LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution)
DEPARTMENT OF MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS & EXAMINATIONS [LR-21]
(w.e.f. Academic Year 2021-22)

B.E. I-Semester

S. No.	Course Code	Category	Course Title	Scheme of Instruction				Scheme of Examination			Credits
				L	T	P/D	Contact Hours/Week	Maximum Marks CIE	Maximum Marks SEE	Duration in Hours	
MC: Three Week Induction Programme											
Theory Course											
1	U21EN102	MC	Indian Constitution	2	-	-	2	40	60	3	-
2	U21MA101	BSC	Mathematics-I	3	1	-	4	40	60	3	4
3	U21CH101	BSC	Engineering Chemistry	3	1	-	4	40	60	3	4
4	U21EE101	ESC	Basic Electrical Engineering	3	-	-	3	40	60	3	3
5	U21EN101	HSMC	English for Professional Communication	2	-	-	2	40	60	3	2
Practical/ Laboratory Course											
6	U21CH1L1	BSC	Engineering Chemistry Lab	-	-	3	3	25	50	3	1.5
7	U21EE1L1	ESC	Basic Electrical Engineering Lab	-	-	3	3	25	50	3	1.5
8	U21EN1L1	HSMC	Effective Communication Skills Lab	-	-	3	3	25	50	3	1.5
9	U21ME1L2	ESC	Engineering & IT Workshop	1	-	4	5	50	50	3	3
Total				**14**	**2**	**13**	**29**	**325**	**500**	**27**	**20.5**

L: Lecture (Hrs/Wk/Sem) **T**: Tutorial (Hrs/Wk/Sem) **P**: Practical **D**: Drawing (Hrs/Wk/Sem)

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination
BSC: Basic Science Course **ESC**: Engineering Science Course
HSMC: Humanities & Social Sciences Including Management Courses
MA: Mathematics **MC**: Mandatory Course
CH: Chemistry **ME**: Mechanical Engineering
EE: Electrical Engineering **EN:** English

Note:

1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

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B.E. II-Semester

S. No.	Course Code	Category	Course Title	Scheme of Instruction				Scheme of Examination			Credits
				L	T	P/D	Contact Hours/Week	Maximum Marks CIE	Maximum Marks SEE	Duration in Hours	
Theory Course											
1	U21CH201	MC	Environmental Science	2	-	-	2	40	60	3	-
2	U21EN201	MC	Essence of Indian Traditional Knowledge	2	-	-	2	40	60	3	-
3	U21MA201	BSC	Mathematics-II	3	1	-	4	40	60	3	4
4	U21PH201	BSC	Engineering Physics	3	1	-	4	40	60	3	4
5	U21CS201	ESC	Programming for Problem Solving	3	-	-	3	40	60	3	3
Practical/ Laboratory Course											
6	U21PH2L1	BSC	Engineering Physics Lab	-	-	3	3	25	50	3	1.5
7	U21CS2L1	ESC	Programming for Problem Solving Lab	-	-	4	4	25	50	3	2
8	U21ME2L1	ESC	Engineering Graphics & Design Practice	1	-	4	5	50	50	3	3
Total				**14**	**2**	**11**	**27**	**300**	**450**	**24**	**17.5**

L: Lecture(Hrs/Wk/Sem) **T**: Tutorial (Hrs/Wk/Sem) **P**: Practical **D**: Drawing (Hrs/Wk/Sem)

CIE: Continuous Internal Evaluation
BSC: Basic Science Courses
MC: Mandatory Course
EN: English
ME: Mechanical Engineering
PH: Physics

SEE: Semester End Examination
ESC: Engineering Science Courses
MA: Mathematics
CH: Chemistry
CS: Computer Science

Note:
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B.E. III-Semester

S. No.	Course Code	Category	Course Title	Scheme of Instruction				Scheme of Examination			Credits
				L	T	P/D	Contact Hours/ Week	Maximum Marks		Duration in Hours	
								CIE	SEE		
Theory Course											
1	U21MA302	BSC	Mathematics-III (PDE & PS)	3	1	-	4	40	60	3	4
2	U21ME301	ESC	Engineering Mechanics	3	-	-	3	40	60	3	3
3	U21EN301	HSMC	English for Technical Communication	2	-	-	2	40	60	3	2
4	U21ME302	PCC	Manufacturing Processes	3	-	-	3	40	60	3	3
5	U21ME303	PCC	Thermodynamics	3	-	-	3	40	60	3	3
Practical / Laboratory Course											
6	U21EN3L1	HSMC	Advanced Communication Skills Lab	-	-	3	3	25	50	3	1.5
7	U21ME3L1	PCC	Manufacturing Processes Lab	-	-	3	3	25	50	3	1.5
8	U21ME3L2	PCC	Machine Drawing and Modelling Lab	-	-	3	3	25	50	3	1.5
Skill Development Course											
9	U21CS3L1	ESC	Programming Language-I	-	-	2	2	25	50	3	1
Bridge Course*											
10	U21CS3L2	ESC	C Programming Lab	-	-	2	2	50	-	-	-
11	U21EN3L2	HMSC	Effective Communication Skills Lab	-	-	2	2	50	-	-	-
Total				**14**	**1**	**11 (*15)**	**26 (*30)**	**300 (*400)**	**500**	**27**	**20.5**

*** Bridge Course for Lateral Entry Students only.**

L: Lecture (Hrs/Wk/Sem) **T**: Tutorial (Hrs/Wk/Sem) **P**: Practical **D**: Drawing (Hrs/Wk/Sem)

CIE: Continuous Internal Evaluation
SEE: Semester End Examination
BSC: Basic Science Course
ESC: Engineering Science Course
MA: Mathematics
EN: English
PCC: Professional Core Courses
ME: Mechanical Engineering
CS: Computer Science
HSMC: Humanities & Social Sciences Including Management Courses

Note:

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2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

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(w.e.f. Academic Year 2022-23)

B.E. IV-Semester

S. No.	Course Code	Category	Course Title	Scheme of Instruction				Scheme of Examination			Credits
				L	T	P/D	Contact Hours/Week	Maximum Marks		Duration in Hours	
								CIE	SEE		
Theory Course											
1	U21MB401	HSMC	Business Economics and Financial Analysis	3	-	-	3	40	60	3	3
2	U21ME402	PCC	Metallurgy and Material Science	3	-	-	3	40	60	3	3
3	U21ME403	PCC	Mechanics of Solids	3	-	-	3	40	60	3	3
4	U21ME404	PCC	Applied Thermodynamics	3	-	-	3	40	60	3	3
5	U21ME405	PCC	Kinematics of Machines	3	1	-	4	40	60	3	4
Practical / Laboratory Course											
6	U21ME4L1	PCC	Metallurgy and Material Testing Lab	-	-	4	4	25	50	3	2
7	U21ME4L2	PCC	Thermal Engineering Lab	-	-	3	3	25	50	3	1.5
Skill Development Course											
8	U21CS4L3	ESC	Programming Language-II	-	-	2	2	25	50	3	1
Total				**15**	**1**	**9**	**25**	**275**	**450**	**24**	**20.5**

L: Lecture (Hrs/Wk/Sem) **T**: Tutorial (Hrs/Wk/Sem) **P**: Practical **D**: Drawing (Hrs/Wk/Sem)

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination
ESC: Engineering Science Courses **PCC:** Professional Core Courses
EN: English **ME**: Mechanical Engineering
HSMC: Humanities & Social Sciences Including Management Courses
CS: Computer Science **MB:** Management Studies

Note:

1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.
3. At the end of IV semester students should undergo summer Industrial Internship of two-week duration- Credits for Summer Internship will be awarded in V semester.

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SCHEME OF INSTRUCTIONS & EXAMINATIONS [LR-21]
(w.e.f. Academic Year 2023-24)
B.E. V-Semester

S. No.	Course Code	Category	Course Title	Scheme of Instruction				Scheme of Examination			Credits
				L	T	P/D	Contact Hours/Week	Maximum Marks		Duration in Hours	
								CIE	SEE		
Theory Course											
1	U21ME501	PCC	Mechanics of Fluids and Hydraulic Machinery	3	-	-	3	40	60	3	3
2	U21ME502	PCC	Dynamics of Machines	3	-	-	3	40	60	3	3
3	U21ME503	PCC	Design of Machine Elements-I	2	-	-	2	40	60	3	2
4	-	OEC	Open Elective Course -I	3	-	-	3	40	60	3	3
5	-	PEC	Professional Elective Course-I	3	-	-	3	40	60	3	3
Practical/ Laboratory Course											
6	U21ME5L1	PCC	Mechanics of Fluids and Hydraulic Machinery Lab	-	-	3	3	25	50	3	1.5
7	U21ME5L2	PCC	Dynamics of Machines Lab	-	-	3	3	25	50	3	1.5
Skill Development Course											
8	U21CS5L3	ESC	Java Programming Lab	-	-	3	3	25	50	3	1.5
Internship											
9	U21ME5P1	PROJ	Internship (During Vacations after IV Semester)	-	-	-	-	50	-	-	1
Total				**14**	**-**	**9**	**23**	**325**	**450**	**24**	**19.5**

