DEPARTMENT OF MECHANICAL ENGINEERING
KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL – 15
(An Autonomous Institute under Kakatiya University, Warangal)
SCHEME OF INSTRUCTION & EVALUATION FOR TWO YEAR POSTGRADUATE PROGRAMME

PRR-20

M.TECH. (DESIGN ENGINEERING)

SEMESTER-I

Sr. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
				L	T	P		CIE –TA							ESE	Total Marks
								I²RE				Minor	MSE	Total		
								ATLP	CRP	CP	PPT					
1	PC	P20DE101	**Professional Core-1:** Mechanical Vibrations	3	-	-	3	8	8	8	6	10	20	60	40	100
2	PC	P20DE102	**Professional Core-2:** Computer Aided Design	3	-	-	3	8	8	8	6	10	20	60	40	100
3	PE	P20DE103	**Professional Elective-I/ MOOCs-I**	3	-	-	3	8	8	8	6	10	20	60	40	100
4	PE	P20DE104	**Professional Elective-II/ MOOCs-II**	3	-	-	3	8	8	8	6	10	20	60	40	100
5	PC	P20DE105	**Core Lab-I:** (*based on Professional Core-I*) Mechanical Vibrations Lab	-	-	4	2	-	-	-	-	-	-	60	40	100
6	PC	P20DE106	**Core Lab-II: (*based on Professional Core-II*)** CAD Lab	-	-	4	2	-	-	-	-	-	-	60	40	100
7	MC	P20MC107	**Research Methodology and IPR**	2	-	-	2	8	8	8	6	10	20	60	40	100
8	AC	P20AC108	**Audit Course - 1**	2	-	-	1	8	8	8	6	10	20	60	40	100
			Total:	16	-	8	19							480	320	800

[L= Lecture, T = Tutorials, P = Practicals, C = Credits, ATLP = Assignments, CRP = Course Research Paper, CP = Course Patent, PPT = Course Presentation, Minor=Minor Examination, MSE=Mid Semester Examination and ESE=End Semester Examination]

Professional Elective-1 / MOOCs–I	Professional Elective-2 / MOOCs–II	Audit Course-1
P20DE103A: Fracture Mechanics	P20DE104A: Analysis and Synthesis of Mechanisms	P20AC108A: English for Research Paper Writing
P20DE103B: Stress Analysis	P20DE104B: Mathematical methods in Engineering	P20AC108B: Sanskrit for Technical Knowledge
P20DE103C: Additive Manufacturing	P20DE104C: Computational Fluid Dynamics	P20AC108C: Constitution of India
P20DE103D: MOOCs	P20DE104D: MOOCs	P20AC108D: Pedagogy Studies

Total Contact Periods/Week: 24 **Total Credits: 19**

P20DE101 MECHANICAL VIBRATIONS

Class: M. Tech. I – Semester **Specialization**: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: transient vibrations and critical speeds of shafts
LO2: two degree of freedom systems and the working principle of vibration absorbers
LO3: multi-degree of freedom systems and continuous systems
LO4: numerical methods in vibrations

UNIT-I (9)

Transient Vibrations: Introduction, response to an impulsive, step and pulse input; phase plane method

Critical Speeds of Shafts: Introduction, critical speed of a light shaft having single and multiple discs with damping; secondary critical speed

UNIT-II (9)

Two Degrees of Freedom Systems: Free vibration of spring-coupled system and mass coupled system; bending vibration of two degree freedom system; forced vibration. **Vibration control**: active method of vibration control-piezoelectric accelerometer; passive method of vibration control -vibration absorber; vibration isolation

UNIT-III (9)

Multi-Degree of Freedom Systems: Normal mode of vibration; flexibility matrix and stiffness matrix; Eigen values and Eigen vectors; orthogonal properties; modal matrix, modal analysis; forced vibration by matrix inversion; model damping in forced vibration

Continuous systems: Vibrations of strings; longitudinal vibrations of bars; torsional vibrations of circular shafts; lateral vibrations of beams

UNIT-IV (9)

Numerical Methods in Vibrations: Introduction, Rayleigh method, Dunkerley's method, matrix iteration method, Stodola's method and Holzer's method

Textbook:

[1] G.K. Grover, *Mechanical Vibrations*, 8th ed. Roorkee: Nemchand & Bros, 2009.

Reference Books:

[1] Rao S.S., *Mechanical Vibrations*, 4th ed. New Delhi: Pearson Education Inc., 2004.

[2] V.P.Singh, *Mechanical vibrations*, 3th ed. New Delhi: Dhanpat Rai & Co., 2006.

[3] William T. Thomson and Marie Dillon Dahleh, *Theory of Vibration with Applications*, 5th ed. Singapore: Pearson Education, 2003.

[4] S. Graham Kelly, *Fundamentals of Mechanical Vibrations,* 2nd ed. Singapore: McGraw-Hill, 2000.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: determine the transient vibrations of the spring mass system and analyze critical speeds of the shaft
CO2: analyze the two degrees of freedom systems & the vibration absorbers
CO3: compute the natural frequencies, mode shapes of a multi degree of freedom system & continuous system
CO4: determine natural frequencies and develop mode shapes by using numerical methods

Course Articulation Matrix (CAM): P20DE101 MECHANICAL VIBRATIONS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DE101.1	2	1	2	2	1
CO2	P20DE101.2	2	1	2	2	1
CO3	P20DE101.3	2	1	2	2	1
CO4	P20DE101.4	2	1	2	2	1
P20DE101		**2**	**1**	**2**	**2**	**1**

P20DE102 **COMPUTER AIDED DESIGN**

Class: M. Tech. I– Semester **Specialization**: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives(LOs):

This course will develop students' knowledge in/on…

LO1: CAD tools and mathematical representations of curves
LO2: mathematical and parametric representation of surfaces
LO3:solid modeling techniques and transformation of geometric models
LO4:CAD/CAM data exchange and system simulation

UNIT – I (9)

CAD Tools: Introduction, application of computer for design, CAD hardware and software, hardware integration and networking, hardware trends, software modules, graphics standards, modeling and viewing; applications and benefits of CAD

Mathematical Representations of Curves: wireframe models, wireframe entities, curve representation; parametric representation of analytic curves, synthetic curves and curve manipulations

UNIT – II (9)

Mathematical Representations of Surfaces: Mathematical representation of surfaces, surface model, surface entities, surface representation; parametric representation of surfaces-plane surface, ruled surface, surface of revolution, tabulated cylinder

Parametric Representation of Synthetic Surfaces: Hermite Bi-cubic surface, Bezier surface, B-Spline surface, COONs surface, blending surface, sculptured surface; surface manipulations–displaying, segmentation, trimming and intersection

UNIT – III (9)

Mathematical Representations of Solids: Solid representation, Boundary representation(B-rep), Constructive Solid Geometry (CSG), Sweep representation, Analytical Solid Modeling (ASM); solid manipulations, solid modeling based applications; mass properties calculations and mechanical tolerancing

Transformation of Geometric Models: Review of transformations, mappings of geometric models; translational mapping, rotational mapping, general mapping, mappings as changes of coordinate system; inverse transformations and mapping; projections of geometric models; orthographic and perspective projections

UNIT –IV (9)

CAD/CAM Data Exchange: Evaluation of Data- Exchange format, IGES, STEP, STL, ACIS & DXF

System Simulation: System simulations, need of simulation, area of applications, components of a system, discrete and continuous systems, model of a system, types of models and types of simulation approaches

Textbook:

[1] Ibrahim Zeid, and Sivasubramanian R.R., *CAD/CAM Theory and Practice*, 2nd ed. New Delhi: Tata Mc Graw Hill, 2010.

Reference Books:

[1] Ibrahim Zeid, *Mastering CAD/CAM*, 1st ed. New Delhi: Mc Graw Hill Higher education, 2010.

[2] Jerry, Banks., John, Carson., Barry, Nelson., and David. Nicol., *Discrete-Event System Simulation*, 5th ed. New Delhi: Pearson Education, India, 2010.

[3] P. N. Rao, *CAD/CAM: Principles and applications,* 3rd ed. New Delhi: Tata McGraw Hill Education Pvt. Ltd., 2010.

[4] P. Radhakrishnan / V. Raju / S. Subramanian, *CAD / CAM / CIM*,3rd ed. New Delhi: New Age International Pvt. Ltd., 2008.

Course Learning Outcomes(Cos):
On completion of this course, students will be able to…

CO1:discuss CAD tools and determine the parametric equation of synthetic curves
CO2: develop mathematical models to represent surfaces and analyze parametric representation of synthetic surfaces
CO3:analyzesolid modeling techniques and determine the transformation mapping of geometrical models
CO4: differentiate various data exchange formats and evaluate system simulation

Course Articulation Matrix (CAM):P20DE102 COMPUTER AIDED DESIGN						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	**P20DE102.1**	2	1	2	2	1
CO2	**P20DE102.2**	2	1	2	2	1
CO3	**P20DE102.3**	2	1	2	2	1
CO4	**P20DE102.4**	2	1	2	2	1
P20DE102		2	1	2	2	1

P20DE103A **FRACTURE MECHANICS**

Class: M. Tech. I Semester **Specialization**: Design Engineering (DE)

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Exam	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on…

LO1: fracture mechanics and energy release rate
LO2: stress intensity factor and crack tip plasticity
LO3: test methods of various techniques
LO4: fatigue failure and environment fracture

UNIT-I (9)

Fracture Mechanics: Modes of fracture failure; brittle and ductile fracture, damage tolerance
Energy release rate: Griffith's dilemma, surface energy, crack resistance, stable and unstable crack growth, r-curve for brittle cracks, critical energy release rate

UNIT-II (9)

Stress Intensity Factor: Stress and displacement fields in isotropic materials; edge cracks, embedded cracks-elliptical crack, semi-elliptical cracks and quarter cracks
Anelastic Deformation at the Crack Tip: shape and size of plastic zone – plane stress, plane strain, effective crack length – approximation approach, Irwin plastic zone correction, plastic zone size through the dugdale approach, effect of plate thickness; j-integral; crack tip opening displacement, fracture toughness

UNIT-III (9)

Test methods: Linear-elastic fracture toughness **(**K_{IC}) test, Different test specimens, Constraints on specimen-Dimensions, Clip Gauge, Load Displacement Test**;** Test methods to determine elastic-plastic fracture toughness (J_{IC}) – Graphical Interpretation, Formulation, Test methods to determine strain energy release rate for mode I crack (G_{IC}) and mode II crack (G_{IIC}); Determination of critical CTOD

UNIT-IV (9)

Fatigue failure: Crack propagation, effect of an overload, crack closure, variable amplitude fatigue load
Environment-Assisted Fracture: Micro mechanisms, test methods – constant load method, constant displacement method; major factors; design considerations

Textbook:

[1] Prashant Kumar, *Element of Fracture Mechanics*, Mc Graw Hill Private Limited, New Delhi, 2014.

