DEPARTMENT OF MECHANICAL ENGINEERING

COS & PROGRAM ARTICULATION MATRIX

B.Tech. Mechanical Engineering

2022-23

Shri G S Institute of Technology & Science Indore

[Govt. Aided Autonomous Institute Estd. In 1952]

ME10149: ENGINEERING GRAPHICS

CO 1	Distinguish standard drawing conventions, draw curves and scales using drawing instruments
CO 2	Apply the concept of orthographic projection of lines and planes.
CO 3	Draw the projections of various solids inclined to both planes and its sections and true shape.
CO 4	Differentiate development of surfaces and concept of isometric projection.
CO 5	To draw Orthographic Projections of simple objects and machine parts using drafting tools andsoftware's for creating 2-D and 3-D shapes.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	–	–	–	–	–	–	–	–	3	1
CO2	3	2	1	1	1	–	–	–	–	–	–	–	3	1
CO3	3	2	1	–	1	–	–	–	–	–	–	–	3	1
CO4	3	2	1	–	1	–	–	–	–	–	–	–	3	1
CO5	3	2	1	–	–	–	–	–	–	–	–	–	3	1
Average	3	2	1	1	1	–	–	–	–	–	–	–	3	1

ME 26011: FLUID MECHANICS

CO 1	Determine the fluid pressure and use various devices for measuring fluid pressure. Calculate hydrostatic force and use of law of conservation mass to fluid flow
CO 2	Apply fluid flow patterns and describe continuity equation
CO 3	To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanics principles in design. Apply Bernoulli's equation to fluid flow problems and boundary layer theory to determine lift and drag forces on a submerged body
CO 4	Apply appropriate equations and principles to analyze pipe flow problems
CO 5	Apply boundary layer concepts

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	1	-	-	-	-	-	-	-	3	1
CO3	3	1	1	-	-	-	-	-	-	-	-	-	2	1
CO4	3	2	2	2	1	-	-	-	-	-	-	-	2	1
CO5	2	2	2	2	1	-	-	-	-	-	-	-	2	1
Average	2.8	1.6	1.6	2	1	-	-	-	-	-	-	-	2.4	1.2

ME 26002: STRENGTH OF MATERIALS

CO1	Distinguish elastic constants, types of stresses and mechanical properties of materials
CO2	Apply shear force and bending moment diagrams to analyze the resistance offered by the beam andable to solve practical problems in real world scenario
CO3	Evaluate principal stresses and strains analytically and graphically
CO4	Determine the deflection and curvature in beams with different supports and buckling of column.
CO5	Analyze and design thin cylinders and energy stored due to deformation

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO2	3	3	2	–	–	–	–	–	–	–	–	1	3	1
CO3	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO4	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO5	3	2	2	–	–	–	–	–	–	–	–	1	3	1
Average	3	2.2	2	–	–	–	–	–	–	–	–	1	3	1

MA 26004: MATHEMATICS-III

CO1	To identify real phenomena as models of partial derivative equations. Solve real problems by identifying them appropriately from the perspective of partial derivative equations
CO2	To demonstrate their understanding of the Dirichlet conditions by using them to evaluate infinite series. Calculatethe Fourier transform of elementary functions from the definition.
CO3	To select and combine the necessary Laplace transform techniques to solve second-order ordinary differentialequations involving the Dirac delta (or unit impulse).
CO4	Apply the concept of approximation methods to solve differentiation and integration problems.
CO5	To define principal concepts about sampling. Explains the advantages of sampling. Lists the stages of samplingprocess. Categorizes and defines the sampling methods.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	_	_	_	_	1	_	_	3	_	_
CO2	3	3	2	1	_	_	_	_	1	_	_	3	_	_
CO3	3	3	2	1	_	_	_	_	1	_	_	3	_	_
CO4	3	3	2	1	_	_	_	_	1	_	_	3	_	_
CO5	3	3	2	1	_	_	_	_	1	_	_	3	_	_
Average	3	3	2	1	_	_	_	_	1	_	_	3	_	_

ME 26008: MATERIALS SCIENCE

CO1	Description of various types of crystal structures and their relation with material properties
CO2	Mechanical properties of materials and role of individual material in varying the properties.
CO3	Various phases of materials, phase diagrams role of phases on properties of materials through iron carbonequilibrium diagram and Time Temp Transformation (TTT) diagram and effect of heat treatment.
CO4	Various ferrous and nonferrous materials used and powder metallurgy technique.
CO5	Testing of materials through nondestructive means. Knowing fundamental of composite materials including theirtypes, applications and constituents.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	–	–	–	–	–	–	–	–	–	–	1	1
CO2	3	1	–	–	–	–	–	–	–	–	–	–	1	1
CO3	3	1	–	2	–	–	–	–	–	–	–	–	1	1
CO4	3	1	2	–	–	–	–	–	–	–	–	–	2	1
CO5	3	1	1	–	–	–	–	–	–	–	–	–	2	1
Average	3	1	1.5	2	–	–	–	–	–	–	–	–	1.4	1