L: Lecture (Hrs/Wk/Sem) **T**: Tutorial (Hrs/Wk/Sem) **P**: Practical **D**: Drawing (Hrs/Wk/Sem)

CIE: Continuous Internal Evaluation
ESC: Engineering Science Course
OEC: Open Elective Course
ME: Mechanical Engineering
CS: Computer Science
SEE: Semester End Examination
PCC: Professional Core Courses
PEC: Professional Elective Courses
PROJ: Project

Note:
1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

LORDS INSTITUTE OF ENGINEERING AND TECHNOLOGY
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SCHEME OF INSTRUCTIONS & EXAMINATIONS [LR-21]
(w.e.f. Academic Year 6-24)
B.E. VI-Semester

S. No.	Course Code	Category	Course Title	Scheme of Instruction				Scheme of Examination			Credits
				L	T	P/D	Contact Hours/Week	Maximum Marks CIE	Maximum Marks SEE	Duration in Hours	
Theory Course											
1	U21ME601	PCC	Metal Cutting and Machine Tools	2	-	-	2	40	60	3	2
2	U21ME602	PCC	Design of Machine Elements-II	3	-	-	3	40	60	3	3
3	U21ME603	PCC	Heat Transfer	3	-	-	3	40	60	3	3
4	U21ME604	PCC	CAD/ CAM/CAE	2	-	-	2	40	60	3	2
5	-	OEC	Open Elective Course-II	3	-	-	3	40	60	3	3
Practical/ Laboratory Course											
6	U21ME6L1	PCC	Metal Cutting and Machine Tools Lab	-	-	3	3	25	50	3	1.5
7	U21ME6L2	PCC	Heat Transfer Lab	-	-	3	3	25	50	3	1.5
8	U21ME6L3	PCC	CAD/CAM/CAE Lab	-	-	3	3	25	50	3	1.5
9	U21EN6L1	HSMC	Research Writing	-	-	2	2	50	-	-	1
Project											
10	U21ME6P1	PROJ	Mini Project	-	-	6	6	50	50	-	3
Total				**13**	**-**	**17**	**30**	**375**	**500**	**24**	**21.5**

L: Lecture (Hrs/Wk/Sem) **T**: Tutorial (Hrs/Wk/Sem) **P**: Practical **D**: Drawing (Hrs/Wk/Sem)

CIE: Continuous Internal Evaluation
SEE: Semester End Examination
PCC: Professional Core Courses
OEC: Open Elective Courses
EN: English
ME: Mechanical Engineering
HSMC: Humanities & Social Sciences Including Management Courses
PROJ: Project

Note:
1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.
3. At the end of VI semester students should undergo summer Industrial Internship of four-week duration- Credits for Summer Internship will be awarded in VII semester.

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SCHEME OF INSTRUCTIONS & EXAMINATIONS [LR-21]
(w.e.f. Academic Year 2024-25)
B.E. VII-Semester (Tentative)

S. No.	Course Code	Category	Course Title	Scheme of Instruction				Scheme of Examination			Credits
				L	T	P/D	Contact Hours/Week	Maximum Marks CIE	Maximum Marks SEE	Duration in Hours	
Theory Course											
1	U21ME701	PCC	Finite Element Techniques	3	-	-	3	40	60	3	3
2	U21ME702	PCC	Metrology and Instrumentation	2	-	-	2	40	60	3	2
3	U21ME703	PCC	Refrigeration and Air Conditioning	3	-	-	3	40	60	3	3
4	-	OEC	Open Elective Course-III	3	-	-	3	40	60	3	3
5	-	PEC	Professional Elective Course II	3	-	-	3	40	60	3	3
6	-	PEC	Professional Elective Course- III	3	-	-	3	40	60	3	3
Practical/ Laboratory Course											
7	U21ME7L1	PCC	Metrology and Instrumentation Lab	-	-	2	2	25	50	3	1
Seminar											
8	U21ME7P2	PROJ	Technical Seminar	-	-	2	2	50	-	-	1
Skill Development Course											
9	U21MA7L1	BSC	Aptitude and Reasoning	-	-	2	2	25	50	3	1
Internship											
10	U21ME7P1	PROJ	Internship (During Vacation after VI Semester)	-	-	-	-	50	-	-	1
Total				**17**	**0**	**6**	**23**	**390**	**460**	**24**	**21**

L: Lecture (Hrs/Wk/Sem) **T**: Tutorial (Hrs/Wk/Sem) **P**: Practical **D**: Drawing (Hrs/Wk/Sem)

CIE: Continuous Internal Evaluation
SEE: Semester End Examination
BSC: Basic Science Courses
PCC: Professional Core Courses
OEC: Open Elective Courses
PEC: Professional Elective Courses
PROJ: Project
MA: Mathematics
ME: Mechanical Engineering
MB: Management Studies
HSMC: Humanities & Social Sciences Including Management Courses

Note:
1. Each contact hour is a Clock Hour.
2. The duration of the practical class is three hours, however it can be extended wherever necessary, to enable the student to complete the experiment.

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SCHEME OF INSTRUCTIONS & EXAMINATIONS [LR-21]
(w.e.f. Academic Year 2024-25)
B.E. VIII-Semester (Tentative)

S. No.	Course Code	Category	Course Title	Scheme of Instruction				Scheme of Examination			CREDITS
				L	T	P/D	Contact Hours/Week	Maximum Marks		Duration in Hours	
								CIE	SEE		
Theory Course											
1	-	OEC	Open Elective Course IV	3	-	-	3	40	60	3	3
2	-	PEC	Professional Elective Course IV	3	-	-	3	40	60	3	3
3	-	PEC	Professional Elective Course V	3	-	-	3	40	60	3	3
Project											
4	U21ME8P1	PROJ	Comprehensive Viva	-	-	4	4	100	-	-	2
5	U21ME8P2	PROJ	Major Project	-	-	16	16	50	150	-	8
Total				**9**	**-**	**20**	**29**	**270**	**330**	**9**	**19**

L: Lecture (Hrs/Wk/Sem) **T**: Tutorial (Hrs/Wk/Sem) **P**: Practical **D**: Drawing (Hrs/Wk/Sem)

CIE: Continuous Internal Evaluation
SEE: Semester End Examination
OEC: Open Elective Courses
PEC: Professional Elective Courses
PROJ: Project
ME: Mechanical Engineering

Note:

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SCHEME OF INSTRUCTIONS & EXAMINATIONS [LR-21]
PROFESSIONAL ELECTIVE COURSES

S. No.	Course Code	Category	Course Title	Scheme of Instructions				Scheme of Examination			CREDITS
				L	T	P/D	Contact Hours/Week	Maximum Marks CIE	Maximum Marks SEE	Duration in Hours	
Theory Course											
1	U21ME504	PEC 1	Design for Manufacture	3	0	0	3	40	60	3	3
	U21ME505		Composite Materials	3	0	0	3	40	60	3	3
	U21ME506		Supply Chain Management	3	0	0	3	40	60	3	3
	U21ME507		Renewable Energy Recourses	3	0	0	3	40	60	3	3
2	U21ME704	PEC 2	Fatigue and Fracture Analysis	3	0	0	3	40	60	3	3
	U21ME705		Non-destructive Testing	3	0	0	3	40	60	3	3
	U21ME706		Production and Operations Management	3	0	0	3	40	60	3	3
	U21ME707		Heat Ventilation and Air conditioning	3	0	0	3	40	60	3	3
3	U21ME708	PEC 3	Mechanical Vibrations	3	0	0	3	40	60	3	3
	U21ME709		Un-Conventional Machining Processes	3	0	0	3	40	60	3	3
	U21ME710		Product Development and Process Planning	3	0	0	3	40	60	3	3
	U21ME711		Turbo Machines	3	0	0	3	40	60	3	3
4	U21ME801	PEC 4	Operations Research	3	0	0	3	40	60	3	3
	U21ME802		Additive Manufacturing Technology	3	0	0	3	40	60	3	3
	U21ME803		Quality and Reliability Engineering	3	0	0	3	40	60	3	3
	U21ME804		Wind Turbines Technology	3	0	0	3	40	60	3	3
5	U21ME805	PEC 5	Mechatronics	3	0	0	3	40	60	3	3
	U21ME806		Tribology	3	0	0	3	40	60	3	3
	U21ME807		Industrial automation	3	0	0	3	40	60	3	3
	U21ME808		Power Transmission Technologies in Electric Hybrid and Vehicle	3	0	0	3	40	60	3	3

PROFESSIONAL ELECTIVES WITH FOUR THREADS

Stream	**Professional Elective 1** **(Semester - V)**	**Professional Elective 2** **(Semester - VII)**	**Professional Elective 3** **(Semester - VII)**	**Professional Elective 4** **(Semester - VIII)**	**Professional Elective 5** **(Semester - VIII)**
Design Engineering	Composite Materials	Fatigue and Fracture Analysis	Mechanical Vibrations	Operations Research	Control Systems
Production Engineering	Design for Manufacture	Non-destructive Testing	Un-Conventional Machining Processes	Additive Manufacturing Technology	Tribology
Industrial Engineering	Supply Chain Management	Production and Operations Management	Product Development and Process Planning	Quality and Reliability Engineering	Automation in Robotics
Thermal Engineering	Renewable Energy Resources	Heat Ventilation and Air conditioning	Thermal Turbo Machines	Wind Turbines Technology	Power Transmission Technologies in Electric Hybrid and Vehicle