Reference Books:

[1] T.L. Anderson, *Fracture Mechanics Fundamentals and Applications*, 4th ed. Oxfordshire, UK: Taylor & Francis Group. 2017.

[2] Broek D, *Elementary engineering fracture mechanics*, Martinusnijhoff publishers, 1982.

[3] A Nadai, W. S. Hemp, *Theory of flow and fracture of solids*, McGraw Hill Book Company, 1950.

[4] Nestor Perez, *Fracture Mechanics*, Kluwer academic publishers, Newyork, 2004.

[5] Richard W. Hertzberg, *Deformation and Fracture Mechanics of Engineering Materials*, 4th ed. John Wiley & Sons, Inc. 1996.

[6] Robert P. Wei, *Fracture Mechanics Integration of Mechanics*, Materials Science and Chemistry, Cambridge University Press, 2010.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: analyze the material behavior for different modes of fracture failure and determine the energy release rate

CO2: determine the stress intensity factor and differentiate crack tip conditions

CO3: solve fracture mechanics problems using various techniques

CO4: appraise the propagation of crack under overload, fatigue load & environmental cracking conditions

Course Articulation Matrix (CAM):
P20DE103A FRACTURE MECHANICS

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DE103A.1	2	1	2	2	1
CO2	P20DE103A.2	2	1	2	2	1
CO3	P20DE103A.3	2	1	2	2	1
CO4	P20DE103A.4	2	1	2	2	1
P20DE103A		**2**	**1**	**2**	**2**	**1**

P20DE103B STRESS ANALYSIS

Class: M. Tech. I– Semester **Specialization**: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: analysis of stress & strain
LO2: stress-strain relations
LO3: pressurized cylinders and rotating disks
LO4: energy principles and variational methods

UNIT – I (9)

Analysis of Stress & Strain: Definition and notation of stress, differential equations of equilibrium, specification of stress at a point, principal stresses and the Mohr diagram, three dimensional stress at a point, boundary conditions in terms of given surface forces; strain components, specification of strain at a point, compatibility equations, three-dimensional strains, Mohr's circle for strains, measurement of strains bonded strain gages

UNIT –II (9)

Stress-Strain Relations: Idealization of engineering materials; generalized Hooke's law-elastic symmetry, elastic constants; strain energy-saint Venant's principle

UNIT– III (9)

Pressurized Cylinders and Rotating Disks: Governing equations, stress in thick walled cylinder under internal and external pressure, shrink fit compound cylinders, stresses in rotating flat solid disk, flat disk with central hole, disk with variable thickness, disk of uniform strength, plastic action in thick walled cylinders and rotating disk

UNIT - IV (9)

Energy Principles and Variational Methods: Principle of potential energy, principle of complementary energy; Rayleigh-Ritz method, Galerkin method; Reciprocal Theorem and Castigliano's Theorems

Textbook:

[1] Ansel. C. Ugural and Saul. K. Fenster, *Advanced Mechanics of Materials and Applied Elasticity,* 5th ed., New Jersey: PTR Prentice Hall, Englewood Cliffs, 2011.

Reference Books:

[1] Richard G. Budynas, *Advanced Strength and Applied Stress Analysis,* 2nd ed., New Delhi: Tata McGraw-Hill, 2011.

[2] C.T. Wang, *Applied Elasticity,* New York: McGraw-Hill, 1953.

[3] G.E. Dieter, *Mechanical Metallurgy,* Singapore: McGraw-Hill Book Company, 1988.

[4] S.P. Timoshenko and J.N. Goodier, *Theory of Elasticity,* New York: 3rd ed. McGraw-Hill, 1985.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: solve stresses under different kinds of static loading and determine the principle stresses & strains by using Mohr's circle

CO2: develop stress – strain relations, equations of elasticity and determine stresses at a point on an object subject to arbitrary loading

CO3: analyze governing differential equations of thick cylinders under uniform pressure & rotating disks

CO4: apply different energy principles and variational methods for structural analysis

Course Articulation Matrix (CAM): P20DE103B STRESS ANALYSIS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DE103B.1	2	1	2	2	1
CO2	P20DE103B.2	2	1	2	2	1
CO3	P20DE103B.3	2	1	2	2	1
CO4	P20DE103B.4	2	1	2	2	1
P20DE103B		**2**	**1**	**2**	**2**	**1**

P20DE103C ADDITIVE MANUFACTURING

Class: M. Tech. I – Semester **Specialization**: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: engineering materials and materials science for Additive Manufacturing (AM)
LO2: basics of AM and Vat Photopolymerization AM Processes
LO3: Extrusion-Based AM Processes and Sheet Lamination AM Processes
LO4: Powder Bed Fusion AM Processes and Directed Energy Deposition AM Processes

UNIT – I (9)

Introduction to engineering materials: Classification, types and their structures, phase diagrams, heat treatment processes- annealing, normalizing, hardening, tempering and chemical hardening techniques, mechanical properties evaluation, types of aluminium alloys, designation, properties and applications, titanium alloys

Materials science for AM - Multifunctional and graded materials in AM, role of solidification rate, evolution of non-equilibrium structure, structure property relationship, steels used in AM and applications

UNIT –II (9)

Introduction to Additive Manufacturing: Introduction to AM, AM evolution, classification of AM, Steps in AM, advantages of AM and types of materials for AM

CAD Data Exchange Formats: CAD data exchange formats, tessellated models, STL format, STL File Problems, STL File manipulation and repair algorithms

Vat Photo polymerization AM Processes: Stereo Lithography (SL), materials, process modeling, SL resin curing process, SL scan patterns, Micro-stereo lithography, mask projection processes, two-photon vat photo polymerization, process benefits, drawbacks and applications of vat photo polymerization

UNIT– III (9)

Extrusion-Based AM Processes: Fused Deposition Modelling (FDM), principles, materials, process modelling, plotting and path control, Bio-Extrusion, contour crafting, process benefits, drawbacks and applications of extrusion-based processes

Sheet Lamination AM Processes: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), gluing, thermal bonding, LOM applications

UNIT - IV (9)

Powder Bed Fusion AM Processes: Selective laser Sintering (SLS), materials, powder fusion mechanism and powder handling, process modelling, SLS metal and ceramic part creation, Electron Beam Melting (EBM), process benefits, drawbacks and applications of powder bed fusion processes

Directed Energy Deposition AM Processes: Process description, material delivery, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), electron beam based metal deposition, process benefits, drawbacks and applications of directed energy deposition processes

Textbooks:

[1] William D. Callister, *Material Science and Engineering an Introduction*, 4th ed. John wiley & sons, Inc., 2007.

[2] Chua Chee Kai., Leong Kah Fai., Chu Sing Lim, *Rapid Prototyping: Principles and Applications in Manufacturing*, 2nd ed. World Scientific, 2003.

[3] Ian Gibson., David W Rosen., Brent Stucker., *Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing*, Springer, 2010.

Reference Books:

[1] Patri K. Venuvinod and Weiyin Ma, *Rapid Prototyping: Laser-based and Other Technologies*, Springer, 2004.

[2] D.T. Pham, S.S. Dimov, *Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling*, Springer 2001.