ME 26005: ENGINEERING THERMODYNAMICS

CO1	Apply first and second laws on thermodynamics systems and explain their applications.
CO2	Evaluate entropy changes in a wide range of processes and determine the available and unavailable energy. Analysis for the performance of different air standard cycles.
CO3	Evaluate properties of pure substances and gas mixtures. Demonstrate various types of high pressure boilers and their relative merits and demerits.
CO4	Performance evaluation of boilers. Apply the fundamentals of thermodynamics for analysis of boiler Performance. Procedure to draw Heat Balance Sheet.
CO5	Classify the concept of draught. Evaluate draught created by chimney. Demonstrate reactive system of combustion process for different fuels. Analyze dry flue gases.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	-	-	-	-	-	-	-	-	3	1
CO2	3	3	3	3	-	-	1	-	-	-	-	-	3	2
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	1
CO4	1	3	2	1	-	-	-	-	-	-	-	-	3	3
CO5	3	3	2	1	-	-	1	-	-	-	-	-	3	2
Average	2.6	3	2.2	1.6	-	-	1	-	-	-	-	-	3	1.8

HU 29481: VALUES, HUMANITIES AND PROFESSIONAL ETHICS

CO1	Explain and elaborate the social institutions and Constitution of India through which the society and nation is governed.
CO2	Describe the kinds of values and ethics and their importance.
CO3	Contextualize the professional attitude and approaches as per needs of society and values.
CO4	Explain and illustrate the process of Social, Political and Technological changes in context to global changes.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	–	1	–	–	–	2	1	2	–	1	–	1	1	1
CO2	1	1	–	–	–	2	–	3	1	2	–	2	1	
CO3	1		–	1	–	2	–	3	1	1	–	1	1	1
CO4	1	1	2	1	–	3	2	3	1	1	–	3	2	1
CO5	1	1	2		1	2	3	2	2	1	–	2	1	1
Average	1	1	2	1	1	2.2	2	2.6	1.25	1.2	–	1.8	1.2	1

ME 26556: MATHEMATICS-IV

CO1	To obtain the series solution of Bessel's and Legendre's differential equations.
CO2	Explain the concept of vector calculus and its applications.
CO3	Distinguish the various concepts of function of complex variables and its applications.
CO4	Apply the concept of numerical analysis for solving linear, nonlinear and ordinary equations.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	_	_	_	_	1	_	_	3	_	_
CO2	3	3	2	1	_	_	_	_	1	_	_	3	_	_
CO3	3	3	2	1	_	_	_	_	1	_	_	3	_	_
CO4	3	3	2	1	_	_	_	_	1	_	_	3	_	_
CO5	3	3	2	1	_	_	_	_	1	_	_	3	_	_
Average	3	3	2	1	_	_	_	_	1	_	_	3	_	_

ME 26551: MACHINE DESIGN I

CO1	Distinguish machine component behavior under different types of loads, select factor of safety and identify the failure criteria.
CO2	Design keys, cotters, couplings, joints and lever
CO3	Design of pressure vessels and pipe joints
CO4	Design of bolted joint, effect of contact stress and selection of antifriction bearing
CO5	Design of riveted and welded joints

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO2	3	3	2	–	–	–	–	–	–	–	–	1	3	1
CO3	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO4	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO5	3	2	2	–	–	–	–	–	–	–	–	1	3	1
Average	3	2.2	2	–	–	–	–	–	–	–	–	1	3	1

ME 26562: KINEMATICS OF MACHINE

CO 1	Analyze the motion of planar four link mechanisms
CO 2	Draw velocity and acceleration diagrams of planar mechanisms by relative velocity, Instantaneous center and graphical differentiation method.
CO 3	Construct different types of cam profile as per given follower motion.
CO 4	Determine parameters of gears and velocity ratio of gear trains
CO 5	Find out the gyroscopic effect in case two-wheelers, four-wheelers, ships aero planes.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO2	3	3	2	–	–	–	–	–	–	–	–	1	3	1
CO3	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO4	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO5	3	2	2	–	–	–	–	–	–	–	–	1	3	1
Average	3	2.2	2	–	–	–	–	–	–	–	–	1	3	1

EC 26563: BASIC ELECTRONICS ENGG

CO 1	Design and analyze diode based electronics circuits and subsystem which can perform logical and arithmeticoperation.
CO 2	Analyze BJT based electronic circuits.
CO 3	Classify the digital circuits through basic logic gates.
CO 4	Analyze and design converters which facilitate the conversion of real world analog signals to digital and viceversa.
CO 5	Differentiate basic internal logic and design of microprocessor and its programming.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	0	-	-	-	-	-	-	-	-	-	1
CO2	3	2	2	2	-	-	-	-	-	-	-	1	-	1
CO3	3	2	2	2	-	-	-	-	-	-	-	1	-	2
CO4	3	2	3	-	-	-	-	-	-	-	-	1	-	1
CO5	3	2	3	3	2	-	-	-	-	-	-	1	-	3
Average	3	2	2.4	2.3	2	-	-	-	-	-	-	1	-	1.6

