NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
B.Tech. in Mechanical Engineering
Proposed Teaching & Examination Scheme
Semester IV

w.e.f. Academic Year 2023-24

Course Code	Course Name	Teaching Scheme (hours/week)				Examination Scheme			
		L	T	P	C	Duration Hours	Component Weightage		
						SEE	CE	LPW	SEE
2ME302	Fluid Mechanics	2	0	2	3	3	0.3	0.3	0.4
2ME103	Manufacturing Processes-I	2	0	2	3	3	0.3	0.3	0.4
2ME701	Automation and Control	2	0	2	3	3	0.3	0.3	0.4
2ME501	Theory of Machines	2	0	2	3	3	0.3	0.3	0.4
2HS301	Economics	2	1	0	3	3	0.6	-	0.4
1MU803	Indian Constitution and Citizenship	2	1	0	3	3	0.6	-	0.4
	Total Credits				**18**	-	-	-	-

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME302
Course Title:	Fluid Mechanics
Course Type:	Core
Year of introduction:	2023-24

Credit Scheme

L	T	Practical component				C
		LPW	PW	W	S	
2	0	2	-	-	-	3

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1 infer the basic principles of fluid statics, (BL2)
2 illustrate the concepts of kinematics and dynamics of fluids, (BL2)
3 utilise the principles of dimensional and model analysis, (BL3)
4 apply the concepts of incompressible and turbulent flows. (BL3)

Syllabus: **Total Teaching Hours: 30**

Unit	Syllabus	Teaching hours
Unit I	**Fluid Statics** Properties of fluids, pressure measurement, forces on submerged bodies, stability of floating bodies.	**06**
Unit II	**Fluid Kinematics and Dynamics** Control-volume analysis of mass, momentum and energy, fluid acceleration, differential equations of continuity and momentum, Bernoulli's equation.	**06**
Unit III	**Dimensional Analysis** Need for dimensional analysis, Buckingham's' method, dimension less numbers and their significance, hydraulic similarities, type of models, model analysis.	**06**
Unit IV	**Viscous Flow of Incompressible Fluids** Introduction of hydrodynamic boundary layer, flow between two parallel plates, Couette flow, flow through pipe, Hagen-Poiseuille equation, head losses in pipe, bend and fittings, different viscometers.	**08**

Unit V **Basics of Turbulent Flow and Compressible Flow** **04**

Reynolds experiment, types of flows, introduction to turbulent flow, Mach number and different flow regimes, Interlocution to Fluid Machines.

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Y A Cengel and J M Cimbala, Fluid Mechanics: Fundamentals and Applications; McGraw Hill Publication.
2. R W Fox, A T McDonald, P J Pritchard, Introduction to Fluid Mechanics; John Wiley and Sons.
3. F M White, Fluid Mechanics; McGraw-Hill Publishing Co.
4. A L Gerhart, B R Munson, J I Hochstein, P M Gerhart, T H Okiishi, Fundamentals of Fluid Mechanics; John Wiley and Sons.
5. D S Kumar, Fluid Mechanics and Fluid Power Engineering; S K Kataria & Sons.

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	Study of viscometers and determination of viscosity by Redwood viscometer.	2
2.	Determination of Reynolds number for different types of flow through closed conduit.	2
3.	Verification of Bernoulli's theorem.	2
4.	Calibration of flow measuring devices.	2
5.	Determination of metacentric height.	2
6.	Calibration of triangular notch.	2
7.	To obtain surface profiles of free vortex flow.	2
8.	To obtain surface profiles of forced vortex flow.	2
9.	Determination of minor losses in piping systems.	2
10.	Determination of major losses in piping systems.	2
11.	Demonstration of Computational Fluid Dynamics (CFD) software tools.	2
12.	To study the applications and basic working principles of various hydraulic machines.	2
13.	Demonstration of in-house wind tunnel facility.	2

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME103
Course Title:	Manufacturing Processes-I
Course Type:	Core
Year of introduction:	2023-24

L	T	Practical component				C
		LPW	PW	W	S	
2	0	2	-	-	-	3

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1	illustrate the basics of manufacturing processes,	(BL2)
2	interpret the effect of process parameters on manufacturing processes,	(BL2)
3	appraise casting and welding processes for functional requirement,	(BL5)
4	recommend suitable metal forming processes for a given application.	(BL5)