[3] Rafiq Noorani, Rapid Prototyping: *Principles and Applications in Manufacturing,* John Wiley & Sons, 2006.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: Explain the various engineering materials utilised in AM processes

CO: Explore the applications of AM processes in various fields

CO3: *Apply the knowledge of solid based processes in AM components*

CO4: Apply the knowledge of powder based processes in AM components

Course Articulation Matrix (CAM): P20DE103C ADDITIVE MANUFACTURING						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DE103C.1	2	1	2	2	1
CO2	P20DE103C.2	2	1	2	2	1
CO3	P20DE103C.3	2	1	2	2	1
CO4	P20DE103C.4	2	1	2	2	1
P20DE103C		2	1	2	2	1

P20DE 104A ANALYSIS AND SYNTHESIS OF MECHANISMS

Class: M. Tech. I Semester **Specialization:** Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):

This course will develop students' knowledge in/on…

LO1: classification of mechanisms analysis of planar mechanisms

LO2: graphical synthesis of planar mechanisms

LO3: analytical synthesis of planar mechanisms

LO4: analysis of spatial mechanisms

UNIT-I(9)

Mechanisms: Analysis and synthesis; definitions and assumptions; planar and spatial mechanisms; mobility; classification of mechanisms (Torfason's categorization)

Analysis of Planar Mechanisms: Loop-closure equation; algebraic position analysis; displacement difference between two points; rotation and translation; review of analytical methods of velocity and acceleration analysis of mechanisms; Euler-Savary equation, Bobillier constructions, cubic of stationary curvature

UNIT-II (9)

Graphical Synthesis of Planar Mechanisms: Type, number and dimensional synthesis; function generation, path generation and body guidance; accuracy (precision) points; types of errors, graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, centre and circle point curves; synthesis of four-bar and slider-crank mechanisms

UNIT-III (9)

Analytical Synthesis of Planar mechanisms: Chebesychev spacing; Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition; analytical synthesis using complex algebra; Bloch's method of synthesis; three accuracy point synthesis using complex numbers, equation of coupler curve, Robert-Chebychev theorem

UNIT-IV (9)

Analysis of Spatial Mechanisms: Introduction; position analysis, velocity and acceleration analysis; denavit-hartenberg parameters, matrix method for position, velocity and acceleration analysis of Hooke universal joint, constant distance method for analysis of RSCR spatial mechanism and dual number method for analysis of RCCC spatial mechanisms

Textbook:

[1] J.J. Uicker, G.R.Pennock and J.E. Shigley, "Theory of Machines and Mechanisms", 3rd ed. Oxford international student edition, 2013.*(Chapters 1 to 5,8 and 9)*

Reference Books:

[1] A. Ghosh and A.K. Mallik, "Theory of Machines and Mechanisms", Affiliated East-West Press, New Delhi, 1988.

[2] A.G. Erdman and G.N. Sandor, "Mechanism Design – Analysis and Synthesis", (Vol. 1 and 2), Prentice Hall India, 1988.

[3] A.S. Hall, "Kinematics and Linkage Design", Prentice Hall of India.

[4] Rao .V. Dukkipati, Spatial Mechanism-Analysis and Synthesis, CRC Press, 2010, New Delhi M/s narosa plublising house.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: analyze the kinematic behavior of planar mechanisms analytically

CO2: synthesize the planar mechanisms by graphical method

CO3: synthesize the planar mechanisms by analytical methods

CO4: analyze the kinematic behavior of spatial mechanisms by different analytical methods

Course Articulation Matrix (CAM):
P20DE104A ANALYSIS AND SYNTHESIS OF MECHANISMS

CO		PO 1	PO2	PO 3	PSO 1	PSO 2
CO1	P20DE104A.1	2	1	2	2	1
CO2	P20DE104A.2	2	1	2	2	1
CO3	P20DE104A.3	2	1	2	2	1
CO4	P20DE104A.4	2	1	2	2	1
P20DE104A		2	1	2	2	1

P20DE104B MATHEMATICAL METHODS IN ENGINEERING

Class: M. Tech. I-Semester **Specialization:** Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation:	60Marks
End Semester Exam:	40 Marks

Course Learning Objectives (LOs)

This course will develop student's knowledge on/in

LO1: various statistical measures to analyze the data in practical design engineering problems
LO2:probability distributions to interpret the data in experimental design engineering problems
LO3:applications of exact sampling distributions in testing of hypothesis
LO4:numericalmethods to solve ordinary and partial differential equations

UNIT-I (9)

Statistical measures: Measures of Central Tendency, measures of dispersion, skewness and kurtosis.

Curve fitting and principle of least squares: Fitting of a straight line, fitting second degree parabola, most plausible solution to system of linear equations, conversion of data to linear form, fitting of orthogonal polynomials

Correlation and Regression: Scatter Diagram, Karl Pearson's coefficient of correlation, rank correlation, multiple and partial correlation, lines of regression, regression coefficients, properties of regression coefficients, angle between two lines of regression, correlation coefficient between observed and estimated value, measures of correlation ratio, multiple linear, non-linear regression analysis

UNIT-II (9)

Random variables and Distribution functions: Discrete random variable, probability mass function, discrete distribution function, continuous random variable, probability density function, continuous distribution function, joint probability law, joint probability mass function, joint probability distribution function, marginal distribution function, joint density function, conditional distribution function, mathematical expectation, weak law of large numbers

Probability Distributions: Binomial, poison and normal distributions, central limit theorem and applications

UNIT-III (9)

Sampling and Large Sample Tests: Types of sampling, parameter and statistic, null hypothesis, alternative hypothesis, errors in sampling, critical region and level of significance, one tailed and two tailed tests, procedure for testing of hypothesis, test of significance for single mean, test of significance for difference of means, test of significance for difference of standard deviations

Applications of Exact sampling distributions: χ^2- test for goodness of fit, t-test for single mean, t-test for difference of means, F-test for equality of population variances, F-test for equality of several means

UNIT-IV (9)

Numerical Solution of Ordinary Differential Equations: Introduction, concept of numerical solution of a differential equation, Initial value problems; Runge-Kutta Methods; Predicator - corrector Methods: Adam's-Moulton, Milne's method

Numerical Solution of Partial Differential Equations: Second order linear partial differential equations; finite - difference approximations to derivatives; numerical solution of Laplace equation, heat equation in one dimension (parabolic equation) and wave equation in one dimension (hyperbolic equation)

Textbooks:

[1] S.C. Gupta and V.K. Kapoor, *fundamentals of mathematical statistics*, 10th ed. New Delhi: Sultan Chand & Sons, 2000.

[2] S.S. Sastry, *Introductory Methods of Numerical Analysis,* 5th ed. Prentice Hall of India**,** 2012.

Reference Books:

[1] S.P. Gupta, *Statistical Methods*, New Delhi: Sultan Chand &Sons

[2] R.V. Hogg, J.W. McKean and A. Craig, *Introduction to mathematical statistics*, 6th ed. PHI, 2006.

[3] MILLER & MILLER, John E. *Freund's mathematical statistics*, 6th ed. New Delhi: PHI, 2003.

[4] M.K. Jain, S.R.K. Iyengar and R.K. Jain., *Numerical Methods for Scientific and Engineering Computations*, Wiley Eastern Limited, 2001.

[5] Ronald E, Walpole, Sharon L. Myers, Keying Ye, *Probability and Statistics for Engineers and Scientists*, 8th ed. Pearson Prentice Hall, 2007

[6] Douglas C. Montgomery, *Design and Analysis of Experiments*, 7th ed. Wiley Student Edition, 2009.

Course Learning Outcome (COs):

On completion of this course, student will be able to …

CO1: analyze the data using various statistical measures

CO2: interpret the data using probability distributions.

CO3: apply exact sampling distributions in testing of hypothesis

CO4: apply numerical methods to solve ordinary and partial differential equations

Course Articulation Matrix (CAM)
P20DE104B: MATHEMATICAL METHODS IN ENGINEERING

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DE104B.1	2	1	1	1	1
CO2	P20DE104B.2	2	1	1	1	1
CO3	P20DE104B.3	2	1	1	1	1
CO4	P20DE104B.4	2	1	1	1	1
P20DE104B		**2**	**1**	**1**	**1**	**1**

P20DE104C COMPUTATIONAL FLUID DYNAMICS

Class: M. Tech. I – Semester

Specialization: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop students 'knowledge in/on...

LO1: governing equations pertinent to CFD
LO2: mathematical behavior of PDEs and turbulence modeling
LO3: discretization schemes used in CFD
LO4: grid generation and solution techniques of incompressible flows

UNIT – I (9)

Introduction: History and philosophy of computational fluid dynamics, comparison of CFD with experimental and analytical methods, application of CFD
Governing Equations of Fluid Dynamics: Substantial derivative; divergence of the velocity; principles of conservation - continuity equation, momentum equation and energy equation; navier-stokes equations pertinent to CFD; Initial and physical boundary conditions

UNIT – II (9)

Mathematical Behaviour of Partial Differential Equations (PDEs): Classification of Quasi-Linear PDEs, Methods of determining the classification, general behaviour of hyperbolic, Parabolic and elliptic equations
Turbulence: Characteristics of turbulence, source, scales, energy cascade; derivation of RANS equations; turbulence modelling – Eddy viscosity, zero equation models, one equation models and k-ε two equation model

UNIT – III (9)

Basic Aspects of Discretization: Discretization techniques – Finite Difference Method (FDM) and Finite Volume Method (FVM); FDM - Taylor series expansion, difference equations, explicit and implicit formulations; uniform and non-uniform spaced grid points; application to heat conduction and wave equations
Errors and Stability Analysis: Diffusion and dispersion errors, stability of 1D diffusion equations, 1D wave equations, consistency and convergence

UNIT - IV (9)

Geometry Modelling and Grid Generation: Practical aspects of computational modeling of flow domains, grid generation, types of mesh and selection criteria
CFD Techniques: Lax-Wendroff technique, MacCormack's technique, Relaxation technique, Alternating-Direction-Implicit (ADI) technique and pressure correction technique

Textbook:

[1] Anderson J.D. (Jr), Computational Fluid Dynamics: The Basics with Applications, New Delhi: McGraw-Hill Education Pvt. Ltd., India, 2012.

Reference Books:

[1] Anderson D.A., Tannehill J.C., Pletcher R.H., Computational Fluid Mechanics and Heat Transfer, New York: Hemisphere Publishing Corporation, U.S.A. 2004.

[2] Hoffmann K. A, Chiang S. T., Computational Fluid Dynamics, 4th ed. USA: Engineering Education System, 2000.

[3] Muralidhar K., Sundararajan T., Computational Fluid Flow and Heat Transfer, 2nd ed. New Delhi: Narosa Publishers, 2003.

[4] Biswas G., Eswaran, V., Turbulent Flows: Fundamentals, Experiments and Modelling, Pangbourne: Alpha Science International Ltd, England, 2002.