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SCHEME OF INSTRUCTIONS & EXAMINATIONS [LR-21]
OPEN ELECTIVE COURSES

S. No.	Course Code	Category	Course Title
1	U21EE508	OEC 1	Non-Conventional Energy Systems
	U21EE509		Energy Conservation and Management
	U21CS508		Fundamentals of Data Base Management Systems
	U21IT502		Data Structures
	U21CD603		Data Ethics
	U21ME509		Basics of Mechanical Engineering*
	U21ME510		Modern Manufacturing Processes*
	U21CE509		Disaster Preparedness and Management
	U21CE510		Green Building Technologies
	U21EC507		Principles of Electronic Communication
	U21EC508		Semi-Conductor Devices
	U21MB501		Business Communication
	U21MB502		Managerial Science and Theory
	U21SH501		History of Science & Technology

S. No.	Course Code	Category	Course Title
2	U21EE608	OEC 2	Fundamental of Power Electronics
	U21EE609		Electrical Installation and Safety
	U21CS607		Introduction to Programming in JAVA
	U21IT607		Introduction to Web Programming
	U21ME608		Basics Of 3-D Printing**
	U21ME609		Optimization Methods for Engineers**
	U21CE608		Construction Materials
	U21CE609		Road Safety Engineering
	U21EC607		Principles of Data Communication and Network
	U21EC608		Embedded Systems
	U21MB602		Total Quality Management
	U21MB603		Innovation Management
	U21SH601		Indian Music System
	U21SH602		Introduction to Art and Aesthetics

S. No.	Course Code	Category	Course Title
3	U21EE711	OEC 3	Introduction to Electrical Vehicles
	U21EE712		Design estimation and Costing of Electrical Systems
	U21CS711		Data Sciences
	U21IT705		Basics of Artificial Intelligence
	U21ME711		Renewable Energy Resources**
	U21ME712		Cooling of Electronic Components**
	U21CE711		Environmental Systems
	U21CE712		Urban Transportation System
	U21EC703		IOT and its protocols
	U21EC704		Television and Video Engineering
	U21MB702		Supply Chain Management
	U21MB703		Start Up Management
	U21SH701		Display Devices
	U21SH702		Comparative Study of Literature

S. No.	Course Code	Category	Course Title
4	U21EE804	OEC 4	Smart Building Systems
	U21EE805		Industrial Automation
	U21CS806		Basics of Machine Learning
	U21IT802		Cloud computing
	U21ME806		Automobile Engineering**
	U21ME807		Power Plant Engineering**
	U21CE806		Sustainable Water and Sanitation System
	U21CE807		Environmental Impact Assessment
	U21EC805		Fundamentals of Wireless Communication
	U21EC806		Fundamental Digital Design using Verilog HDL
	U21MB802		Entrepreneurship
	U21MB803		Digital Marketing
	U21SH801		Corrosion Science and Technology
	U21SH802		Introduction To Philosophical Thoughts

Note: **Subject is not offered to the students of Mechanical Engineering Department.

Course Code	Course Title						Core/Elective
U21ME501	**Mechanics of Fluids and Hydraulic Machinery**						**Core**
Pre requisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Mathematics & Engineering Mechanics	**3**	**-**	**-**	**-**	**40**	**60**	**3**

Course Objectives

The objective of the course is to:

1. Know various fluid properties, concepts and methods of fluid measurement.
2. Understand the basic concepts and principle of fluid flow.
3. Study different equations of fluid motion and fluid dynamics.
4. Analyze different flow characteristics of laminar flows.
5. Understand the working principle of hydraulic turbines and pumps and their performance**.**

Course Outcomes

After completing the course, the student will be able to:

1. Distinguish the properties of the fluids and different types of pressure and measure them.
2. Explain different types of flows and analyze them.
3. Analyze the flow between parallel plates and in pipes and also calculate drag and lift coefficients.
4. Demonstrate the working principles of various hydraulic turbines and estimate their performance.
5. Demonstrate the working principles of various hydraulic pumps and estimate their performance.

UNIT–I

Basic Concepts and Properties of Fluid : Definition, distinction between solid and fluid, , Properties of fluids, density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension, units and dimensions.

Fluid statics: Concept of fluid static pressure, absolute and gauge pressures, pressure measurements by manometers and pressure gauges.

UNIT-II

Fluid Kinematics: Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform & non-uniform, laminar & turbulent, rotational &irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows.

Fluid Dynamics: Equations of motion, Euler's equation along a streamline, Bernoulli's equation, applications. Venturi meter, Orifice meter, Pitot tube.

UNIT-III

Flow through pipes: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.
Basics of turbo machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

UNIT-IV

Hydraulic Turbines: Definitions and Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube theory- functions and efficiency.

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT-V

Hydraulic Pumps: Definition and classifications, Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves. **Reciprocating pump:** classification, working principles, indicator diagram, performance curves, cavitation in pumps.

Suggested Readings:

1. Fluid Mechanics and Hydraulics Machine, Bansal, R.K.,, Laxmi publications(P) Ltd.Delhi (5^{th} edition),1995.
2. Hydraulic and Fluid Mechanics, Modi & Seth –standard book house, 2002.
3. Fluid Mechanics and Fluid Power Engineering, Kumar D.S., S.K. Kataria &Sons.
4. Introduction to fluid mechanics and fluid machines, Som, S.K.,and Biswas,G., Tata Mc Graw-Hill, ^{2nd} edition,2004.
5. Fluid Mechanics, White, F.M., Tata Mc Graw-Hill, 5^{th} Edition, New Delhi, 2003.

Course Code	Course Title						Core / Elective
U21ME502	Dynamics of Machines						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Mechanics of Solids	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Introduce some of the components mainly used in IC Engines and make analysis of various forces involved. Understand the gyroscopic couple and its effect on vehicles in motion.
2. Know the working principles and characteristics of typical governors, as also the function of flywheels.
3. Compute frictional torque in clutches and understand the working of brakes and dynamometers.
4. Know the concept of unbalancing rotating and reciprocating masses in single and multi-cylinder in line and radial engines and understand the phenomena of free vibration, including the effect of damping for single, DOF systems.
5. Determine natural frequencies of undammed, damped and forced vibrating systems of one, two and freedom systems.

Course Outcomes:

After completing the course, the student will be able to:

1. Analyse static and dynamic forces in slider crank and other mechanisms; determine the magnitude of gyroscopic couple and its effect on vehicles in motion
2. Evaluate the performance of various types of governors and design flywheels considering speed and energy fluctuation.
3. Determine frictional torque in clutches and understand the working of brakes and dynamometers.
4. Analyse problems of balancing in rotating and reciprocating machinery.
5. Evaluate the natural frequencies of single and two degree of freedom systems in free and forced vibration mode, also considering the effect of damping

Unit-I

Static and Dynamic Force Analysis: Static force analysis of planar mechanisms – Analytical Method Dynamic Force Analysis – D'Alembert's principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism.

Precession: Gyroscopes, effect of precession, motion on the stability of moving vehicles such as motor car, motor cycle, aeroplanes and ships.

Unit-II

Governors: Working principle of governor, Classification & types of governors, analysis of Watt, Porter, Proell and Hartnell governors. Characteristics of governors: Controlling Force, Stability, Isochronism, Sensitivity, Power and Effort of governors.

Turning Moment Diagram and Flywheels: Engine Force Analysis – Piston Effort, Crank Effort, etc, Turning moment diagram –fluctuation of energy – flywheels and their design – crank effort and torque diagrams.

Unit-III

Friction: pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches – Types – Single plate, multi-plate and cone clutches

Brakes and Dynamometers: Simple block brakes, internal expanding brake, band brake of vehicle, Dynamometers – absorption and transmission types.

Unit-IV

Balancing Rotating Masses: Static balancing, dynamic balancing, balancing of several masses rotating in several planes,

Balancing of Reciprocating Masses: primary balancing shaking forces in single cylinder engine, partial balancing and its effects, secondary balancing, Balancing of locomotives, hammer blow, variation of traction effort and swaying couple

Unit-V

Vibrations: Vibrations of Single degree freedom system (axial, transverse and torsional), Whirling speed of shafts.

Damped Vibrations: Types of damping, Vibrations with viscous damping, damping factor and logarithmic decrement.

Torsional Vibrations: Two rotor, three rotor system, Natural frequencies of two degree freedom systems, Modes of vibration approximate methods for determining natural frequencies: Dunkerley's method, Rayleigh's method.