Syllabus: **Total Teaching Hours: 30**

Unit	Syllabus	Teaching Hours
Unit I	**Introduction to manufacturing processes:** classification, applications and limitations **Metal Casting:** Casting principle, Metal casting processes and equipment, Gating system, melting of metal in foundry, Solidification, fluidity test, Shrinkage, cleaning of casting, Casting defects and residual stresses. Special casting processes.	**10**
Unit II	**Metal Joining** Physics of welding, Formation of a fusion welded joint, welding arc, welding power source characteristics, Metal transfer, Heat flow, Thermal stresses, Metallurgical aspect of welding, Solid state joining processes, Brazing and Soldering, Welding defects, NDT in welding, welding quality standards,WPS	**10**
Unit III	**Metal Forming**	**10**

Fundamentals of plastic deformation, Fundamentals of hot and cold working processes, Forging, Rolling, Extrusion, Wire drawing and Sheet metal forming, Load estimation of forming processes, Forming defects, Advanced metal forming processes.

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Kalpakjian S and Schmid S., Manufacturing Processes for Engineering Materials, Pearson Education India.
2. Rao P. N., Manufacturing Technology: Foundry, Forming & Welding, Tata McGraw Hill Education.
3. Ghosh Amitabh and Malik A. K., Manufacturing science, East-West Press Ltd.
4. George E. Dieter, Mechanical Metallurgy, Tata McGraw Hill Education.
5. Campbell John, Casting, Elsevier publication

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	Pattern allowance calculations for given component in sand casting.	2
2.	Measurement of properties of moulding sand.	2
3.	Effect of proportion of oxygen and acetylene on the gas welding flame and gas cutting.	2
4.	Effect of welding parameters on weld seam quality in MMAW.	2
5.	Preparation of joints using Tungsten Insert Gas(TIG) welding process.	2
6.	Preparation of joints using Metal Insert Gas (MIG) welding process.	2
7.	Preparation of different type of joints by using spot welding and butt welding process.	2
8.	Determination of forging load in open die forging.	2
9.	Determination of rolling load in two high rolling mill.	2
10.	Study of various extrusion processes.	2
11.	Spring back effect in sheet metal and GI Pipe bending process.	2
12.	Study of incremental sheet metal forming	2
13.	Demonstration of friction stir welding processes.	2

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME701
Course Title:	Automation and Control
Course Type:	Core
Year of introduction:	2023-24

L	T	Practical component				C
		LPW	PW	W	S	
2	0	2	-	-	-	3

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1 develop a mathematical model and analyse the control system, (BL3)
2 select and integrate the suitable sensors and actuators with controller, (BL3)
3 infer the concept of automation system, (BL2)
4 make use of various simulation software for analysis of control system. (BL3)

Syllabus: **Total Teaching Hours: 30**

Unit	Syllabus	Teaching Hours
Unit I	**System modeling** Classification of control systems, Transfer function, Nodal diagram, analogous systems, block diagram modeling and reduction, signal flow graph,	**06**
Unit II	**Analysis of control system** Standard test signals, Response analysis of first order and second order system, transient response specification, steady state error constant, stability analysis using Hurwitz criteria, Routh criteria, Root locus, Bode plot and its interpretation.	**10**
Unit III	**Sensors, Actuators and Controllers** Types of sensors: Position, distance, velocity, acceleration, vision, angle sensors, force torque sensors. Types of actuators: Hydraulic, pneumatic, electrical Various control actions (PID), pneumatic controllers, hydraulic controllers, introduction of Microcontrollers, programming of microcontroller, introduction of PLC, Ladder logic diagram, fuzzy logic control, use of simulation software.	**08**

Unit IV **Automation systems** **06**

Introduction to automation system, automation principles and strategies, Basic elements of automated systems, levels of automation, automated storage and retrieval system, automated production lines, automated assembly systems, Industry 4.0.

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Katsuhiko Ogata, Modern Control Engineering, Prentice Hall
2. Groover, M. P. Automation, production systems, and computer-integrated manufacturing. Pearson Education India.
3. Kant, K. Computer-based Industrial Control. PHI.
4. Webb, J. W., & Reis, R. A. Programmable logic controllers: principles and applications. Prentice Hall.
5. Chang, T. C., & Wysk, R. A. An introduction to automated process planning systems. Prentice Hall.
6. Amber, G. H., & Amber, P. S. Anatomy of automation. Prentice-Hall.
7. Nagrath and Gopal, Control Systems engineering, New Age