Course Learning Outcomes (COs):

Upon completion of this course, the student will be able to…

CO1: solve the basic governing equations for fluid flow and heat transfer
CO2: analyze the behavior of PDEs and turbulence modelling
CO3: apply the different discretization schemes for incompressible flow problems
CO4: create grid and develop the solution techniques for incompressible flows

Course Articulation Matrix (CAM): P20DE104C COMPUTATIONAL FLUID DYNAMICS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DE104C.1	2	1	2	2	1
CO2	P20DE104C.2	2	1	2	2	1
CO3	P20DE104C.3	2	1	2	2	1
CO4	P20DE104C.4	2	1	2	2	1
P20DE104C		**2**	**1**	**2**	**2**	**1**

P20DE105 MECHANICAL VIBRATIONS LAB

Class: M. Tech. I- Semester **Specialization:** Design Engineering

Teaching Scheme :

L	T	P	C
-	-	4	2

Examination Scheme :

Continuous Internal Evaluation	:	60 marks
End Semester Examination	:	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in /on

LO1*: undamped, free translational vibrations of a one degree , two degree freedom system*
LO2*: torsional, viscously damped system and dunkerley's rule*
LO3*: sinusoidal pulse, coulomb damping, impact*
LO4*: three degree freedom, mode shapes, unit step functions and critical speeds of a system*

LIST OF EXPERIMENTS

1. Plot the non-dimensional response magnitude and phase angle for a system with harmonically moving base
2. Study of undamped free vibrations, plot the time variations of the displacement, velocity and acceleration of the mass in a given spring mass system
3. Determine the free-vibration response of a given two degree of freedom system with the initial conditions.
4. Study of damped torsional oscillations & plot the free vibration response of a viscously damped system.
5. Plot the response for two-degree of freedom torsional system.
6. Verification of Dunkerley's rule with experimental values conducted on beam.
7. Response for Simplified one degree of freedom model of vehicle suspension system when vehicle encounters bump in road modelled as a versed sinusoidal pulse
8. Response of a single degree of freedom spring-mass system subjected to coulomb damping
9. Plot the impulse response of a single degree of freedom structure due to a single impact and double impact.
10. Obtain the natural frequencies & mode shapes for a 3-degree of freedom system
11. Plot the displacement response of all the masses in a 3 degree of freedom system subjected to unit step function u(t).
12. Whirling of shaft and analysis of critical speed of shaft.

Exercises will be solved using MATLAB or C++ during regular class work in each week.

Laboratory Manual:

[1] Mechanical Vibrations Lab Manual, Faculty of Mechanical Engineering, Department of ME, KITSW.

Reference Books:

[1] Rao V Dukkipati , *Solving Vibration Analysis Problems using MATLAB* , 1st ed. New Delhi: New Age International (P) Limited, 2007**.**

[2] Rao V Dukkipati , *Solving Engineering System Dynamics Problems with MATLAB*, New Delhi: New Age International (P) Limited, 2007.

[3] Rao S.S., "Mechanical Vibrations", 4th ed. Noida: Pearson Education Inc., 2004.
[4] William T. Thomson and Marie Dillon Dahleh, *Theory of Vibration with Applications*, 5th ed. Singapore: Pearson Education, 2003.
[5] R.Venkatachalam, Mechanical Vibrations, New Delhi: PHI Learning, 2014.

Course Learning Outcomes (Cos):

Upon completion of the course, students will be able to:

CO1: analyze undamped, free translational vibrations of a one degree, two degree freedom system

CO2: examine torsional, viscously damped system and apply Dunkerley's rule

CO3: determine the response of sinusoidal pulse, coulomb damping, impulse response of the impact

CO4: Identify mode shapes, three degree freedom system, its response to unit step function and critical speeds of a system

Course Articulation Matrix (CAM): P20DE105 Mechanical Vibrations Lab						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DE105.1	**2**	**2**	**1**	**2**	**1**
CO2	P20DE105.2	**2**	**2**	**1**	**2**	**1**
CO3	P20DE105.3	**2**	**2**	**1**	**2**	**1**
CO4	P20DE105.4	**2**	**2**	**1**	**2**	**1**
P20DE106		**2**	**2**	**1**	**2**	**1**

P20DE106 **CAD LAB**

Class: M. Tech. I- Semester **Specialization:** Design Engineering

Teaching Scheme :

L	T	P	C
-	-	4	2

Examination Scheme :

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in /on

LO1: 2D geometric modeling
LO2: 3D part modeling
LO3: assembly modeling
LO4: analyzing and printing of physical model using 3D printer

LIST OF EXPERIMENTS

Module-I:

1. Introduction to CAD software, GUI (Graphical User Interface)
2. Working with profile tools, operation tools and Constraints in sketcher module
3. Working with transformation features, Boolean operations, datum planes
4. Working with assembly types and generating views

Module-II:

5. Sketch racket pawl using 2D tools
6. Create a 3D model for Plummer block
7. Create a fidget spinner model using transformation features
8. Develop a screw-driver with knurling and helix tools
9. Construct and assemble the screw jack parts using assembly constraints
10. Construct, assemble the parts of knuckle joint, generate views and BOM

Module-III:

11. Develop S-wrench using CAD tools and convert it to STL file
12. Develop, analyse and print a mechanical component using 3D printer

Note: *Experiments will be performed using CREO/ CATIA software during regular class work in each week.*

Laboratory Manual:

[1] CAD Lab Manual, Faculty of Mechanical Engineering, Department of ME, KITSW.

Reference Books:

[1] Prof. Sham Tickoo, *AutoCAD 2017* for Engineers and Designers, 23rd ed. India Dream tech Press, Wiley Publisher, , 2016.

[2] Prof. Sham Tickoo, *Pro / Engineer PTC Creo Parametric 3.0 for Engineers and Designers,* 5th ed.Dream tech Press, USA, 2015.

[3] Michael J. Rider Ph.D., *Designing with CREO Parametric 3.0,* USA, Ohio Northern University, SDC publications, 2015.

[4] Jaecheol Koh, *CATIA V5 Design Fundamentals*, ONSIA Inc., 2012.

[5] Prof. Sham Tickoo, *CATIA V5 – 6R 2017 for Designers,*15th ed. USA, BPB Publications, 2017.

Course Learning Outcomes (COs):

On *completion of this course, the student will be able to…*

CO1: construct a 2D geometry
CO2: create a 3D part model
CO3: build assembly model
CO4: analyze and print a physical model using 3D printer

Course Articulation Matrix (CAM) : P20DE106 CAD LAB						
CO Code		**PO 1**	**PO 2**	**PO 3**	**PSO 1**	**PSO 2**
CO1	**P20DE106.1**	2	2	2	1	2
CO2	**P20DE106.2**	2	2	2	1	2
CO3	**P20DE106.3**	2	2	2	1	2
CO4	**P20DE106.4**	2	2	2	1	2
P20DE106		**2**	**2**	**2**	**1**	**2**

P20MC107: RESEARCH METHODOLOGY AND IPR

Class: **M. Tech., I-Semester**

Specialization(s): SCE, DE, VE, PE, SE DS, DC & CSP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):

This course will develop students' knowledge in/on

LO1: research methodology, approaches, principles of experimental design and research plan

LO2: sampling design, data collection, data representation and statistical analysis

LO3: layout of a research report, technical paper writing, oral presentation and intellectual property

LO4: patent rights and developments in IPR.

UNIT-I (6)

Research Methodology: Meaning of research, objectives, motivation, types, approaches, research methods vs methodology, scientific method, research process, criteria for good research, literature review, research ethics, plagiarism, problems encountered by researchers in India

Defining the Research Problem and Research Design: Selecting a research problem, necessity and techniques in defining research problem, need for research design, features of good design, different research designs, basic principles of experimental design, developing a research plan

UNIT – II (6)

Sampling Design: Census and sample survey, implications, steps, criteria of selecting a sampling procedure, characteristics of a good sample design, types of sample designs, complex random sampling designs

Data Collection & Data Analysis: Collection of primary and secondary data, observation method, interview method, collection of data through questionnaires, schedules, data organization, methods of data grouping, diagrammatic and graphic representation of data, regression modeling, direct and interaction effects, ANOVA, F-test, Time series analysis, autocorrelation and autoregressive modeling

UNIT – III (6)

Interpretation and Report Writing: Interpretation technique, precaution in interpretation, significance, steps and layout of report writing, types of reports, oral presentation, mechanics of writing a research report, precautions, format of the research report, synopsis, dissertation, thesis, references/bibliography/webliography, technical paper writing/ journal/ report writing, making presentation, use of visual aids

Nature of Intellectual Property: Patents, designs, trade and copyright

Process of Patenting and Development: Technological research, innovation, patenting, development

UNIT – IV (6)

Patent Rights: Scope of patent rights, licensing and transfer of technology, patent information and databases, geographical indications

New Developments in IPR: Administration of patent system, new developments in IPR, IPR of biological systems, computer software etc. traditional knowledge case studies, IPR and IITs

Textbooks:

[1] C.R Kothari and Gaurav Garg, "*Research Methodology, Methods & Techniques*", 4th ed., New Age International Publishers, 2019 (*Chapters 1, 2, 3, 6, 7, 11, 14*)

[2] Deborah Ebouchoux, "*Intellectual Property, The Law of Trademarks, Copyrights, Patents and Secrets*", 4th ed., Delmar, Cengage Learning, 2012 *(Chapter 1, 2, 3, 17, 18)*

[3] ***Anti-plagiarism policy of KITSW*** - A handout prepared by Dean, Research and Development, KITSW, Jan 2020.