IP 26552: MANUFACTURING PROCESSES-I

CO 1	Discuss the underlying principles and process of common casting processes
CO 2	Explain the construction and operations of common melting furnaces
CO 3	Provide the various allowances to the patterns and convert the OEM drawing to pattern drawing
CO 4	Design the core considering strength and other conditions
CO 5	Design multi-cavity layout

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	–	2	–	2	2	2	–	–	–	–	2	–	2
CO2	3	2	2	2	2	2	–	2	–	–	–	2	3	3
CO3	3	2	2	2	2	2	–	–	2	–	2	2	3	3
CO4	3	2	3	2	2	2	–	–	–	2	–	2	3	3
CO5	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Average	2.75	2	2.25	2	2	2	2	2	2	2	2	2	3	2.75

ME 26881: MACHINE DRAWING &COMPUTER GRAPHICS

CO1	Develop the skill of drafting using CAD software
CO2	Apply standard drawing conventions and practices
CO3	Represent surface finish and tolerances of machine elements in drawing.
CO4	Draw the machine elements like couplings, cotters, riveted, bolted and welded joints.
CO5	Prepare an assembly drawing using part drawings of machine components.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	–	3	–	–	–	2	2	–	2	3	2
CO2	2	2	1	–	1	–	–	–	2	2	–	2	3	1
CO3	2	2	2	–	2	–	–	–	2	2	–	2	2	1
CO4	3	2	2	–	3	–	–	–	2	2	–	2	2	2
CO5	3	2	2	–	3	–	–	–	2	2	–	2	2	2
Average	2.40	2.00	1.60	_	2.40	_	_	_	2.00	2.00	_	2.00	2.40	1.60

HU /29507: ECONOMICS FOR ENGINEERS

CO1	Explain economic cyclic flow and Estimate the demand and demand elasticity for a product.
CO2	Plan the production; choose appropriate production technology (combination of production factors); and estimate feasible range of production.
CO3	Analyze the production-cost-profit relation and select the suitable project for investment
CO4	Estimate price and the equilibrium for a firm/organization in different competitive market situations.
CO5	Review, summarize and compare the financial statements of an accounting entity and able to apply financial ratiotechnique for financial analysis.

ARTICULATION MATRIX:

CO	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2				2		1					1	2
CO2	2			2		1	1			2		2	2
CO3	1	2			2	2				3	1	1	
CO4	1				2	2				3		1	
CO5		3		2	2	1		2	2	3	1	2	2
Average	1.5	2.5	0	2	2	1.5	1	2	2	2.75	1	1.4	2

ME 36011: DYNAMICS OF MACHINES

CO 1	Apply friction and lubrication mechanism to analysis of friction in different machine elements like thrust and radial load bearings, power screw, belt drive etc.
CO 2	Analyze various friction devices like clutch, brake and dynamometers.
CO 3	Illustrate construction, working and Dynamic analysis of different governors.
CO 4	Analyze dynamics of reciprocating mechanism and flywheel.
CO 5	Computation of unbalance in rotating and reciprocating machines.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	–	–	–	–	–	–	–	–	–	3	1
CO2	3	1	1	–	–	–	–	–	–	–	–	–	3	2
CO3	3	2	1	–	–	–	–	–	–	–	–	–	3	1
CO4	3	2	2	–	–	–	–	–	–	–	–	–	3	2
CO5	3	3	2	1	–	–	–	–	–	–	–	–	3	1
Average	3	2	1.6	1	–	–	–	–	–	–	–	–	3	1.4

ME 36003: MEASUREMENT ANDAUTOMATIC CONTROL

CO1	Analyze measurement instruments, identify errors, and conduct uncertainty analysis
CO2	Utilize temperature and pressure/velocity measurement techniques effectively
CO3	Design and implement strain and motion/force/torque measurement systems proficiently
CO4	Enhancement of analytical skills for mathematical modeling and understand control system concepts
CO5	Analyze system responses and apply stability criteria to control systems

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	–	–	–	–	–	–	–	–	–	–	1	1	1
CO2	3	3	3	–	–	–	–	–	–	–	–	1	1	1
CO3	3	2	3	1	–	–	–	–	–	–	–	1	1	1
CO4	3	3	3	–	–	–	–	–	–	–	–	1	2	1
CO5	3	2	2	1	–	–	–	–	–	–	–	–	–	–
Average	3	2.5	2.75	1	–	–	–	–	–	–	–	1	1.25	1