Suggested Readings:

1. Theory of Machines, S.S. Rattan, Tata McGraw-Hill, 3rdEdition, 2009.
2. Theory of machines and Mechanisms, J. E. Shigley, McGraw Hill Publications, 2005.
3. Theory of Machines and Mechanisms- Rao & Dukkipati (Wiley)
4. The Theory of Machines, Thomas Bevan, CBS Publishers & Distributors, 2004.
5. Theory and Practice of Mechanical Vibrations, J.S. Rao and Gupta, Prentice Hall, 1984

Course Code	Course Title						Core / Elective
U21ME503	Design of Machine Elements -I						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Mechanics of Solids	2	-	-	-	40	60	2

Course Objectives:

The objective of the course is to:

1. Understand the various steps involved in the Design Process.
2. Explain the principles involved in design of machine elements, subjected to different kinds of forces, from the considerations of strength, rigidity, functional and manufacturing requirements.
3. Understand and interpret different failure modes and application of appropriate criteria for design of machine elements.
4. Learn to use national and international standards, standard practices, standard data, catalogs, and standard components used in design of machine elements.
5. Develop the capability to design elements like shafts, couplings, welded joints, screwed joints, and power screws.

Course Outcomes:

After completing the course, the student will be able to:

1. Apply the fundamentals of design of machine elements, and behavior of members subjected to various types of complex loads, and criteria of failure to satisfy the applications
2. Identify the principles involved in evaluating the shape and dimensions of a component, when subjected to various types of fatigue loading, and methods to reduce the stress concentration and
3. Design the shafts used in various industrial applications.
4. Map out and design the different Couplings used in different industrial applications.
5. Design the machine components joined by Riveted, Welded and bolted joints, and to analyze the different ways in which riveted and welded joints can fail.

UNIT-I

Introduction: Design Process, definition of design, phases of design, and review of engineering materials and their properties and manufacturing processes; use of codes and standards, selection of preferred sizes. Review of axial, bending, shear and torsion loading on machine components, combined loading, two- and three dimensional stresses, principal stresses, stress tensors.

Design for static strength: Factor of safety and service factor. Failure mode: definition and types. , Failure of brittle and ductile materials; even and uneven materials; Theories of failure- maximum normal stress theory, maximum shear stress theory, distortion energy theory, strain energy theory

UNIT-II

Fatigue loading: Introduction to fatigue failure, Mechanism of fatigue failure, types of fatigue loading,S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit. Modifying factors: size effect, surface effect,

Stress concentration effects, Notch sensitivity, Soderberg and Goodman relationships, stresses due to combined loading, cumulative fatigue damage, and Miner's equation.

UNIT-III

Design of shafts: Torsion of shafts, solid and hollow shaft design with steady loading based on strength and rigidity, ASME and BIS codes for power transmission shafting, design of shafts subjected to combined bending, torsion and axial loading. Design of shafts subjected to fluctuating loads

Design of keys and couplings :Keys: Types of keys and their applications, design considerations in parallel and tapered sunk keys, Design of square and rectangular sunk keys. Couplings: Rigid and flexible coupling-types and applications, design of Flange coupling, and Bush and Pin type coupling.

UNIT-IV

Design of Permanent Joints: Types of permanent joints-Riveted and Welded Joints.

Riveted joints: Types of rivets, rivet materials, Caulking and fullering, analysis of riveted joints, joint efficiency, failures of riveted joints, boiler joints, riveted brackets.

Welded joints: Types, strength of butt and fillet welds, eccentrically loaded welded joints

UNIT-V

Design of Temporary Joints: Types of temporary joints- cotter joints, knuckle joint and fasteners. Design of Cotter and Knuckle Joint.

Threaded Fasteners: Stresses in threaded fasteners, effect of initial tension, design of threaded fasteners under static, dynamic and impact loads, design of eccentrically loaded bolted joints

Suggested Readings :

1. Design of Machine Elements, V. B. Bhandari, Tata McGraw-Hill Publ, 3rd Edn. 2010.
2. Mechanical Engineering Design, J.E. Shigley & Charles R. Mischke Tata McGraw-Hill.,6th ed.2010.
3. Machine Design, P. Kannaiah, Sci-Tech Publ., 2009.
4. Machine Design, P.C. Sharma & D.K. Aggarwal, S.K. Kataria & Sons, 10th edn, 2003
5. Design Data Book, 2nd edition", V. B. Bhandari, Tata McGraw-Hill Publ, 2019

Course Code	Course Title						Core / Elective
U21ME504	Design for Manufacture						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Manufacturing Processes	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Identify the manufacturing constraints that influence the design of parts and part systems.
2. Introduced to the Design for Manufacturability (DFM) methodology, and will be motivated to understand infeasible or impractical designs.
3. Expose product specification and standardization, Methods of material, shape and process selections.
4. Design rules for manufacturing and assembly processes, Design for quality and reliability, Approach towards robust design.
5. Design for optimization, Case studies on design for manufacturing and assembly.

Course Outcomes:

After completing the course, the student will be able to:

1. Outline the appropriate design for economical production and select the materials.
2. Select between various machining and metal joining processes.
3. Apply a systematic understanding of knowledge in the field of metal casting and forging.
4. Fabricate basic parts and assemblies using powered and non – powered machine shop equipment in conjunction with mechanical documentation.
5. Integrate the knowledge of compliance analysis and interference analysis for assembly and also use visco-elastic and creep in plastics.

Unit-I

Introduction: Design philosophy, steps in design process, general design rules for manufacturability, basic principles of designing for economical production, creativity in design, application of linear & non-linear optimization techniques. **Materials:** Selection of materials for design – developments in material technology – criteria for material selection – material selection interrelationship with process selection – process selection charts.

Unit-II

Machining process: Overview of various machining processes, general design rules for machining, dimensional tolerance and surface roughness, design for machining ease, redesigning of components for machining ease with suitable examples, general design recommendations for machined parts.

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines – pre and post treatment of welds – effects of thermal stresses in weld joints – design of brazed joints.

Unit-III

Metal casting: Appraisal of various casting processes, selection of casting process, general design considerations for casting, casting tolerances, use of solidification simulation in casting design, product design rules for sand casting. Forging: Design factors for forging, closed die forging design, parting lines of dies, drop forging die design, general design recommendations.

Unit-IV

Extrusion and sheet metal work: Design guidelines for extruded sections, design principles for punching, blanking, bending, and deep drawing, Keeler Goodman forming line diagram, component design for blanking.

Unit-V

Assembled parts design: bolted connections, welded parts, arc, resistance , brazed and soldered parts, gear box assembly, bearing assembly, flanged connections, press fitted connections, surface finishing, plated parts, Heat treated parts, NC machining , Group technology, low cost automation, computer aided manufacture, product design requirements.

Suggested Readings:

1. Product Design for Manufacture and Assembly by Geoffrey Boothroyd, CNC Press, 2010.
2. Hand book of product design for manufacturing by James G.Bralla, MC Graw Hill Co., 1986.
3. Design for Manufacturability Handbook, McGraw-Hill Handbooks,1998.
4. Knowledge based design for manufacture by K.G. Swift, Kogan page limited, 1987.

Course Code	Course Title						Core / Elective
U21ME505	Composite Materials						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Metallurgy and Material Science	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Discuss the basic structure of composites
2. Define Elastic constants and Hygro-thermal stresses
3. Identify stress-strain relations in composites
4. Describe the behavior and Design with composites
5. Demonstrate the basic equations of plate bending

Course Outcomes:

After completing the course, the student will be able to:

1. Demonstrate knowledge of composites and their structure
2. Predict the Elastic constants and Hygrothermal stresses
3. Analyse the stress - strain relationship in composites
4. Summarise and apply the Design procedure and the failure criteria.
5. Formulate Plate bending equations for various Boundary conditions of composite plates.

Unit-I

Introduction: Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composite, carbon fibre composites.

Unit-II:

Micromechanics of Composites: Mechanical Properties: Prediction of Elastic constant, micromechanical approach, Halpin-Tsai equations, Transverse stresses. Thermal properties: Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

Unit-III

Macromechanics of Composites: Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams.

Unit-IV

Strength, fracture, fatigue and design: Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: Single and multiple fracture, de-bonding, fibre pullout and de- lamination failure, fatigue of laminate composites, Effect of variability of fibre strength. Strength of an orthotropic lamina: Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials.

Unit-V

Analysis of plates and stress: Plate equilibrium equations, Bending of composite plates, Levy and Navier solution for plates of composite material. Analysis of composite For the academic years 2020-2024 114 cylindrical shells under axially symmetric loads.

Suggested Readings :

1. Mechanics of Composite Materials, Jones, R.M., Mc-Graw Hill Co., 1967.
2. The Analysis of Laminated Composite Structures, Calcote, L.R., Van Nostrand, 1969.
3. Experimental Mechanics of Fibre Reinforced Composite Materials‘,Whitney. I.M., Daniel, R.B. Pipes, Prentice Hall, 1984.
4. Stress Analysis of Fibre-Reinforced Composite Materials‘,Hyer. M.W., McGraw Hill Co., 1998.
5. Principles of Composite Material Mechanics, Ronald Gibson, TMH, 1994.

Course Code	Course Title						Core / Elective
U21ME506	Supply Chain Management						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Business Economics and Financial Analysis	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Acquaint with key drivers of supply chain performance and their inter-relationships with strategy.
2. Impart analytical and problem-solving skills necessary to develop solutions for a variety of supply chain management & design problems.
3. Study the complexity of inter-firm and intra-firm coordination in implementing programs such as E-collaboration, quick response, jointly managed inventories and strategic alliances.