[4] Frequently Asked Questions, Office of CGPDTM, INDIA 2020

[5] Patent Office Procedures: http://www.ipindia.nic.in/writereaddata/images/pdf/patent-office-procedures.pdf

References Books:

[1] Stuart Melville and Wayne Goddard, "*Research methodology: An Introduction for Science & Engineering Students*" 2nd ed., JUTA, 2007.

[2] Robert P. Merges, Peter S. Menell, Mark A. Lemley, "*Intellectual Property in New Technological Age - I*", Clause 8, 2016.

[3] Dobera J Halbert, "*Resisting Intellectual Property*", Taylor & Francis Ltd., 1st ed., 2005.

[4] Ranjit Kumar, "*Research Methodology: A Step by Step Guide for beginners*", 3rd ed., Sage Publications India Pvt. Ltd, New Delhi, 2011.

[5] T. Ramappa, "*Intellectual Property Rights Under WTO*", 4th ed., .S. Chand, 2008

[6] R. Ganesan, "*Research Methodology for Engineers*", MJP Publishers, Chennai, 2011

[7] Patent application procedures: https://patentinindia.com/cost-patent-registration-india/

[8] http://www.ipindia.nic.in/history-of-indian-patent-system.htm

[9] Patent Law India: https://www.mondaq.com/india/patent/656402/patents-law-in-india--everything-you-must-know

[10] How to file patents: https://iptse.com/how-to-file-patents-understanding-the-patent-process-in-india/

[11] How Can I get a patent for my project: https://patentinindia.com/cost-patent-registration-india/

Course Learning Outcomes (COs):

On completion of this course, students will be able to

CO1: develop and formulate research problem using research methodology techniques.

CO2: utilize techniques of data modeling and analysis to solve research problem

CO3: choose an appropriate methodology to write a technical report and present a research paper

CO4: judge patent rights and adapt new developments in IPR for their patent publications

Course Articulation Matrix (CAM): **P20MC107 RESEARCH METHODOLOGY & IPR**

CO		PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	P20MC107.1	2	2	1	2	1
CO2	P20MC107.2	2	2	1	2	1
CO3	P20MC107.3	2	2	1	2	1
CO4	P20MC107.4	2	2	-	2	1
P20MC107		**2**	**2**	**1**	**2**	**1**

P20AC108A: ENGLISH FOR RESEARCH PAPER WRITING

Class: M. Tech. I-Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC &CSP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60 Marks
End Semester Examination	40 Marks

Course Learning Objectives (LOs):

This course will develop students' knowledge in /on

LO1*: planning for quality research writing with improved level of readability*
LO2*: constituents and attributes of a research paper*
LO3*: specifications for research transcription and pedagogic skills for reporting research*
LO4*: guidelines for publishing research papers in quality journals*

UNIT-I (6)

Skills for Research Writing: Planning and preparation, word order, breaking up long sentences, structuring paragraphs and sentences, being concise and removing redundancy

Improving Level of Readability: Avoiding ambiguity and vagueness, clarifying who did what, highlighting your findings, hedging and criticizing, paraphrasing and plagiarism

UNIT-II (6)

Constituents of a Research Paper: Abstract, styles of abstract, keywords, characteristics of poor abstract, assessing quality of abstract, introduction- outline in introduction, assessing quality of introduction, review of literature, ways of referring to authors in literature

Attributes of a Research paper: Methodology, use of tenses and articles in methodology, results, styles of reporting results, discussion, styles of writing discussions, conclusions, impact of writing conclusions, assessing quality of conclusions, final check-Do's and Don'ts

UNIT-III (6)

Specifications for Research Transcription: Structuring phrasing and summarizing of title and abstract, structuring phrasing and summarizing of introduction, critical review of literature, limitations of previous work and demonstration of innovation in proposed research

Pedagogic skills for reporting research: Structuring and justifying the methodology, structuring, reporting, interpreting and summarizing results, structuring, comparing, interpreting and summarizing discussions, styles of writing discussions, structuring, differentiating and summarizing of conclusions

UNIT-IV (6)

Quality Assurance and Corroboration of Research: Indexing and harnessing useful phrases, adapting final check for readability, clarity in logical order of argumentation, checking for journal guidelines, consistency, accuracy, acknowledgements and spell-check

Textbook:

[1] Adrian Wallwork, "*English for Writing Research Papers*", 2nd ed., New York, Dordrecht Heidelberg London, Springer books, 2016.

Reference Books:

[1] Goldbort R, "*Writing for Science, London*", 2nd ed Yale University Press, 2006

[2] Day R, "*How to Write and Publish a Scientific Paper*", 8th ed, Cambridge University Press, 2016

[3] Adrian Wallwork , "*English for Academic Research ,Grammar, Usage and Style*",2nd ed, Springer New York Dordrecht Heidelberg London, Springer Books ,2012.

Course Learning Outcomes (Cos):

On completion of this course, the student will be able to…

CO1: *develop essential skills for research writing with improved level of readability.*
CO2: *organize the constituents of research paper and derive conclusions with a final check of Do's and Don'ts*
CO3: *justify, interpret, compare and summarize results for proposed methodologies in research paper*
CO4: *adopt quality assurance methods like final check for readability, consistency and accuracy of a research paper.*

Course Articulation Matrix: P20AC108A ENGLISH FOR RESEARCH PAPER WRITING					
CO Code	PO 1	PO 2	PO 3	PSO 1	PSO 2
P20AC108A.1	1	2	2	-	-
P20AC108A.2	1	2	2	-	-
P20AC108A.3	1	2	2	-	-
P20AC108A.4	1	2	2	-	-
P20AC108A	**1**	**2**	**2**	**-**	**-**

P20AC108B: SANSKRIT FOR TECHNICAL KNOWLEDGE

Class: M. Tech. I – Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CSP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: proficiency in illustrious Sanskrit, the scientific language in the world
LO2: the depth of grammar in sanskrit
LO3: deeper insight into tenses used in sanskrit
LO4: concepts related to various technical fields

UNIT – I (6)

Introduction: Alphabets, vowels, consonants, Māheśvara sutras, combined alphabets, verbs, basic words

UNIT –II (6)

Study of grammar I: Singular/dual/plural, nominative case, accusative case, instrumental case, dative case, ablative case, genitive case, locative case

UNIT– III (6)

Study of grammar II: Nouns and adjectives, indeclinable, present tense, past tense, future tense, order and request, prefixes, number word, combinations ablative case, genitive case, locative case and cases

UNIT - IV (6)

Technical concepts related to various fields: Technical concepts of mathematics, chemistry, electrical science, mechanics & mechanical science, metallurgy, aeronautics, marine science, measurement of time, astronomy, architecture, botany, agriculture, hygiene & health

Textbooks:

[1] Dr.Vishwas, *Abhyaspustakam,* 1st ed. New Delhi: Samskrita-Bharti Publication, 2014

[2] Suresh Soni, *India's Glorious Scientific Tradition,* 1st ed. NewDelhi: Ocean books (P) Ltd, 2008 (Unit IV)

Reference Books:

[1] Vempati Kutumbshastri, *Teach You Sanskrit*, 1st ed. New Delhi: Prathama Deeksha Rashtriya Sanskrit Sansthanam, 2012

Course Learning Outcomes (COs):
On completion of this course, students will be able to ...

CO1: understand to read and write basic Sanskrit language
CO2: identify the usage of grammar in the ancient Indian language
CO3: make use of tenses in Sanskrit language
CO4: analyze the ancient Sanskrit literature on Science and Technology

Course Articulation Matrix (CAM): P20AC108B SANSKRIT FOR TECHNICAL KNOWLEDGE						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20AC108B.1	1	1	-	-	-
CO2	P20AC108B.2	1	1	-	-	-
CO3	P20AC108B.3	1	1	-	-	-
CO4	P20AC108B.4	1	1	-	-	-
P20AC108B		**1**	**1**	**-**	**-**	-

P20AC108C: CONSTITUTION OF INDIA

Class: M. Tech. I – Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CSP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: state policy and parliamentary form of government, council of ministers
LO2: necessity of act of information technology and its powers, cyber security and its laws
LO3: consumer protection act, rights of consumer-deficiency in service
LO4: crimes against women, different legislations, process of investigation and right to information act

UNIT – I (6)

Constitutional Law: Constitution meaning and significance-constitutional history-status of fundamental rights-role of fundamental duties-implementation of the directive principles of the state policy-parliamentary form of government-president-prime minister-council of ministers-federal structure in constitution-relations between central and state-amendment of constitution –procedure and kinds of amendments

UNIT –II (6)

Law of information technology: Evolution-genesis and necessity of information technology act-features and various authorities under it act-their powers-impact of other related enactments-e-commerce laws in India-digital and electronic signatures in Indian laws-e-contracts and its validity in India-cyber tribunals-definition and necessity of cyber security-computer and cyber security-e-mail security-database security-operating system security-advance computers-network and mobile security techniques- sensitive personal data and information in cyber laws-cyber crimes-hacking-phishing –stalking-cyber terrorism

UNIT– III (6)

Corporate Law: Definition and essentials of valid contract - corporate incorporation and management-directors of company-company secretary-corporate governors-different system of corporate governors-corporate governance and social responsibility-emerging trends-corporate and social environment responsibility-competition law-objectives competition commission of India-consumer protection act-consumerism-rights of consumer-deficiency in service-unfair trade practices-e-contracts etc.