ME 36006: HEAT & MASS TRANSFER

CO1	Explain basic modes of heat transfer. Application of Fourier's law in plane, composite walls, cylinder and sphere.
CO2	Analyze finned surfaces and assess how fins can enhance heat transfer and unsteady state heat conduction.
CO3	Describe various convection modes and their application to solve heat transfer problems for tubes, flat plates For laminar and turbulent flow.
CO4	Design heat exchangers using LMTD and NTU methods and explain heat transfer with change of phase.
CO5	Apply the principles of radiation heat transfer and basics of mass transfer to real world problems.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	1	2	–	–	–	–	–	3	3
CO2	3	3	3	3	2	–	–	–	–	–	–	–	3	3
CO3	3	3	3	3	3	–	–	–	–	–	–	–	3	3
CO4	3	3	3	3	3	–	1	–	–	–	–	–	3	3
CO5	3	3	3	3	–	–	–	–	–	–	–	–	3	3
Average	3	3	3	3	2.75	1	1.5	–	–	–	–	–	3	3

E 36007: STEAM AND GAS POWER SYSTEMS

CO1	Analyze simple power plant cycles including reheat, regenerative and binary cycles.
CO2	Evaluate performance of nozzle and its efficiency. Explain and differentiate between impulse and reaction turbine. Analyze various energy losses in turbines
CO3	Explain the working principle of gas turbines and calculate its efficiency for various modifications in cycles.
CO4	Describe elements and principle of operation for Jet propulsion systems and calculate thrust, power and efficiency.
CO5	Analyze Combined cycle steam and gas power system. Purpose of condenser in steam power system

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	–	–	–	–	–	–	–	–	3	3	1
CO2	3	3	2	–	–	–	–	–	–	–	–	3	3	1
CO3	3	3	2	–	–	–	–	–	–	–	–	3	3	1
CO4	3	3	2	–	–	–	–	–	–	–	–	3	3	1
CO5	3	3	2	–	–	–	–	–	–	–	–	3	3	1
Average	3	3	2	–	–	–	–	–	–	–	–	3	3	1

IP 36062: MANUFACTURING PROCESSES -II

CO1	To apply fundamental knowledge about basic mechanism of metal cutting, conventional machine tools and estimation and relationship between performance measures and machining parameters
CO2	To explain Shaping, Milling and Broaching operation and their importance.
CO3	To illustrate Grinding functions and processes on grinding machines.
CO4	To demonstrate Gear elements and gear manufacturing and finishing processes.
CO5	To infer the surface finishing, super finishing and polishing processes and their importance.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	–	2	–	2	2	2	–	–	–	–	2	–	2
CO2	3	2	2	2	2	2	–	2	–	–	–	2	3	3
CO3	3	2	2	2	2	2	–	–	2	–	2	2	3	3
CO4	3	2	3	2	2	2	–	–	–	2	–	2	3	3
CO5	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Average	2.75	2	2.25	2	2	2	2	2	2	2	2	2	3	2.75

ME 36501: REFRIGERATION & AIR CONDITIONING

O1	Describe the basic concepts of refrigeration system and explain various types of refrigerants and their properties
CO2	Explain and analyze vapour compression systems
CO3	Analyze vapour absorption systems, low temperature and unconventional refrigeration systems
CO4	Analyze air-conditioning processes using the principles of psychometric
CO5	Explain air-conditioning systems and their applications in real world scenario.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-		-	-	-	-	-	-	3	1
CO2	3	3	2	3	-		1	-	-	-	-	-	3	1
CO3	3	2	2	2	-		-	-	-	-	-	-	3	1
CO4	3	3	2	2	-		-	-	-	-	-	-	3	1
CO5	3	3	2	2	-		-	-	-	-	-	-	3	1
Average	3	2.8	2	2.2	-	-	1	-	-	-	-	-	3	1

ME 36503: MACHINE DESIGN – II

CO1	Apply the theory of dynamics loading, fatigue, endurance limits, creep and stress concentration to solve engineering problems.
CO2	Design analysis of different types of gears.
CO3	Design of different types of springs, axle and shaft, power screw
CO4	Design analysis and selection of different types of journal bearings, selection of belts and chains
CO5	Design analysis of various I.C. engine components

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3			2					2	3	1
CO2	3	3	3	3	1							2	3	1
CO3	3	3	3	3	1							2	3	1
CO4	3	3	3	3	1							2	3	1
CO5	3	3	3	3	2							2	3	1
Average	3	3	3	3	1.25		2					2	3	1

ME 36506: FLUID MACHINERY

CO1	Describe the working of impact of jet and Pelton turbine along with their performance parameters.
CO2	Describe the working of Francis and Kaplan along their performance parameters. To select and analyze an appropriate turbine with reference to given situation in power plants.
CO3	Discuss the operation of centrifugal pumps and to estimate performance parameters of a given Centrifugal and Reciprocating pump.
CO4	Discuss the operation of reciprocating pumps and their performance parameters.
CO5	Explain basic concepts of homogeneity and visualize dimensional analysis.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	1	-	-	-	2	-	-		3	2
CO2	3	2	2	3	1	-	-	-	2	-	-	1	3	2
CO3	3	2	2	3	3	-	-	-	2	-	-	1	3	1
CO4	3	2	2	2	1	-	-	-	-	-	-	-	3	1
CO5	3	3	3	2	-	-	-	-	-	-	-	1	3	2
Average	3	2.2	2.2	2.6	1.5	-	-	-	2	-	-	1	3	1.6

