maximum shear stress, Mohr's circle, Constitutive stress-strain equations, Fracture and yield criteria, Constraint and triaxiality effects, Plane stress and plane strain conditions,

Stresses in cylinder: **(8 Hrs)**

Thin walled theory, Thick walled cylinder theory (Lame Equations), Compound cylinders, Plastic deformation of cylinders, Initial difference in Radii at the junction of a compound cylinder for shrinkage, Expression for stresses in a rotating thin disc. Disc of uniform strength.

Beam structures : **(8 Hrs)**

Beam structures under static and dynamic loading, Stresses in simply supported beam with centre load and eccentric point load, Stress concentration in steel and composite plates, Stress and strain variation in a pressure vessel subjected to different loading conditions,

Finite Element Analysis: **(8 Hrs)**

Introduction to computational stress analysis, Introduction to FEA, Types of elements, Integration points, Meshing, Mesh convergence, Visualisation, Results interpretation,

TEXT BOOKS

7. Experimental Stress Analysis by UC Jindal. Pearson India Education Services Pvt. Ltd
8. *Experimental Stress Analysis* by Dr. Sadhu Singh. Khanna Publishers, New Delhi
9. Advanced Strength of Materials by J.P.Den Hartog. Dover Publications Inc.
10. Strength of Materials by Dr R K Bansal. Laxmi Publications P Ltd
11. Mechanics of Materials by Ferdinand Beer, Jr. Johnston. McGraw-Hill Education
12. Strength of Materials by R K Rajput. S Chand Publications

REFERENCE BOOKS

1. Practical Finite Element Analysis **by** Nitin S.Gokhale
2. Structural and Stress Analysis by T.H.G. Megson · 2019, Butterworth-Heinemann publication.
3. Experimental Stress Analysis by James W. Dally and William F. Riley