UNIT - IV (6)

Criminal Law: Definition of crime--crimes against women including cyber crimes-criminal justice systems-protection for women for atrocities-different legislations like constitution, Indian penal code, human rights, domestic violence, equality in rights, dowry prohibition, prevention of child marriage, prevention of sexual harassment against woman at work place, protection of children some sexual harassment – investigation – compliant - process of investigation – FIR, panchanama, closure report, charge sheet etc - procedure of search

Right to Information Act: Freedom of information - Indian constitution and right to information - legislating the right to information - salient features of the right to information act 2005 - public authority under RTI act - nature of RTI, exemptions and limitations - composition, powers and functions of the information commissions - right to information and implementation issues

Textbooks:

[3] M.P.Jain, Indian *Constitutional Law*, Vol.1, Wadhwa & Co, Nagpur, 2003

[4] Vakul Sharma, *Information Technology – Law and Practice,* Universal Law Publishing, 3rd ed. 2011

[5] Gower and Davies, *Principles of Modern Company Law,* Sweet and Maxwell Publishing, 10th ed.

[6] Ratan Lal and Dhiraj Lal: *Indian Penal Code*, Wadhwa & Co., 36th ed. 2000

[7] O.P.Srivastava: *Principles of Criminal Law,* Eastern Book Company, 6th ed. 2016

[8] KM Shrivastava, *The Right to Information: A Global Perspective*, Lancer Publisher, New Delhi (2013)

Reference Books:

[1] H.M.Seervai, *Constitutional Law of India, Vol.3,* N. M. Tripathi, 4th ed., 1997

[2] G.C.V.Subba Rao, *Indian Constitutional Law*, S. Gogia& Co., Hyderabad

[3] Dr.S.R.Myneni, *Information Technology Law (Cyber Laws),* Asia Law House, Hyderabad, 1st ed. 2018.

[4] J.M. Thomson: *Palmer's Company Law, Vol.4, 21st Ed. Wildy & Sons Ltd.*

[5] P.S.Achutan Pillai: *PSA Pillai's Criminal Law*, Butterworth Co., 2000.

[6] K.D.Gour: *Criminal Law*, *Cases and Materials*, 9th ed. LexisNexis, 2019.

[7] Sairam Bhat, *Right to Information and Good Governance*, National Law School of India University, 2016.

[8] Dheera Khandelwal and KK Khandelwal, *A Commentary and Digest on the Right to Information Act 2005,* 2nd ed., 2014.

Course Learning Outcomes (COs):
On completion of this course, students will be able to ...

CO1: develop the knowledge in state policy and parliamentary form of government
CO2: make use of information technology act and cyber security
CO3: utilize the consumer protection act and rights consumer
CO4: perceive the legislations and understand the process of investigation and right to information act

Course Articulation Matrix (CAM): P20AC108C : CONSTITUTION OF INDIA						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20AC108C.1	1	1	1	-	-
CO2	P20AC108C.2	1	1	1	-	-
CO3	P20AC108C.3	1	1	1	-	-
CO4	P20AC108C.4	1	1	1	-	-
P20AC108B		**1**	**1**	**1**	**-**	-

P20AC108D : PEDAGOGY STUDIES

Class: M. Tech. I –Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CSP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop student's knowledge in/on

LO1: terminology of pedagogy studies, role of curriculum, relation between teaching and learning
LO2: effectiveness of pedagogical practices and teaching strategies
LO3: student centered approaches of learning
LO4: factors supporting effective pedagogy, research gaps and future directions of potential areas

UNIT-I (6)

Methodology: Aims and rationale, policy background, conceptual framework and terminology, theories of learning- behaviourism, constructivism, social constructivism, critical theory, difference between curriculum and syllabus, curriculum, importance of curriculum for students and teachers, role played by the curriculum

Teaching- Learning Process: Introduction, concept of pedagogy, principles of teaching, maxims of teaching, phases of learning, relationship between teaching and learning, factors of teaching and learning in classroom situation, difference between teaching and learning

UNIT-II (6)

Overview of pedagogical practices in developing countries: Overview and aims, pedagogy approaches, pedagogy as practice, pedagogy as ideas, pedagogy and equity, curriculum, teacher education - initial teacher education, continuing professional development, training unqualified teachers, **e**effectiveness of pedagogical practices, pedagogic theory and pedagogical strategies, teachers' attitudes and beliefs

Strategies of Teaching: Features, characteristics, advantages and limitations of lecture method, demonstration method, experimental method and discussion method

UNIT-III (6)

Student Centred Approaches: Features, characteristics, advantages and limitations of constructivist approach of learning, discovery method of learning, enquiry method, Project Based Learning (PBL), Activity Based Learning (ABL)

Practical Approaches: features of experiential learning and teacher's role, peer tutoring, field visits and process of organizing, e-learning tools, strengths and weaknesses

UNIT-IV (6)

Role of teacher education, school curriculum, guidance materials in supporting effective pedagogy: Professional development, alignment with classroom practices and follow-up support, peer support, support from the head teacher and the community, curriculum and assessment, barriers to learning: limited resources and large class sizes

Research gaps and future directions: Research design, contexts, pedagogy, teacher education, curriculum and assessment, dissemination and research impact

Textbooks:

[1] Dr. S. K. Bhatia, Dr. Sonia Jindal, *A Textbook of curriculum, pedagogy and evaluation*, 1st ed., New Delhi: Paragon International Publishers, 2016.

[2] Jo Westbrook, Naureen Durrani, Rhona Brown, David Orr, John Pryor, Janet Boddy, Francesca Salvi, *Pedagogy, Curriculum. Teaching Practices and Teacher Education in Developing Countries*, Education Rigorous Literature Review, Center for International Education, University of Sussex, December 2013.

Reference Books:

[1] Ackers J, Hardman F, *Classroom interaction in Kenyan primary schools*, Compare, 31 (2): 245-261, 2001.

[2] Agrawal M, *Curricular reform in schools: The importance of evaluation*, Journal of Curriculum Studies, 36 (3): 361-379, 2004.

[3] Akyeampong K, *Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1.* London: DFID, 2003.

[4] Akyeampong K, Lussier K, Pryor J, Westbrook J, *Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?* International Journal Educational Development, 33 (3): 272–282, 2013.

[5] Alexander RJ, *Culture and pedagogy: International comparisons in primary education.* Oxford and Boston: Blackwell, 2001.

[6] Chavan M, *Read India: A mass scale, rapid, 'learning to read' campaign,* 2003.

[7] www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Learning Outcomes (COs):
On completion of this course, the students will be able to…

CO1: describe the significance of curriculum, relationship between teaching and learning
CO2: justify the effectiveness of pedagogical practices of teaching and compare the lecture, demonstration, experimental and discussion methods of teaching strategies
CO3: analyze the role of student centred approaches in learning of a student and identify suitable approaches for the improvement
CO4: exemplify the role of professional development, curriculum, assessment for effective pedagogy and identify the research gaps in allied areas

Course Articulation Matrix: P20AC108D PEDAGOGY STUDIES						
CO		**PO 1**	**PO 2**	**PO 3**	**PSO 1**	**PSO 2**
CO1	P20AC108D.1	-	1	-	-	-
CO2	P20AC108D.2	1	1	1	-	-
CO3	P20AC108D.3	1	1	1	-	-
CO4	P20AC108D.4	1	1	1	-	-
P20AC108D		**1**	**1**	**1**	**-**	**-**

DEPARTMENT OF MECHANICAL ENGINEERING
KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL – 15
(An Autonomous Institute under Kakatiya University, Warangal)
SCHEME OF INSTRUCTION & EVALUATION FOR TWO YEAR POSTGRADUATE PROGRAMME

PRR-20

M.TECH. (DESIGN ENGINEERING)

SEMESTER-II

Sr. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
								CIE - TA							ESE	Total Marks
								I²RE				Minor	MSE	Total		
				L	T	P		ATLP	CRP	CP	PPT					
1	PC	P20DE201	**Professional Core-3:** Finite Element Methods	3	-	-	3	8	8	8	6	10	20	60	40	100
2	PC	P20DE202	**Professional Core-4:** Mechanics of Composite Materials	3	-	-	3	8	8	8	6	10	20	60	40	100
3	PE	P20DE203	**Professional Elective-3/ MOOCs-III**	3	-	-	3	8	8	8	6	10	20	60	40	100
4	PE	P20DE204	**Professional Elective-3/ MOOCs-IV**	3	-	-	3	8	8	8	6	10	20	60	40	100
5	PC	P20DE205	**Core Lab-3:**(*based on Professional Core-3*) FEM Lab	-	-	4	2	-	-	-	-	-	-	60	40	100
6	PC	P20DE206	**Core Lab-4: (***based on Professional Core-4)* Composite Materials Lab	-	-	4	2	-	-	-	-	-	-	60	40	100
7	PROJ	P20DE207	**Mini Project with Seminar**	-	-	4	2	-	-	-	-	-	-	100	-	100
8	AC	P20AC208	**Audit course - 2**	2	-	-	1	8	8	8	6	10	20	60	40	100
			Total:	14	-	12	19							520	280	800

[L= Lecture, T = Tutorials, P = Practicals, C = Credits, ATLP = Assignments, CRP = Course Research Paper, CP = Course Patent, PPT = Course Presentation, Minor=Minor Examination, MSE=Mid Semester Examination and ESE=End Semester Examination]

Professional Elective-3 / MOOCs–III	Professional Elective-4 / MOOCs–IV	Audit Course-2
P20DE203A: Tribology in Design	P20DE204A: Industrial Automation	P20AC208A: Stress Management by Yoga
P20DE203B: Robotics	P20DE204B: Design of Machine Components	P20AC208B: Value Education
P20DE203C: Product Design	P20DE204C: Design of Pressure vessels and Piping	P20AC208C: Personality Development through Life Enlightenment Skills
P20DE203D: MOOCs	P20DE204D: MOOCs	P20AC208D: Disaster Management

Total Contact Periods/Week: 26 **Total Credits: 19**

P20DE201 **FINITE ELEMENT METHODS**

Class: M. Tech. II-Semester **Specialization:** Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Exam	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on…
LO1: finite element method and formulation of the problem
LO2: linear FEM, beams and frames
LO3: finite element formulation of 2D problems and 1D plasticity
LO4: computer implementation of finite element method and contact problems