ME 36509: INTERNAL COMBUSTION ENGINE

CO1	Analyze various air standard and actual cycles. Classify internal combustion engines based on different parameters.
CO2	Describe various qualities of engine fuels, carburetor fundamentals and its function for automobiles.
CO3	Analyze the phenomenon of combustion and describe the functioning of fuel injection system in SI engine and analyze the combustion phenomenon in CI engine.
CO4	Discuss pollutant formation and their control. Explain modern trends in IC engines
CO5	Describe various mechanisms of lubrication and cooling systems. Evaluate the performance of engines.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3			2					2	3	1
CO2	3	3	3	3	1							2	3	1
CO3	3	3	3	3	1							2	3	1
CO4	3	3	3	3	1							2	3	1
CO5	3	3	3	3	2							2	3	1
Average	3	3	3	3	1.25		2					2	3	1

IP36504: INDUSTRIAL ENGINEERING AND PRODUCTION MANAGEMENT

CO1	Distinguish the basic concepts of industrial engineering.
CO2	Analyze the fundamentals of production management, PPC, and facilitiesplanning.
CO3	Apply the quantitative models in aggregate production planning and scheduling.
CO4	Explain the fundamentals of materials management.
CO5	Explain the fundamentals of quality control.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO2	3	3	2	–	–	–	–	–	–	–	–	1	3	1
CO3	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO4	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO5	3	2	2	–	–	–	–	–	–	–	–	1	3	1
Average	3	2.2	2	–	–	–	–	–	–	–	–	1	3	1

ME 46018: AUTOMOBILEENGINEERING

CO1	Analyze and evaluate vehicle structures for safety and integrity.
CO2	Predict vehicle handling and understand steering system design.
CO3	Optimize vehicle ride comfort, stability, and performance.
CO4	Understand and analyze friction clutches, electrical systems, and general automobile engineering principles.
CO5	Analyze vehicle performance and understand transmission systems for efficient operation.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	–	–	–	–	–	–	–	–	1	–	2
CO2	3	3	–	–	–	–	–	–	–	–	–	1	–	1
CO3	3	3	2	–	–	–	–	–	–	–	–	1	1	1
CO4	3	3	1	–	–	–	–	–	–	–	–	1	2	1
CO5	3	3	–	–	–	–	–	–	–	–	–	1		1
Average	3	3	1.67	–	–	–	–	–	–	–	–	1	1.5	1.2

ME 46051: VIBRATION & NOISECONTROL

CO 1	Develop mathematical models of machines/structures as SDOF Systems and estimation of natural frequencies, damping factors.
CO 2	Determine response of SDOF damped Systems under external excitation
CO 3	Analyze 2DOF systems to find out modal data, design of undammed dynamic vibration absorber, Analyze modal parameters.
CO 4	analyze vibration records and determine sound levels on logarithmic scale (dB), loudness, and loudness levels
CO 5	Apply techniques of noise control as per industry norms.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	–	–	–	–	–	–	–	–	1	2	2
CO2	3	3	2	–	–	–	–	–	–	–	–	1	2	2
CO3	3	3	2	–	–	–	–	–	–	–	–	1	2	2
CO4	3	3	2	2	1	–	2	–	–	–	–	1	2	2
CO5	3	3	2	–	1	3	2	–	–	–	–	1	2	2
Average	3	3	2	2	1	3	2	–	–	–	–	1	2	2

ME 46020: COMPUTER AIDED DESIGN

CO 1	Distinguish the application of CAD Hardware and Software.
CO 2	Explain the Mathematical modeling of curves representation for geometric modeling and geometric models transformation
CO 3	Design and application of parametric representation of curves for surface modeling.
CO 4	Apply solid modeling tools and understanding about reverse engineering
CO 5	Apply numerical methods for analysis of the various types of models

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO2	3	3	2	–	–	–	–	–	–	–	–	1	3	1
CO3	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO4	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO5	3	2	2	–	–	–	–	–	–	–	–	1	3	1
Average	3	2.2	2	–	–	–	–	–	–	–	–	1	3	1

ME 46219: ADVANCED MACHINE DESIGN

CO1	Design analysis of rotating ring, disk and curved machine member and their applications in designing of different machine components.
CO2	Design analysis of parts of unsymmetrical section
CO3	Demonstrate reliability based design. Design of machine tool derives for different machines such as lathe,milling and drilling
CO4	Explain optimum design analysis of simple machine members and human factors in design.
CO5	Design analysis of automotive gear box.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO2	3	3	2	–	–	–	–	–	–	–	–	1	3	1
CO3	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO4	3	2	2	–	–	–	–	–	–	–	–	1	3	1
CO5	3	2	2	–	–	–	–	–	–	–	–	1	3	1
Average	3	2.2	2	–	–	–	–	–	–	–	–	1	3	1