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	Mathematical modelling of the system – Block diagram method	2
2.	Mathematical modelling of the system – signal flow diagram method	2
3.	Response analysis of first order system (using Matlab Simulink)	2
4.	Response analysis of second order system (using Matlab Simulink)	2
5.	Stability analysis of the system using root locus	2
6.	Stability analysis of the system using Bode plot	2
7.	Programming of microcontroller	2
8.	Programming of PLC	2
9.	Interfacing of sensors and actuator with microcontrollers	2
10.	Simulation of automation system using Automation Studio software	2
11.	Preparing the hydraulic circuit using hydraulic trainer kit	2
12.	Preparing the pneumatic circuit using pneumatic trainer kit	2

NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	B.Tech. in Mechanical Engineering
Course Code:	2ME501
Course Title:	Theory of Machines
Course Type:	Core
Year of introduction:	2023-24

L	**T**	**Practical component**				**C**
		LPW	**PW**	**W**	**S**	
2	**0**	**2**	**-**	**-**	**-**	**3**

Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1 infer the concepts of machines and mechanisms, (BL2)
2 analyse the kinematics of planar mechanisms, (BL4)
3 solve the static and dynamic forces in planar mechanisms, (BL3)
4 appraise various motion transmission elements such as gears, gear trains and cams. (BL5)

Syllabus: **Total Teaching Hours: 30**

Unit	**Syllabus**	**Teaching Hours**
Unit I	**Links & Mechanism** Links- kinematics pairs, Higher and lower pairs, Constraints, Degrees of freedom of mechanism, Four-bar chain and slider-crank chain mechanism and their inversions, Straight line motion mechanism, Steering gear mechanisms, Condition for correct steering, Davis and Ackermann steering gears.	**07**
Unit II	**Motion analysis** Velocity and acceleration in machine parts, Instantaneous centre method, Centrode and its laws, Velocity and acceleration diagrams for simple kinematic mechanisms (vector and graphical approach), Computer aided kinematic analysis of mechanism like slider-crank mechanism and four-bar mechanism.	**08**
Unit III	**Gears, Cams and Gyroscope** Classification of gears, Terminology, Law of gearing, Forms of teeth, Path of contact of gears, Arc of contact of gears, Contact ratio, Interference in involute gears, Minimum number of teeth required in gears, Undercutting, Simple gear train, Compound gear trains, Reverted gear trains, Epicyclic gear trains, Analysis	**06**

of epicyclic gear train, Types of cams and followers and related terminology, Follower displacement diagram, Derivatives of follower motion, Layout of cam profile, Analysis of an elastic cam system, Gyroscopic couple, Gyroscopic effect on aeroplanes and naval ships, Stability of an automobile (two-wheeler)

Unit IV **Static and Dynamic force analysis** **09**

Static equilibrium of two force and three force members, Members with two force and a torque, Free body diagrams, Superposition, Principle of virtual work, D' Alembert's principle, Equivalent offset inertial force, Dynamic analysis of four bar chain and slider crank mechanism, Turning moments of crankshaft, Dynamically equivalent systems, Inertia of connecting rod, Inertia forces in reciprocating engines, Fluctuation of energy, Flywheels

Self – Study: The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work: Laboratory work will be based on above syllabus with minimum 10 experiments to be incorporated

Suggested Readings/References:

1. Rattan S. S., Theory of Machines, Tata McGraw Hill Education
2. Norton R. L., Kinematics and Dynamics of Machinery, Tata McGraw Hill Education
3. Ambekar A. G., Mechanism and Machine Theory, PHI Learning Private Ltd.
4. Ghosh Amitabha & Mallik Ashok Kumar, Theory of Mechanisms and Machines, East West Press.
5. Uicker J.J., Pennock G.R., Shigley J.E., Theory of Machines and Mechanisms, Oxford University Press.
6. Rao J.S and Dukkipati R.V., Mechanism and Machine Theory, Wiley-Eastern Ltd., New Delhi.
7. Hannah John and Stephens R.C, Mechanics of Machines, Edward Arnold

Suggested list of experiments: (not restricted to the following)

Sr. No.	Title	Hours
1.	Static force analysis of planner mechanism – graphical method	2
2.	Static force analysis of planner mechanism using superposition method – graphical method	2
3.	Static force analysis of planner mechanism – analytical approach	2
4.	Dynamic force analysis of planner mechanism – graphical method	2
5.	Dynamic force analysis of planner mechanism – analytical approach	2
6.	Development of cam profile	4
7.	Estimation of cam jump speed	2
8.	Study of the simple, compound, and reverted gear trains	2

Sr. No.	Title	Hours
9.	Velocity analysis of epicyclic gear trains	2
10.	Determine the gyroscopic couple	2
11.	Estimation of degrees of freedom of planner mechanism	2
12.	Velocity analysis of planner mechanism using graphical approach	2
13.	Acceleration analysis of planner mechanism using graphical approach	2