UNIT-I (9)

Introduction: Classification of problems – dimensionality, time dependence, boundary value problems, initial value problems, linear problems and non-linear problems

Finite Element Formulation : Differential equation as the starting point for FEM, steps in finite element method, discretization, types of elements, shape functions, linear elements, local and global coordinates, coordinate transformation and nodal degrees of freedom; convergence, h-refinement and p-refinement and Pascal's triangle

UNIT-II (9)

Linear FEM: FE formulation of 1D bar, 2D plane strain, Plane stress, 3D linear elastic continuum; Iso-parametric mapping and Numerical integration

Beams and Frames: Element matrices, assembling of global stiffness matrix, solution for displacements, reactions and stresses

UNIT-III (9)

Two dimensional problems: Constant Strain Triangle(CST), Linear Strain Triangle (LST), four noded and eight noded rectangular elements, lagrange basis for triangles and rectangles, serendipity interpolation functions; axisymmetric problems- axisymmetric formulations, element matrices, boundary conditions; heat transfer problems - conduction and convection - two-dimensional fin

FE formulation for 1D plasticity: Elastic, perfectly plastic material; isotropic and kinematic hardening; integration algorithms for 1D plasticity; fe formulation; Newton-Raphson method for solving nonlinear equilibrium equations

UNIT-IV (9)

Computer Implementation of Finite Element Method: Preprocessing – model definition, element type and material property definitions, types of analysis, loading and boundary conditions; meshing techniques – free and mapped meshing, quality checks; processing- solving for field variable; post processing – interpretation and validation of results and data interpretation

Contact Problems: Condition of impenetrability; Gap elements for modelling contact; tangent stiffness matrix and force vectors for 2D frictionless contact problems

Textbook:

[1] Chandrupatla T. R. and Belegundu A. D., *Introduction to Finite Elements in Engineering*, 4th ed. New Delhi: Pearson Education India, 2015. *(Chapters 1 to 5, 7 and 8)*

Reference Books:

[1] Singiresu S. Rao, *The Finite Element Method in Engineering*, 6th ed. Massachusetts: Elsevier Butterworth–Heinemann, 2017.
[2] David V. Hutton, *Fundamentals of Finite Element Analysis*, New Delhi: Tata McGraw-Hill India, 2017.
[3] Robert D. Cook, *Concepts and Applications of Finite Element Analysis*, 4th ed. New Delhi: Wiley India, 2007.
[4] J.N. Reddy, *Introduction to the Finite Element Method,* 4th ed. New Delhi: McGraw-Hill, 2018.
[5] Bathe K. J., *Finite Element Procedures*, 2nd ed. New Jersey: Prentice-Hall Inc., 2016.
[6] Logan Deryl L., *A First Course in Finite Element Method*, 5th Ed. New York: Thomson Brook/Cole, 2012.
[7] J. C. Simo and T. J. R. Hughes, *Computational Inelasticity*, 2nd ed. New York: Springer-Verlag New York, Inc., 1998.
[8] O. C. Zienkiewicz and R. L. Taylor, *Finite Element Method: Volume 2 Solid Mechanics*, 5th ed. Oxford: Butterworth-Heinemann, 2000.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: identify a given problem based on its dimensionality, time dependence &linearity; choose correct nodal degrees of freedom and develop suitable shape functions for an element
CO2: apply finite element formulation for linear problems in solid mechanics and solve beam & frame problems to determine displacements, reactions & stresses
CO3: analyze 2D problems, conduction & convection in 2D fins and solve non-linear equations of equilibrium using Newton-Raphson method
CO4: make use of commercial software for implementation of FEM to obtain stress concentration, elongations at nodes and solve contact problems using the techniques of non-linear FEM

Course Articulation Matrix (CAM):

P20DE201 FINITE ELEMENT METHOD

CO		PO 1	PO 2	PO 3	PSO 1	PSO 2
CO1	**P20DE201.1**	2	1	2	2	1
CO2	**P20DE201.2**	2	1	2	2	1
CO3	**P20DE201.3**	2	1	2	2	1
CO4	**P20DE201.4**	2	1	2	2	1
P20DE201		**2**	**1**	**2**	**2**	**1**

P20DE202 MECHANICS OF COMPOSITE MATERIALS

Class: M. Tech. II -Semester

Specialization: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):

This course will develop student's knowledge in/on…

LO1: basic concepts of composites and differences between composite materials and conventional materials
LO2: the stress-strain relations, relation between mathematical and engineering constants to find the strength of unidirectional lamina
LO3: elastic behavior of laminate by considering strain-displacement relations, stress-strain relation of layer within a laminate
LO4: stress and failure modes of laminates and design methodology for structural composite materials

UNIT- I (9)

Introduction: Overview, significance of composite materials, classification of composite materials, advantage and limitations of composite materials, comparison of composite materials with conventional materials and scope of the composite materials

Characteristics of Composite Materials: Geometric and physical definition, material response, scale of analysis; micromechanics, basic lamina properties, constituent materials and properties

UNIT-II (9)

Elastic Behavior of Unidirectional Lamina: Stress-Strain relations, relation between mathematical and engineering constants, transformation of stress, strain and elastic parameters

Strength of Unidirectional Lamina: Micromechanics of failure; failure mechanisms, macro-mechanical strength parameters, macro mechanical failure theories

UNIT-III (9)

Elastic Behavior of Laminate: Basic assumptions, strain-displacement relations, stress-strain relation of layer within a laminate, force and moment resultant, general load–deformation relations, analysis of different types of laminates

UNIT-IV (9)

Stress and Failure Analysis of Laminates: Types of failures, stress analysis and safety factors for first ply failure of symmetric laminates, micromechanics of progressive failure; progressive and ultimate laminate failure, design methodology for structural composite materials

Textbook:

[1] Isaac M. Daniels, Ori Ishai, *Engineering Mechaincs of Composite Materials*, 2nd ed., New York: Oxford University Press, 2006.

Reference Books:

[1] Bhagwan D. Agarwal, Lawrence J. Broutman, *Analysis and Performance of fiber composites*, 4th ed., USA: John Wiley and Sons, Inc. 2017.

[2] Madhujit Mukhopadhyay, *Mechanics of Composite Materials and Structures*, Hyderabad: University Press, 2004.

[3] Robert M. Jones, *Mechanics of Composite Materials*, 2nd ed., New York: Taylor and Francis, Inc., 1999.

Course Learning Outcomes (COs):
On completion of this course, students will be able to…

CO1: describe the basic concepts and differentiate composite materials with conventional materials
CO2: derive the stress-strain relations, relation between mathematical and engineering constants to find the strength of unidirectional lamina
CO3: estimate the elastic behavior of laminate by considering strain-displacement relations and stress-strain relation of layer within a laminate
CO4: analyze stress and failure modes of laminates and apply design methodology for structural composite materials

Course Articulation Matrix (CAM): P20DE202 MECHANICS OF COMPOSITE MATERIALS

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DE202.1	2	1	2	2	1
CO2	P20DE202.2	2	1	2	2	1
CO3	P20DE202.3	2	1	2	2	1
CO4	P20DE202.4	2	1	2	2	1
P20AC208D		2	1	2	2	1

P20DE 203A **TRIBOLOGY IN DESIGN**

Class: M. Tech. II -Semester **Specialization**: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation:	60 marks
End Semester Exam :	40 marks

Course Learning Objectives:
This course will develop students' knowledge in/on…
LO1: fundamentals of tribology, theories of friction, wear and lubrication to predict the frictional behavior
LO2: lubrication of bearings and hydrodynamic thrust bearing
LO3: hydrostatic, squeeze film and elasto-hydrodynamic lubrication
LO4: tribological aspects of rolling contact

UNIT-I (9)

Introduction: Definition; tribology in design - mechanical design of oil seals and gasket; tribology in industrial maintenance; bearings - sliding contact, rolling contact, terminology and comparison

Friction and Wear: Friction–laws, classification, causes; theories of dry friction, friction measurement, stick-slip motion and friction instabilities; wear– classification, wear between solids, wear between solid and liquid, factors affecting wear, measurement of wear; theories of wear, approaches to friction control and wear prevention, boundary lubrication, bearing materials and construction.

UNIT-II (9)

Lubrication Of Bearings: Mechanics of fluid flow - theory of hydrodynamic lubrication - mechanism of pressure development in oil film; two dimensional Reynolds's equation and its limitations; idealized bearings, infinitely long plane fixed sliders, infinitely long plane pivoted sliders, infinitely long journal bearings, infinitely short journal bearings; Raimondi and Boyd method - petroff's solution - parameters of bearing design - unit pressure temperature rise - length to diameter ratio - radial clearance - minimum oil-film thickness

Hydrodynamic Thrust Bearing: Introduction, pressure equation, load, center of pressure, friction - flat plate thrust bearing, and tilting pad thrust bearing

UNIT-III (9)

Hydrostatic and Squeeze Film Lubrication: Hydrostatic lubrication- basic concept, advantages and limitations; viscous flow through rectangular slot, load carrying capacity and flow requirement, energy losses, optimum design; squeeze film lubrication-basic concept, squeeze action between circular and rectangular plates, squeeze action under variable and alternating loads; application to journal bearings, piston pin lubrications

Elasto-Hydrodynamic Lubrication: Principles and applications, pressure viscosity term in Reynolds's equation, hertz's theory, Ertel-Grubin equation, Lubrication of spheres, Gear teeth bearings, Rolling element bearings

UNIT-IV (9)

Gas (Air) Lubricated Bearings: Introduction, merits, demerits and applications; tilting pad bearings, magnetic recording discs with flying head, hydrostatic bearings with air lubrication, hydrodynamic bearings with air lubrication, thrust bearings with air lubrication

Tribological Aspects of Rolling Motion: The mechanics of tyre- road interactions, road grip and rolling resistance, tribological aspects of wheel on rail contact.