ME 4620B: DESIGN OF AIR CONDITIONING EQUIPMENT

CO1	Distinguish various types of compressors, evaporators and condensers used in refrigeration industry.
CO2	Explain Kyoto protocol and need for using eco-friendly refrigerants.
CO3	Classify psychometric properties and air washer.
CO4	Analyze the size of air conditioning for a particular commercial application.
CO5	Design air conditioning and air distribution to maintain indoor air quality.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	–	1	–	–	–	–	–	–	1	3	2
CO2	3	2	1	–	1	–	–	–	–	–	–	1	3	2
CO3	3	1	1	–	1	–	–	–	–	–	–	–	3	1
CO4	3	1	2	–	1	–	–	–	–	–	–	–	3	1
CO5	3	2	1	–	1	–	–	–	–	–	–	–	3	2
Average	3	1.6	1.2	–	1	–	–	–	–	–	–	1	3	1.6

ME 4620A: INDUSTRIAL TRIBOLOGY ANDMAINTENANCE ENGG

CO1	Demonstrate the origin of tribology, its constituents, microscopic factors involved,surface topography and applications.
CO2	Explain basics of friction, its laws, theories, mechanism, material andparameter influence.
CO3	Explain basics of wear phenomenon, its types, wear equations andparameters.
CO4	Categorize lubrication mechanisms, their mathematical aspects, designfactors, applications and types.
CO5	Classify maintenance techniques and machine health monitoring.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	–	1	–	2	–	–	–	–	1	3	2
CO2	3	2	1	–	1	2	2	–	–	–	–	1	3	2
CO3	3	2	2	–	2	2	–	–	–	–	–	–	3	1
CO4	3	1	2	–	1	–	–	–	–	–	–	–	3	1
CO5	3	2	1	–	1	–	–	–	–	–	–	–	3	2
Average	3	1.8	1.4	–	1.2	2	2	–	–	–	–	1	3	1.6

ME 46218: MECHATRONICS ANDAUTOMATION

CO 1	Distinguish various control actions and apply the concepts of transfer functions for mathematical modeling mechanical and electrical system
CO 2	Explain system stability criteria, method and application of PID controller
CO 3	Discuss various types of solenoids, relays and electromechanical actuators and Demonstrate various hydraulic and pneumatic systems and their applications
CO 4	Apply different motion control techniques in various engineering applications.
CO 5	Explain signal conditioning and data acquisition process.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	–	2	–	–	–	–	–	–	2	2	2
CO2	2	3	3	2	2	–	–	–	–	–	–	1	3	2
CO3	2	1	–	–	–	–	–	–	–	–	–	1	3	–
CO4	2	2	2	–	–	–	–	–	–	–	–	2	2	–
CO5	2	–	–	–	–	–	–	–	–	–	–	1	2	–
Average	2	2	2.333	2	2	–	–	–	–	–	–	1.4	2.4	2

ME 46671: ARTIFICIAL INTELLIGENCE

CO1	Build intelligent agents for search and games
CO2	Solve AI problems through programming with Python
CO3	Compute optimization and inference algorithms for model learning
CO4	Design and develop programs for an agent to learn and act in a structured environment
CO5	Apply the principle of reinforcement learning

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	1	2	–	–	–	–	1	3	2
CO2	3	2	1	2	2	2	2	–	–	–	–	1	3	2
CO3	3	2	1	–	2	2	–	–	–	–	–	–	3	1
CO4	3	2	1	–	1	1	–	–	–	–	–	–	3	1
CO5	3	2	1	–	1	–	–	–	–	–	–	–	3	2
Average	3	2	1	–	1.4	1.5	2	–	–	–	–	1	3	1.6

IP 46316: OPERATIONS RESEARCH

CO1	Analyze any real life system with limited constraints and depict it in a model form and convert the problem into a mathematical model
CO2	Analyze and Simulate different real life probabilistic situations using Monte Carlo simulation technique.
CO3	Analyze variety of problems such as linear programming, assignment, transportation, Game theory and Dynamic programming etc.
CO4	Design and develop programs for an agent to learn and act in a structured environment.
CO5	Explain different queuing situations and find the optimal solutions using models for differentsituations.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	–	1	1	–	–	–	–	1	1	2	2	1
CO2	2	3	–	1	1	–	–	–	1	1	1	1	2	1
CO3	2	3	–	1	1	–	–	–	1	1	2	2	2	1
CO4	2	3	–	1	1	–	–	–		1	2	1	2	1
CO5	2	3	–	1	1	–	–	–	1	1	1.5	1.5	2	1
Average	2	3	–	1	1	–	–	–	1	1	1.5	1.5	2	1

ME 46315: HYDRAULIC, PNEUMATIC &FLUIDIC CONTROL

CO1	Develop understanding the principles of operation of hydraulic, pneumatic and fluidic control systems.
CO2	Categorize fluid power symbols; demonstrate knowledge of basic fluid power theory and fluid conditioning.
CO3	Demonstrate mechanical aptitude to accomplish maintenance, testing and repair of hydraulic and pneumatic components and systems.
CO4	Compute programmable Logic Controllers, Basic logic operations, and feedback devices and sensors.
CO5	Explain fluidic components, analogue and digital amplifiers and sensors.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	2	1	-	-	-	-	-	-	-	-	-
CO3	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	2	2	1	-	-	-	-	-	-	-	-	-
Average	2.8	1.6	1.6	2	1	–	–	–	–	–	–	-	-	-