Course Outcomes:

After completing the course, the student will be able to:

1. Relate competitive and supply chain strategies.
2. Identify drivers of supply chain performance.
3. Analyze factors influencing network design.
4. Analyze the influence of forecasting in a supply chain.
5. Summarize different Safety Inventory measures, emerging trends and impact of IT on Supply chain.

Unit-I

Strategic Framework: Introduction to Supply Chain Management, Decision phases in a supply chain, Process views of a supply chain: push/pull and cycle views, Achieving Strategic fit, Expanding strategic scope.

Supply Chain Drivers and Metrics: Drivers of supply chain performance, Framework for structuring Drivers, Obstacles to achieving strategic fit.

Unit-II

Designing Supply Chain Network: Factors influencing Distribution Network Design, Design options for a Distribution network, E-Business and Distribution network, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.

Unit-III

Forecasting in SC: Role of forecasting in a supply chain, Components of a forecast and forecasting methods, Risk management in forecasting.

Unit-IV

Aggregate Planning and Inventories in SC: Aggregate planning problem in SC, Aggregate Planning Strategies, Planning Supply and Demand in a SC.

Managing uncertainty in a SC: Safety Inventory.

Unit-V

Current Trends: Supply Chain Integration - Building partnership and trust in Supply chain Value of Information: Bullwhip Effect - Effective forecasting - Coordinating the supply chain. Supply Chain restructuring, Supply Chain Mapping - Supply Chain process restructuring, Postpone the point of differentiation – IT in Supply Chain - Agile Supply Chains -Reverse Supply chain. Future of IT in supply chain- E-Business in supply chain.

Suggested Readings:

1. Supply Chain Management - Strategy, Planning and Operation, Sunil Chopra and Peter Meindl, 6th Edition, Pearson Education Asia, 2016.
2. Supply Chain Metrics That Matter, Lora M. Cecere, Wiley, First Edition, 2015.
3. Designing and Managing the Supply Chain - Concepts Strategies and Case Studies, David Simchi-Levi, Philp Kamintry and Edith Simchy Levy, 3rd Edition, TMH, 2008.
4. Modeling the Supply Chain, Shapiro Jeremy F, Thomson Learning, Second Reprint, 2002.

Course Code	Course Title						Core / Elective
U21ME507	Renewable Energy Resources						Elective
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
Basic Electrical Engineering	L	T	D	P			
	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Understand the concept of various forms of Renewable energy resources and Non-Renewable energy resources.
2. Outline division aspects and utilization of renewable energy sources for both domestics and industrial applications.
3. Identify Wind energy as alternate form of energy and to know how it can be tapped
4. Make the students understand the advantages and disadvantages of different renewable energy resources
5. Know the concepts of thermo and bio-chemical process along with novel technologies to conversion of biomass to Bio fuel.

Course Outcomes:

After completing the course, the student will be able to:

1. Summarize the renewable and non-renewable sources of energy
2. Acquire the knowledge of various components, principle of operation and present scenario of different conventional and non-conventional sources.
3. Explain the use of solar energy and the various components used in the energy production with respect to applications
4. Design wind turbine blades and know about applications of wind energy for water pumping and electricity generation
5. Relate the concept of Biomass energy resources and their classification, types of biogas Plants-applications and summarize the knowledge of Ocean energy, tidal energy, and geothermal energy.

Unit-I

Introduction: Classification of Energy Resources, Conventional Energy Resources, Non-Conventional Energy Resources, Alternative Energy Resources, World energy status, Current energy scenario in India, Environmental aspects of energy utilization, Energy and sustainable development. Energy policies in India

Unit-II

Solar energy: solar energy basic concepts, Solar cells, Solar collectors, Solar Thermal Applications-Heating, Cooling, Distillation, Desalination, Drying, Cooking, Solar pumping, Solar photo voltaic systems. Solar PV Applications, Government schemes and policies.

Unit-III

Wind energy: Principles of wind energy conversion systems - Nature of wind - Power in the Wind-Basic components of WECS -Classification of WECS -Site selection considerations - Advantages and disadvantages of WECS -Wind energy collectors -Wind electric generating and control systems - Applications of Wind energy -Environmental aspects.

UNIT-IV

Energy from the Oceans: Ocean Thermal Electric Conversion (OTEC) methods - Principles of tidal power generation -Advantages and limitations of tidal power generation -Ocean waves - Wave energy conversion devices -Advantages and disadvantages of wave energy - Geo-thermal Energy - Types of Geo-thermal Energy Systems - Applications of Geo-thermal Energy.

Unit-V

Energy from Biomass: Biomass conversion technologies / processes - Photosynthesis - Photosynthetic efficiency - Biogas generation - Selection of site for Biogas plant - Classification of Biogas plants - Details of commonly used Biogas plants in India - Advantages and disadvantages of Biogas generation - Thermal gasification of biomass -Biomass gasifiers. Bio fuels- Bioethanol, Biobutanol, Biodiesel production

Suggested Readings:

1. Non-Conventional Sources of Energy, Rai G.D, Khandala Publishers, New Delhi, 1999.
2. Power Plant Technology, M.M.El-Wakil, McGraw Hill, 1984.
3. Solar Energy, Sukhatme S.P., Tata McGraw Hill, 1984
4. Renewable Energy Engineering and Technology, Kishore V V N, Teri Press, New Delhi,2012.
5. Wind Energy Conversion Systems, Freris. L.L., Prentice Hall, UK, 1990.

Course Code	Course Title						Core/Elective
U21ME5L1	**Mechanics of Fluids and Hydraulic Machinery Lab**						**Core**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Material Testing Lab	-	-	-	3	25	50	1.5

Course Objectives

The objective of the course is to:

1. Understand the working of pumps of different kinds and their behaviour.
2. Understand the concept of different kinds of turbines and their behaviour.
3. Gain theory knowledge of working of various flow measuring devices and their utility in industry.

Course Outcomes

After completing this course, the student will be able to:

1. Practice and experiment on different types of turbines.
2. Analyze the performance of turbines at rated and off design conditions.
3. Investigate through experimentation different types of pump models and estimate their performance.
4. Apply the principle of different flow measuring instruments and their adoptability to the industry.
5. Develop the hydraulic circuits to cater the needs of the industry.

List of Experiments:

1. Verification of Bernoulli's Theorems.
2. To determine coefficient of discharge of venturi meter
3. To determine coefficient of discharge of orifice meter
4. Determination of friction factor for a given pipe line.
5. Impact of Jets on Vanes
6. Performance and characteristic curves of Reciprocating pump
7. Performance and characteristic curves of Single Stage Centrifugal Pump.
8. Performance Test on Multi Stage Centrifugal Pump.
9. Performance and characteristic curves of Pelton Wheel
10. Performance and characteristic curves of Francis Turbine
11. Performance and characteristic curves of Kaplan Turbine

Note: At least 10 experiments must be conducted in the semester.

Course Code	Course Title						Core / Elective
U21ME5L2	Dynamics of Machines Lab						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Material Testing	-	-	-	3	25	50	1.5

Course Objectives:

The objective of the course is to:

1. Understand the effects and importance of kinematic and dynamic analysis of mechanisms.
2. Study the gyroscope, governors and cams.
3. Understand static and dynamic balance.
4. Understand effects and analysis of Single degree freedom vibration systems.

Course Outcomes:

After completing the course, the student will be able to:

1. Estimate the Gyroscopic couple and its effect on a Precessing rotating member.
2. Evaluate performance characteristics of centrifugal governors.
3. Determine the magnitude, location and orientation of a balancing mass required to balance the unbalance rotating system and verify the static and dynamic balancing.
4. Analyze the cam profile for motion characteristics.
5. Determine the time period and natural frequencies of simple and compound pendulum.

List of Experiments:

1. To determine time period and natural frequency of a simple pendulum.
2. To determine time period and natural frequency of a compound pendulum.
3. Undamped torsional vibrations of single and double rotor system.
4. Free vibration of simply supported cantilever beam.
5. Damped and undamped torsional vibrations of single rotor system.
6. Find the motion of the follower for the given profile of the cam.
7. To Study the gyroscopic effects and estimation of gyroscopic couple on a rotating disc.
8. To Study the controlling force curves on Watt governor.
9. To determine the effect of varying mass on the centre of sleeve in porter governor.

10. To determine time period, amplitude and frequency of undamped free longitudinal vibration of single degree spring mass systems.
11. The balance masses statically and dynamically for single rotating mass systems.
12. To determine the critical speed of a given shaft for different n-conditions.
13. Dunkerley Method to Find Fundamental Frequencies.

Note: At least 10 experiments must be conducted in the semester.

Course Code	**Course Title**						Core/Elective
U21CS5L5	**JAVA PROGRAMMING LAB**						**SD**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
		-	**-**	**3**	**25**	**50**	**1.5**

Course Objectives:

The objectives of this course are:

1. Build software development skills using java programming for real world applications.
2. Create Java application programs using sound OOP Practices such as interface ,exception handling ,multithreading
3. Understand fundamentals of Object Oriented programming in Java
4. Implement classical problems using java programming
5. Implement fronted and backed of applications

Course Outcomes:

1. At the end of the course, the students will be able to:
2. Develop java application using the concept of Inheritance, Interface, packages, access control specifies
3. Implement the concept of Exception Handling I Java Application
4. Read and Write data using different Java I/O stream
5. Create graphical user interfaces ad Applets by applying the knowledge of Event Handling
6. Create roust application using Java standard class libraries and retrieve data from database with JDBC

List of Experiments

1) Write a Java program to illustrate the concept of
   a) Command line arguments
   b) Type Casting
2) Illustrate the working of Scanner
   a) Write a java program to print prime numbers using Scanner
   b) Write a java program to check whether the number is Armstrong or not using Scanner
3) Write a java program to accept two arrays and find the sum of corresponding elements using Buffered Reader.
4) Write a java program to create user defined package.
5) Demonstrate how to implement polymorphism concept
   a) Write a Java program to illustrate the polymorphism concept with method overloading
   b) Write a Java program to illustrate the polymorphism concept with method overriding

6) Write a Java Program that reads a line of integers, and then displays each integer, and the sum of all the integers.
7) Write a Java program to illustrate the concept of Single level and Multi level Inheritance.
8) a) Write a java program to demonstrate Abstract class
   b) Write a Java program to demonstrate the Interface
9) Write a Java program to implement the concept of exception handling.(try, catch, throw, throws and finally)
10) Write a java program to implement thread concept
   a) create thread using Thread class
   b) create thread using Runnable interface
11) Write a Java program that reads a file name from the user, and then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes.
12) a) Write a java program to create a simple JList
   b) Write a java program to create simple check box using JCheckBox.
13) a) Write an applet program that displays a simple message.
   b) Write a Java program compute factorial value using Applet.
   c) Write a program for passing parameters using Applet.
14) a) Write a java program that connects to a database using JDBC
   b) Write a java program to connect to database using JDBC &insert values into table
   c) Write a java program to connect to a database using JDBC and delete values from table.
15) Write a java program that works as a simple calculator. Use a Grid Layout to arrange buttons for digits and for the + - * % operations. Add a text field to display the result.

<table>
<tr><th>Course Code</th><th colspan="6">Course Title</th><th>Core / Elective</th></tr>
<tr><td>U21ME5P1</td><td colspan="6">Internship</td><td>Core</td></tr>
<tr><td rowspan="2">Prerequisite</td><td colspan="4">Contact Hours Per Week</td><td rowspan="2">CIE</td><td rowspan="2">SEE</td><td rowspan="2">Credits</td></tr>
<tr><td rowspan="2">-</td><td>L</td><td>T</td><td>D</td><td>P</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>50</td><td>-</td><td>1</td></tr>
</table>

Course Objectives:

The objective of the course is to:

1. Produce an accurate record of work performed during the Internship/Co-op
2. Apply engineering knowledge to a problem in industry
3. Produce a technical report
4. Discuss work in a team environment, if relevant to the project
5. Conduct herself/himself responsibly, safely, and ethically in a professional environment

Course Outcomes:

After completing the course, the student will be able to:

1. Design/develop a small and simple product in hardware or software.
2. Complete the task or realize a pre specified target, with limited scope, rather than taking up a complex task and leave it.
3. Learn to find alternate viable solutions for a given problem.
4. Evaluate these alternatives with reference to pre specified criteria.
5. Implement the selected solution and document the same.

Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch upto five students will be attached to a person from the Government or Private Organizations/Computer Industry/Software Companies/R&D Organization for a period of 4 weeks. This will be during the summer vacation following the completion of the II-year Course. One faculty coordinator will also be attached to the group of 3 students to monitor the progress and to interact with the industry co- ordinate (person from industry). The course schedule will depend on the specific internship/training experience. The typical time per topic will vary depending on the internship

1. Overview of company/project, its vision and missions.
2. Safety training and disaster management.
3. Discussions with project teams
4. Background research, review of documents, scientific papers and its implementation.
5. Planning, designing, and reviewing the planned work

6. Executing the plans
7. Documenting progress, experiments, and other technical documentation
8. Further team discussions to discuss results
9. Final report writing and presentation

After the completion of the project, each student will be required to:
1. Submit a brief technical report on the project executed and
2. Present the work through a seminar talk (to be organized by the Department)

Note: Students have to undergo summer internship of 4 weeks at the end of semester IV and credits will be awarded after evaluation in V semester.

Course Code	Course Title						Core / Elective
U21ME601	Metal Cutting and Machine Tools						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Metallurgy and Material Science	2	-	-	-	40	60	2

Course Objectives:

The objective of the course is to:

1. Learn the geometry and mechanics of metal cutting for turning, drilling milling and tool materials.
2. Understand the heat distribution, tool wear and tool life.
3. Know the various machining processes such as lathe, drilling, milling, boring, broaching, grinding etc.
4. Know various types of work and tool holding devices for conventional machining.
5. Understand the basics of Unconventional Machining processes.

Course Outcomes:

After completing the course, the student will be able to:

1. Develop the relations for shear angle, shear strain, forces and temperatures associated with orthogonal cutting.
2. Select the cutting fluids, tool materials and coatings to control the tool wear and temperature.
3. Evaluate the tool life and economics of machining for maximum production and minimum cost.
4. Select the appropriate machine tool and tool & work holding devices for machining of components.
5. Illustrate the various finishing techniques and unconventional machining processes.

Unit-I

Basic chip formation process. Tool geometry: Nomenclature of single point cutting tool by ASA,ORS and NRS. Geometry of drills, Milling cutters and broaches. Recommended Tool angles. Chip formation: Types of chips, BUE, Chip breakers. Machining: Orthogonal and oblique cutting, Mechanics of Orthogonal Cutting: Merchant‟s analysis, Friction. Shear angle: Shear angle Solutions of Merchant and Lee & Shafer. Cutting tool materials: High carbon steel, HSS, Carbides, Ceramics, Coated carbides, Cermets, HPC, cBN & Diamond.

Unit-II

Measurement of Cutting Forces: Lathe tool dynamometers, Drilling, Milling and Grinding Dynamometers. Thermal aspects of metal cutting: Sources of heat and heat distribution, various methods of measurement of temperature, Cutting fluids and applications. Tool wear, Tool life & Machinability : Types of wear, mechanism of tool wear, Tool life & Machinability . Effects of process parameters on Tool life, Taylor's tool life equation. Economics of machining: Tool life for maximum production, minimum cost.

Unit-III

Constructional features and specifications of machine tools: Various operations on Lathe, Types of

Lathes and special attachments on a Centre Lathe. Drilling, Milling operations. Indexing methods. Shaper, planer and slotter and their differences. Quick return mechanisms, Automatic feed devices. Jig Boring machines- Differences between horizontal and vertical jig boring machines. Principles of Broaching.

UNIT-IV

Abrasive Processes: Grinding machines. Types of grinding, Abrasives and bonds used for grinding wheels. Specification and selection of wheels. Lapping, Honing, Polishing, Buffing, Super finishing and burnishing. Screws and gear manufacturing: Screw making by tapping, Chasers, Thread rolling, Thread milling, Thread grinding. Gear shaping, Gear hobbing, Gear shaving and grinding.

Unit-V

Jigs and Fixtures: Design principles for location and clamping. Tool holding and work holding devices. Quick clamping devices. Types of Jigs and fixtures. Unconventional machining: Principles of working and applications of USM, AJM, WJM, EDM, ECM,LBM , EBM and PAM.

Suggested Readings:

1. Metal Cutting Theory and Practice, A. Bhattacharyya, New Central Book Agency (P) Ltd., 2006.
2. Fundamentals of Metal Machining and Machine Tools / Geoffrey Boothroyd / McGraw Hill.
3. Manufacturing Technology – Metal Culling & Machine Tools", P.N. Rao,Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
4. Machine Tool Practices/ Kibbe, Johne. Neely, T. White, Rolando O. Meyer/ Pearson
5. Manufacturing Science, Amitabha Ghosh and Ashok Kumar Mallik, Affiliated East-West Press Pvt. Ltd., 2nd Edition, 2010.

Course Code	Course Title						Core / Elective
U21ME602	Design of Machine Elements-II						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Design of Machine Elements-I	3	-	-	-	40	60	3

Course Objectives:

The objective of the course is to:

1. Understand various elements involved in a mechanical system.
2. Analyze various forces acting on the elements of a mechanical system and design them using appropriate techniques, codes, and standards
3. Select transmission elements like gears, belts, pulleys, bearings from the manufacturers' catalogue
4. Design a mechanical system integrating machine elements
5. Produce assembly and working drawings of various mechanical systems involving machine elements like belts, pulleys, gears, springs, bearings

Course Outcomes:

After completing the course, the student will be able to:

1. Demonstrate the design, development and use of Different types of Springs and apply design principles for the design of mechanical systems involving belts, pulleys, and wire rope.
2. Apply design concepts of hydrodynamic bearings for different applications and select anti friction bearings for different applications using the manufacturers, catalogue
3. Apply the knowledge of design, selection of material, shape and standard parameters of fins for piston, to withstand the buckling, tension and compressive loads for piston and connecting rod.
4. Analyze and differentiate the of curved beams and straight beams in terms of load distribution across the section of different shaped elements
5. Demonstrate the basic knowledge in the designing, choosing the best materials for Spur gear, helical gear, worm gears for different operating temperature, speed and number of operating hours.