ME 4630A: BIO MECHANICS

CO 1	Explain the mechanical functioning of human body.
CO 2	Discussion of through and expression in the field of biomechanics.
CO 3	Application of biomechanical in biomechanical system of human body.
CO 4	Categorize the biomechanical system for human devil development.
CO 5	Explain the application of force, torque etc. to human body.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	1	-	-	-	-	-	-	-	3	2
CO2	3	2	2	2	1	-	-	-	-	-	-	-	3	2
CO3	3	1	1	-	-	-	-	-	-	-	-	-	3	1
CO4	3	2	2	2	1	-	-	-	-	-	-	-	3	1
CO5	2	2	2	2	1	-	-	-	-	-	-	-	3	1
Average	2.8	1.6	1.6	1.75	1	-	-	-	-	-	-	-	3	1.4

E 46327: DATA SCIENCES

CO1	Demonstrate understanding of the mathematical foundations needed for data science.
CO2	Collect, explore, clean, munge and manipulate data.
CO3	Implement models such as k-nearest Neighbors, Naive Bayes, linear and logistic regression, decision trees, neural networks and clustering.
CO4	Build data science applications using Python based toolkits.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	–	–	1	–	–	–	–	–	–	1	1	1
CO2	3	2	–	–	1	–	–	–	–	–	–	1	1	1
CO3	3	2	–	2	1	–	–	–	–	–	–	1	1	1
CO4	3	2	2	–	1	–	–	–	–	–	–	1	2	1
CO5	3	2	1	–	1	–	–	–	–	–	–	1	2	1
Average	3	2	1.5	2	1	–	–	–	–	–	–	1	1.4	1

ME 4630C: POWER PLANT & ENERGY MANAGEMENT

CO1	Enhancement of power plant & energy management
CO2	Analyze problem in domain of power plant.
CO3	Exposure to application oriented problem solving and building capabilities to formulate and solve such problems.
CO4	Inculcation of sense of social responsibility
CO5	Explain the importance of sustainable development and evolving approaches for it.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	–	1	1	–	–	–	–	–	–	2	2	1
CO2	3	2	–	1	1	–	–	–	–	–	–	2	2	1
CO3	3	2	–	2	1	–	–	–	–	–	–	1	2	1
CO4	3	2	2	–	1	–	–	–	–	–	–	1	2	1
CO5	3	2	1	–	1	–	–	–	–	–	–	1	2	1
Average	3	2	1.5	1.33	1	–	–	–	–	–	–	1.4	2	1

ME 46667: COMPOSITE MATERIALS

CO1	Discuss the development of composite materials, their importance, its engineering potential and classification of composites.
CO2	Identify constituents of composites with their types, role, development, selection and their influence on mechanical properties.
CO3	Describe fundamentals of manufacturing processes used for development of composites, their types, methods, parameter to be controlled, relative advantages and limitations.
CO4	Categorize micro-mechanical concepts of composites, stress-strain characteristics of FRP composites, anisotropic/orthotropic materials, and their transformation.
CO5	Discuss the strength and failure concept in composites, failure mechanics of composites, and know about composite codes & standards and testing.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	–	–	–	–	–	–	1	2	1
CO2	3	2	1	1	1	–	–	–	–	–	–	1	2	1
CO3	3	2	1	1	1	–	–	–	–	–	–	1	2	1
CO4	3	2	1	–	–	–	–	–	–	–	–	1	2	1
CO5	3	2	1	–	–	–	–	–	–	–	–	1	2	1
Average	3	2	1	1	1	–	–	–	–	–	–	1	2	1

ME 46668: RENEWABLE ENERGY SOURCES

CO1	Discuss the potential impacts of harnessing energy sources.
CO2	Measure solar radiation and understand methods of utilizing solar energy.
CO3	Classify of wind turbines and its subsystems
CO4	Classify of biomass and bio-energy.
CO5	Distinguish the methods of harnessing ocean, geothermal and hydel energy.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	–	–	2	2	–	–	–	–	–	3	1
CO2	3	2	2	2	1	–	–	–	–	–	–	–	3	1
CO3	3	1	1	–	2	2	–	–	–	–	–	–	3	1
CO4	3	1	–	–	2	2	2	–	–	–	–	–	3	1
CO5	3	–	–	–	–	1	1	–	–	–	–	–	3	1
Average	3.00	1.25	1.67	2.00	1.67	1.75	1.67	–	–	–	–	–	3	1

ME 46670: FINITE ELEMENT METHODS

CO1	Evaluate of problems by approximate methods over the whole domain.
CO2	Apply FEM to formulate and solve 1-D problems.
CO3	Solve truss, beam and frame problems by finite element method
CO4	Write shape functions two dimensional and quadrilateral elements and solve two dimensionalproblems.
CO5	Solve problems of bars for free vibration, forced vibration and transient vibration