UNIT-I

Springs: Types of springs, spring materials, stresses in helical coil springs of circular and non-circular cross sections. Tension and compression springs, concentric springs; springs under fluctuating loads.

Leaf Springs: Stresses in leaf springs, equalized stresses, and nipping of leaf springs. Introduction to torsion and Belleville springs.

UNIT-II

Belts: Materials of construction of flat and V belts, power rating of belts, concept of slip and creep, initial tension, effect of centrifugal tension, maximum power condition. Selection of flat and V belts-

length & cross section from manufacturers' catalogues. Construction and application of timing belts.
Wire ropes: Construction of wire ropes, stresses in wire ropes, and selection of wire ropes.

UNIT-III

Bearings: Classification of Bearings. Viscosity of Lubricants Theory of Hydrostatic and Hydrodynamic lubrication
Sliding contact bearings: Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design.
Rolling contact bearings: Ball and roller bearings – Static load – dynamic load – equivalent radial load – design and selection of ball & roller bearings

UNIT-IV

Engine Parts: Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends –Pistons, Forces acting on piston – Construction, Design and proportions of piston.
Curved beams: Theory of bending of members with initial curvature - rectangular, circular and Trapezoidal sections. Design of crane Hooks, Machine frames and C-clamps.

UNIT-V

Gear drives: Classification of gears, materials for gears, standard systems of gear tooth, lubrication of gears, and gear tooth failure modes.
Spur Gears: Definitions, stresses in gear tooth: Lewis equation and form factor, design for strength, dynamic load and wear.
Helical Gears: Definitions, transverse and normal module, formative number of teeth, design based on strength, dynamic load and wear
Bevel Gears: Definitions, formative number of teeth, design based on strength, dynamic load and wear

Suggested Readings :

1. Design of Machine Elements, V. B. Bhandari, Tata McGraw-Hill Publ, 3rd Edn. 2010.
2. Mechanical Engineering Design, J.E. Shigley & Charles R. Mischke, Tata McGraw-Hill.,6th ed.2010.
3. Machine Design, P. Kannaiah, Sci-Tech Publ., 2009.
4. Machine Design, P.C. Sharma & D.K. Aggarwal, S.K. Kataria & Sons, 10th edn, 2003
5. Design Data Book, V. B. Bhandari, 2nd edition, ", Tata McGraw-Hill Publ, 2019

Course-Code	Course Title						Core/ Elective
U21ME603	Heat Transfer						Core
Prerequisites	Contact Hour per Week				CIE	SEE	Credit
	L	T	D	P			
Thermodynamics	3	-	-	-	40	60	3

Course Objectives :

The objective of the course is to:

1. Develop the fundamental principles and laws of heat transfer and to explore the implications of these principles for system behavior.
2. Formulate the models necessary to study, analyse and design heat transfer systems through the application of these principles.
3. Develop the problem-solving skills essential to good engineering practice of heat transfer in real-world applications.

Course Outcomes :

After completing the course, the student will be able to:

1. Illustrate the basic modes of heat transfer with its associated laws in simple geometries.
2. Solve the problems of steady state and transient heat conduction with simple and multi-layer geometries. Analyze heat transfer coefficients for free and forced convection, considering boundary layers.
3. Develop relationships for radiation exchange between (Opaque, Diffuse, Gray) Surfaces in an enclosure.
4. Familiarize with time dependent heat transfer and compute convective heat transfer coefficients in forced, natural convection.
5. Analyse heat exchanger performance by using the methods of Log Mean Temperature Difference (LMTD).

UNIT-I

Heat transfer fundamentals; Basic heat transfer mechanisms (conduction, convection and radiation), Conduction: General conduction equation on cartesian coordinates, Cylinders and spheres. One dimensional steady state conduction through plane walls, hollow cylinders and spheres with and without heat generation. Thermal resistance network, Boundary Conditions, Effect of variable thermal conductivity for one-dimensional steady-state conduction in a plane wall.

UNIT-II

Fins: Heat transfer analysis of a body with negligible internal temperature gradients, fins efficiency and effectiveness. Lumped system analysis within the body with negligible internal temperature

gradients. Transient heat transfer analysis of an infinite slab with specified temperature and connective boundary conditions.

UNIT-III

Convection: Physical mechanism of convection, Buckingham pi-theorem and use of dimensional analysis in free and forced convection, Physical significance of different dimensionless numbers. Concept of velocity boundary layer, thermal boundary layer. Reynolds analogy, Chilton-Colburn analogy for turbulent flow over flat surfaces. Calculation of heat transfer for flow over plates, cylinders and in pipes in free and forced convection using empirical formulae.

UNIT-IV

Radiation: Absorptivity, Reflectivity, and Transmissivity, Concept of a blackbody, Emissivity, the Planck Distribution law, Wien's Displacement Law, Stefan-Boltzmann, Kirchhoff's Law. The View factor, View factor relations, View Factors between Infinitely Long Surfaces: The Crossed-Strings Method, Radiation exchange between Opaque, Diffuse, Gray Surfaces in an enclosure.

UNIT-V

Heat Exchangers: Heat exchanger types, overall heat transfer coefficient. Heat exchanger analysis: Use of the Log Mean Temperature Difference (Parallel-Flow, Counter-Flow), the Effectiveness–NTU Method. Heat Exchanger Design and Performance Calculations (LMTD, ε-NTU methods), Selection of heat exchangers. Boiling: Pool boiling regimes, nucleate pool boiling, and critical heat flux for nucleate pool boiling, minimum heat flux. Conduction Process.

Suggested Readings :

1. Heat Transfer, Holman, J.P., McGraw Hill Publication, New Delhi, 2010 2.
2. Heat and Mass Transfer, Rajput, R.K., S. Chand & Company Ltd, New Delhi, 2004.
3. Heat and Mass Transfer, Yadav, R., Sanjay. and Rajay.,Central Publishing House, Allahabad, 2004
4. Fundamentals of Engineering Heat and Mass Transfer , Sachdeva,R.C., New Age International (P) Ltd Publishers, New Delhi,
5. A course in Heat and Mass Transfer, Arora, S.C. and Domkandwar., DhanpatRai& Sons, New Delhi, 2004.

Course Code	Course Title						Core / Elective
U21ME604	**CAD/CAM/CAE**						**Elective**
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
Metal Cutting and Machine Tools	L	T	D	P			
	2	-	-	-	40	60	2

Course Objectives:

The objective of the course is to:

1. Introduce the concepts of CAD and advanced modeling techniques
2. Help the student in understanding advanced manufacturing concepts like Group technology, flexible manufacturing systems, Computer aided Process Planning, and Computer aided quality control, Artificial Intelligence etc.
3. Help the students in understanding the functioning of computer numerical control machine tools and also in writing programs for operating this machines.
4. Understand the various assemblies and part design with CAD Software's.
5. Create awareness among students about the advanced Software's.

Course Outcomes:

After completing the course, the student will be able to:

1. Apply the fundamental applications of computer in design, manufacturing and geometric transformation techniques in CAD.
2. Develop mathematical Model for curves, surfaces, solid models and understand the fundamental concepts of Finite Element Analysis.
3. Develop CNC Part program for manufacturing components.
4. Differentiate the concepts of Machining Centre's, adaptive control and as well as fundamentals knowledge of robotics.
5. Analyze the working of various components of an modern manufacturing systems

Unit-I

CAD Fundamentals, Product life cycle in conventional and computer-based manufacturing system, Hardware integration and networking. CAD Software: Definitions of system software and application software. Graphic Standards and Exchange Formats. CAD database and structure.

Unit-II

Geometric modeling: 3-D wire frame modeling: wire frame entities and their definitions, Interpolation and approximation of curves, synthetic curves and curve fitting. Definitions of cubic, Bezier, and B-spline curves.

Unit-III

Surface modeling: Definitions of basic surfaces, surface of revolution, blends, intersection, and Cubic, Bezier, B-spline surfaces. Solid Modeling: Solid entities, Boolean operations, B-rep and C-rep approaches. Feature based modeling: Concepts and applications, Assembly modeling.

UNIT-IV

Parametric Representation of Synthetic Surfaces: Hermite Bicubic surface, Bezier surface, BSpline surface, COONs surface, Blending surface Sculptured surface, Surface manipulation Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

Unit-V

Group Technology: Organization, G.T. layout, part classification and coding, CAPP: Variant and Generative approaches and their relative features. Computer Aided Quality Control: Computer in quality control, Contact and non-contact inspection, optical and non-optical computer aided testing, Experts systems. Artificial intelligence, CAD/CAM integration.