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	1	–	–	–	–	–	–	1	1
CO2	3	2	1	1	1	1	–	–	–	–	–	–	1	1
CO3	3	2	1	1	1	1	–	–	–	–	–	–	1	1
CO4	3	2	1	–	–	–	–	–	–	–	–	–	1	1
CO5	3	2	1	1	–	–	–	–	–	–	–	–	1	1
Average	3	2	1	1	1	1	–	–	–	–	–	–	1	1

ME 4660A: ROBOTICS

CO1	Classify basic terminologies and concepts associated with Robotics and Automation.
CO2	Categorize robot kinematics and dynamics to explain motion and force analysis in robotics.
CO3	Application of different types of sensors and actuating system in robotics.
CO4	Apply concept of control system in robotics
CO5	Application of AI and Embedded systems in Robotics

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	–	1	1	–	–	–	–	–	2	1
CO2	3	2	1	1	–	–	–	–	–	–	–	–	2	1
CO3	3	1	1	–	–	–	–	–	–	–	–	–	1	1
CO4	3	1	1	–	–	–	–	–	–	–	–	–	1	1
CO5	3	1	1	–	–	–	–	–	–	–	–	–	1	1
Average	3	1.4	1	1	–	1	1	–	–	–	–	–	1.4	1

ME 46705: ENGINEERINGOPTIMIZATION

CO1	Evaluate complex engineering problems into mathematical models to solve for optimize solutions.
CO2	Apply various optimization techniques for single and multi-variable problems.
CO3	Analyze various methods of solving the unconstrained optimization problems.
CO4	Analyze various methods of solving the constrained optimization problems.
CO5	Analyze various non-traditional and neural network based optimizations methods.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	–	1	1	–	–	–	–	–	2	1
CO2	3	2	1	2	–	1	1	–	–	–	–	–	2	1
CO3	3	1	1	1	–	1	1	–	–	–	–	–	2	1
CO4	3	1	1	1	–	–	–	–	–	–	–	–	2	1
CO5	3	1	1	1	–	–	–	–	–	–	–	–	2	1
Average	3	1.4	1	1.4	–	1	1	–	–	–	–	–	2	1

ME 46704: DESIGN OF THERMALSYSTEMS

CO1	Distinguish various types of heat exchangers and terminologies related to them.
CO2	Design shell and tube type heat exchanger for particular industrial applications.
CO3	Design evaporator, cooling towers and condensers.
CO4	Discuss the fouling phenomenon, prevention and mitigation.
CO5	Design a heat exchanger using different software.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	2	1	-	-	-	-	-	-	-	3	2
CO2	3	3	2	1	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	3	-	-	-	-	-	-	-	-	3	2
CO4	3	3	2	2	-	-	-	-	-	-	-	-	3	2
CO5	3	1	1	1	1	2	1	-	-	-	-	-	3	2
Average	3	2.6	1.6	1.8	1	2	1	-	-	-	-	-	3	2

ME 4670A: GAS DYNAMICS & FLUIDFLOW

CO1	Discuss the types of flows through the nozzle and diffusers and factors affecting them.
CO2	Classify the boundary layer theory including drag and lift.
CO3	Classify the hydrodynamics lubrication and selection of lubrications for specific purpose.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	1	-	-	-	-	-	-	-	2	1
CO2	3	2	2	1	-	-	-	-	-	-	-	-	2	1
CO3	3	2	1	2	-	-	-	-	-	-	-	-	2	1
CO4	3	2	1	1	-	-	-	-	-	-	-	-	2	1
CO5	3	2	1	1	1	2	1	-	-	-	-	-	2	1
Average	3	2	1.2	1.4	1	2	1	-	-	-	-	-	2	1

ME 46706: 3D PRINTING AND DESIGN

CO1	Analyze CAD data formats, assess the importance of STL files, and differentiate between additive and conventional manufacturing processes.
CO2	Select and apply additive manufacturing processes and parameters for diverse applications in aerospace, electronics, healthcare, defense, automotive, construction, and food processing.
CO3	Classify materials, including polymers, metals, non-metals, and ceramics, and evaluate their properties for additive manufacturing.
CO4	Design additive manufacturing equipment, understand bonding mechanisms, troubleshoot faults, and comprehend the role of lasers in additive manufacturing
CO5	Implement post-processing techniques, inspect and test products for defects, ensuring adherence to quality requirements in additive manufacturing.

ARTICULATION MATRIX:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	–	3	–	–	–	–	–	–	1	3	2
CO2	3	2	3	–	–	–	–	–	–	–	–	1	3	2
CO3	3	2	3	–	–	–	1	–	–	–	–	1	3	2
CO4	3	3	2	–	–	–	–	–	–	–	–	1	3	2
CO5	3	2	2	–	3	–	–	–	–	–	–	1	3	2
Average	3	2.2	2.4	–	3	–	1	–	–	–	–	1	3	2