Suggested Readings:

1. CAD/CAM, theory and practice, Ibrahim Zeid, McGraw Hill Inc, N.Y.1991.
2. CAD/CAM, Grover, MP and Zimmers E.W., Prenctice Hall of India 1989.
3. Computer Aided Manufacturing, Rao P.N., Tiwari N.K., Kundra T.K., Tata McGraw Hill, New Delhi, 1993.
4. CAD/CAM/CIM, Radhakrishnan. P, Subramanyan. S, Raju. V, New Age international (P) Ltd., 2nd Edn., 2004.

Course-Code	Course Title						Core/ Elective
U21ME6L1	Metal Cutting and Machine Tools Lab						Core
Prerequisites	Contact Hour per Week				CIE	SEE	Credit
	L	T	D	P			
Manufacturing Processes Lab	-	-	-	3	25	50	1.5

Course Objectives :

The objective of the course is to:

1. Have knowledge of various precision measuring instruments.
2. Familiarise machining and metal cutting operations.

Course Outcomes :

After completing the course, the student will be able to:

1. Demonstrate the need of machine alignment test for qualitative production.
2. Practice calibration principles for maintaining the required precision of instruments / tools.
3. Select and practice the methods of temperature measurement.
4. Select cutting tool materials and tool geometries along with appropriate cutting conditions for different work materials and grind the cutting tools to the required geometry.
5. Recognize and summarize the features and applications of various machine tools like Lathe, Milling, Drilling, Grinding, Shaping, Slotting etc.
6. Practice calibration principles for maintaining the required precision of instruments / tools

List of Experiments:

1. Typical exercises on lathe machine (Turning, Step Turning).
2. Typical exercises on lathe machine (Taper Turning and Knurling).
3. Thread cutting exercise on lathe machine as single start .
4. Machining of holes using Drilling and boring machines.
5. Typical exercises on shaper machine.
6. Typical exercises on cylindrical grinding machine.
7. Typical Exercise on milling machine.
8. Typical Exercise on slotting machine.
9. Typical Exercise on Planning machine.
10. Production of threads with taps and threading dies and milling cutters.
11. Grinding of Tool angles using Cylindrical / Surface Grinding.
12. Study of geometrical tests on lathe machine.

Note: At least 10 experiments must be conducted in the semester.

Course-Code	Course Title						Core/ Elective
U21ME6L2	Heat Transfer Lab						Core
Prerequisites	Contact Hour per Week				CIE	SEE	Credit
	L	T	D	P			
Thermal Engineering Lab	-	-	-	3	25	50	1.5

Course Objectives :

The objective of the course is to:

1. Understand applications of Heat Transfer Concepts through experimentation.
2. Provide knowledge in Concentric Sphere, Metal Rod.
3. Understand the working principal of Conduction and Convection.
4. Understand the Heat Flow Exchangers and the Demonstrations.

Course Outcomes :

After completing the course, the student will be able to:

1. Perform steady state conduction experiments to estimate thermal conductivity of different materials.
2. Perform transient heat conduction experiment.
3. Estimate heat transfer coefficients in forced convection, free convection , condensation and correlate with theoretical values
4. Obtain variation of temperature along the length of the pin fin under forced and free convection.
5. Perform radiation experiments: Determine surface emissivity of a test plate and Stefan-Boltzmann's constant and compare with theoretical value.

List of Experiments:

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.

11. Stefan Boltzman Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Film and Drop wise condensation apparatus

Note: At least 10 experiments must be conducted in the semester.

Course Code	Course Title						Core / Elective
U21ME6L3	CAD/CAM/CAE Lab						Core
Prerequisite	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
Metal Cutting and Machine Tools	-	-	-	3	25	50	1.5

Course Objectives:

The objective of the course is to:

1. Introduce fundamentals of the analysis software, its features and applications.
2. Understand and handle design problems in a systematic manner.
3. Promote equipment and develop application capability of the concepts sciences to engineering design and processes.
4. Know the concept of discretization of continuum. Loading conditions and analyze the structure using pre-processor and postprocessor conditions.

Course Outcomes:

After completing the course, the student will be able to:

1. Classifying the types of Trusses and Beams (2D & 3D) with various cross sections and to determine Stress, Strains and deflections under static, thermal loading.
2. Generalized Plane stress, plane strain conditions & axi-symmetric loading on in plane members to predicting the failure behavior and finding the SCF.
3. Analyse connecting rod with tetrahedron and brick elements, performing static analysis on flat & curved shells to determine stresses, strains with different boundary conditions.
4. Simulate steady state heat transfer analysis of chimney, Transient heat transfer of castings, Non linear, Buckling analysis of shells CFD analysis.
5. Predict the natural frequencies and modes shapes using Modal, Harmonic analysis. Also finding the critical load using Buckling analysis.

List of Experiments:

1. Part Modeling: Generation of various 3D Models through Extrusion, revolve, sweep. Creation of various features.
2. Study of parent child relation. Feature based and Boolean based modeling and Assembly Modeling. Study of various standard Translators. Design of simple components.
3. Analysis of Plane Truss & Spatial Truss with various cross sections and materials to determine member forces, member strains & stresses, joint deflections under static and thermal loading.
4. 2D & 3D beam analysis with different sections, different materials for different loads (forces and

moments with different end supports.

5. 1D, 2D and 3D meshing with different element sizes for different CAD geometry.
6. Static analysis of plates with a hole to determine the deformations, the Stresses to study the failure behavior and SCF.
7. Plane stress, plane strain and axi-symmetric loading on the in plane members with in plane landing to study the stresses and strains.
8. Static analysis of connecting rod with tetrahedron and brick elements.
9. Buckling analysis of plates, shells and beams to estimate BF and modes.
10. Modal analysis of beams, plates and shells for natural frequencies and mode shapes.
11. Harmonic analysis of a Shaft subjected to periodic force and transient analysis of plate subjected to stepped and ramped loading with varying time.
12. Steady state heat transfer Analysis Cross section of chimney and transient heat transfer analysis of solidification of castings.
13. CFD analysis of aerofoil design.
14. Use of MATLAB / Python for finding B matrix, stiffness matrix and loading matrices of beam/in plane/solid elements and interfacing with CAE software's

Note: At least 10 experiments must be conducted in the semester.

Course Code	Course Title						Core/Elective
U21EN6L1	**Research Writing [IT, CSE(AI&ML), AIML, MECH, EEE]**						**-**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
English for Technical Communication	**-**	**-**	**-**	**2**	**25**	**50**	**1**

Course Objectives

The objective of the course is to:

1. Improve students' writing skills and level of readability
2. Understand the nuances of a research paper.
3. Develop the content and format of a research paper.
4. Produce original research papers without plagiarism

Course Outcomes

After completion of this course, the student will be able to:

1. Demonstrate the ethics and nuances of plagiarism.
2. Construct the topic of research and formulate hypothesis.
3. Analyze the research process elaborately.
4. Organize and rephrase the data in a sequential order as per format.
5. Interpret the data by the use of methodology and discussion

ACTIVITY - I

Introduction to Research: What is research, Purpose of research, Types of research, Ethics and Plagiarism, Format of a research paper

ACTIVITY - II

Research Process-I: Selection of topic, Formulation of Hypothesis

ACTIVITY - III

Research Process-II: Collection of data, Analysis of Data, Interpretation of Data, Presentation of Data

ACTIVITY - IV

Structure of a Research Paper-I: Title, Abstract, Introduction, Literature Review

ACTIVITY - V

Structure of a Research Paper II: Methodology, Discussion, Finding/Results, Conclusion, Documenting Sources (IEEE style)

Suggested Readings:

1. Research Methodology Methods and Techniques, C. R Kothari, Gaurav, Garg,4/e, New AgeInternational Publishers.
2. How to Write and Publish a Scientific Paper**",** Day R, Cambridge University Press, 2006
3. Quick Guide to Writing Great Research Papers, Lauri Rozakis, Schaum's, Tata McGraw Hills Pvt. Ltd, New Delhi.
4. Cite Right: A quick guide to citation styles; MLA, APA, Chicago, the sciences, professions, and more, Lipson, Charles (2011), (2^{nd} ed.) Chicago [u.a]: University of Chicago Press.

Course Code	Course Title					Core / Elective
U21ME6P1	Mini Project					Elective
Prerequisite	Contact Hours Per Week			CIE	SEE	Credits
Internship	L	T	P			
	-	-	6	50	50	3

Course Objectives:

The objective of the course is to:

1. Enhance practical and professional skills.
2. Familiarize tools and techniques of systematic literature survey and documentation
3. Expose the students to industry practices and team work.
4. Encourage students to work with innovative and entrepreneurial ideas and its implementation.
5. Make students evaluate different solutions based on economic and technical feasibility

Course Outcomes:

After completing the course, the student will be able to:

1. Formulate a specific problem and give valuable and economical solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained
5. Write the documentation in standard format

Guidelines:

1. As part of the curriculum in the VI- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
2. Four students will be allotted to one faculty supervisor for mentoring.
3. Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
4. Mini projects shall have inter-disciplinary/ industry relevance, which can be implemented practically.
5. The students can select a mathematical modelling based/Experimental investigations or Numerical modelling
6. All the investigations should be clearly stated and documented with the reasons/explanations/Justifications.
7. The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and reference
8. Project Review Committee: Supervisor and a minimum of two faculty members.