Finite Bearings: Porous bearings foil bearings, Heat in bearings

Text books:

[1] S. K. Basu, S. N. Sengupta, B. B. Ahuja, *Fundamentals of Tribology*, New Delhi, Phi Learning Pvt. Ltd.,2015.*(Chapters 1,4 to 9 and ,12)*

[2] Michael M Khonsari and E.Richard Boosar, *Applied Tribology*, 3rd ed. jhon wiley & sons Ltd. New delhi, ,2017.*(chapter 2)*

Reference Books:

[1] B.C. Majumdar, *Tribology*, 3rd ed. Tata McGraw Hill Co. Ltd., 2019.

[2] Halling, *Introduction to Tribology*, london, Wykeham Publications Ltd., 1976.

[3] H.G.Phakatkar, R.R.Ghorpade,*Tribology*, NiraliPublications,2019.

[4] J. Halling,Principles in Tribology, first ed., *london and basingstoke* the macmillan press ltd, 1975.

Course Learning Outcomes (COs):
On completion of this course, students will be able to…

CO1: apply the principles of tribology and theories of friction, wear & lubrication
CO2: characterize features of rough surface & liquid lubricants and discuss the mechanism of pressure development in oil film
CO3: distinguish the hydrostatic, squeeze film and elasto-hydrodynamic lubrication systems
CO4: analyze the tribological behavior of rolling contact systems and explain the gas (air) lubricated bearings

Course Articulation Matrix (CAM):
P20DE203ATRIBOLOGY IN DESIGN

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	**P20DE203A.1**	**2**	**1**	**2**	**2**	1
CO2	**P20DE203A.2**	**2**	**1**	**2**	**2**	1
CO3	**P20DE203A.3**	**2**	**1**	**2**	**2**	1
CO4	**P20DE203A.4**	**2**	**1**	**2**	**2**	1
P20DE203A		**2**	**1**	**2**	**2**	**1**

P20DE203B ROBOTICS

Class: M. Tech. II Semester **Specialization**: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation:	60 marks
End Semester Exam :	40 marks

Course Learning Objectives:
This course will develop students' knowledge in/on…
LO1: classification, drives, control systems and applications of robotics
LO2: robot arm kinematics and D-H representation
LO3: machine vision system
LO4: robot programming

UNIT-I (9)

Introduction: Classification, robot work cell design and applications

Drives and Control system for robotics: Drive systems-types, actuators, selection; types of transmission systems; types of controllers-closed loop control; continuous verses discrete control; control system components –sensors and actuators

UNIT-II (9)

Robot arm kinematics: Direct kinematics-rotation matrices, composite rotation matrix, rotation matrix about an arbitrary axis, rotation matrix with Euler angle representation; transformation matrices for rotations, combined rotations and Denavit -Hartenberg (D-H) representation

UNIT-III (9)

Machine Vision System: Vision System Devices, image acquisition, masking, sampling and quantization, image processing techniques, noise reduction methods, edge detection and segmentation

UNIT-IV (9)

Robot Programming: Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands and subroutines

Programming Languages: Introduction to various types - RAIL and VAL II features of type and development of languages for recent robot systems

Textbook:

[1] K.S. Fu, R.C. Gonzalez, C.S.G. Lee, *Robotics*, New Delhi: McGraw Hill, 2008. *(Chapters 1 to 5)*

Reference Books:

[1] J.J. Craig, *Robotics,* 3rd ed. New Jersey: Pearson Education Inc., 2005.
[2] Y. Koren, *Robotics for Engineers,* New York: McGraw Hill Inc., 1985.
[3] Robert J. Schilling, *Fundamentals for Robotics: Analysis and Control,* New Delhi: Prentice-Hall of India Pvt. Ltd., 1996.
[4] R.K. Mittal and I.J. Nagrath, *Robotics and Control*, New Delhi: Tata McGraw-Hill Education, 2003.
[5] S.K. Saha, *Introduction to Robotics*, 2nd ed. New Delhi: Tata McGraw-Hill Education, 2015.
[6] Saeed B. Niku, *Introduction to Robotics: Analysis, Control, Applications*, 2nd ed. Wiley India, 2011.

Course Learning Outcomes (COs):
On completion of this course, students will be able to…

CO1: categorize robots and compare different drives & control systems for robotics
CO2: analyze robot arm manipulator using direct kinematics & D-H representation
CO3: assess the machine vision systems based on its sub-systems & processes
CO4: construct a robot program using lead through method & subroutines and develop robot programming languages

Course Articulation Matrix (CAM):P20DE203B ROBOTICS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DE203B.1	2	1	2	2	1
CO2	P20DE203B.2	2	1	2	2	1
CO3	P20DE203B.3	2	1	2	2	1
CO4	P20DE203B.4	2	1	2	2	1
P20DE203B		**2**	**1**	**2**	**2**	**1**

P20DE203C **PRODUCT DESIGN**

Class: M. Tech. II Semester

Specialization: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Exam	40 marks

Course Learning Objectives (LOs):

This course will develop students' knowledge in/on…

LO1: design process, planning and case studies

LO2: design concept generation and evaluation

LO3: engineering specifications and Industrial design

LO4: product evaluation and cost estimation

UNIT-I (9)

Design Process: Describing mechanical design problems and processes–types of mechanical design problems, languages of mechanical design, constraints, goals and design decisions, designers and design teams

Planning of design process: Overview of the design processes, organization techniques, developing design project plans, steps in planning, case studies

UNIT-II (9)

Design concept generation and evaluation: Technique for functional decomposition, generating and developing concepts, evaluation based on feasibility judgment, technology – readiness assessment, go/no go screening, decision matrix

UNIT-III (9)

Development of engineering specifications: Steps in development of engineering specification, identification of customer\s requirements, Quality Functional Deployment (QFD)

Industrial Design: Design for emotion and experience, human behavior in design

UNIT-IV (9)

Product Evaluation: Importance and goals of performance evaluation, robust design, sensitivity analysis, Cost estimation in design, design for reliability, design for environment and maintenance

Textbook:

[1] David G. Ullman, *The Mechanical Design Process*,4th ed. McGraw Hill, New York,2011.

Reference Books:

[1] George E. Dieter, *Engineering Design*, 4th ed. McGraw Hill Education, New Delhi, 2013.

[2] Karl T. Ulrich and Steven D. Eppinger, *Product Design and Development* 2nd ed. McGraw Hill Education, New Delhi, 2012.

[3] E.N.Baldwin and B.W. Niebel, *Designing for Production,* 2nd ed. Homewood, Illinois, 1975.

[4] J.C.Jones, *Design Methods, Seeds of Human Futures,* 3rd ed. John Wiley, New York, 1978.

[5] J.G.Bralla, *Handbook of Product Design for Manufacture,* 2nd ed. McGraw-Hill, New York, 1988.

Course Learning Outcomes (COs):
On completion of this course, students will be able to…

CO1: describe design processes, planning and case studies
CO2: compare the design concepts and evaluation techniques
CO3: develop engineering specifications and industrial design
CO4: evaluate the performance of the product for reliability and cost

Course Articulation Matrix (CAM): P20DE203CPRODUCT DESIGN						
CO		**PO 1**	**PO2**	**PO 3**	**PSO 1**	**PSO 2**
CO1	**P20DE203C.1**	2	1	2	2	1
CO2	**P20DE203C.2**	2	1	2	2	1
CO3	**P20DE203C.3**	2	1	2	2	1
CO4	**P20DE203C.4**	2	1	2	2	1
P20DE203C		**2**	**1**	**2**	**2**	**1**

P20DE204A **INDUSTRIAL AUTOMATION**

Class: M. Tech. II Semester **Specialization**: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation:	60 marks
End Semester Exam :	40 marks

Course Learning Objectives:
This course will develop student's knowledge in/on…

LO1: automation techniques in manufacturing and process industry
LO2: material handling and identification technologies
LO3: PLC technology in automation
LO4:distributed control system and automated inspection and testing

UNIT-I (9)

Automation in Manufacturing Industries: Automation in production system, principles and strategies of automation, basic elements of an automated system, advanced automation functions, levels of automations, automated flow lines and transfer mechanisms. analysis of transfer lines without storage, automated flow lines with storage buffers

UNIT-II (9)

Material handling and identification technologies: Types of material handling equipment, automated guided vehicle system, automated storage systems, interfacing handling and storage with manufacturing, automatic identification methods

Automated Manufacturing Systems: Classification, components of AMS, Cellular manufacturing, flexible manufacturing system, automated assembly system

UNIT-III (9)

Automation in Process Industries: Computer based industrial automation- Direct Digital Control (DDC), Distributed Control System (DCS) and Supervisory Control and Data Acquisition (SCADA) based architectures

Programmable Logic Controller (PLC): block diagram, Programming languages, basic instruction sets; design of alarm and interlocks; networking of PLC; PLC case studies - safety automation

UNIT-IV (9)

Distributed Control System- Local Control Unit (LCU) architecture, LCU process interfacing issues, block diagram and LCU security design; networking of DCS
Automated Inspection and Testing: Inspection and testing, statistical quality control, automated inspection -principles and methods, Sensor technologies; coordinate measuring machine- types; machine vision-principles and operation

Textbooks:

[1] M.P.Groover, *Automation, Production Systems and Computer Integrated Manufacturing*, 5th ed. New Delhi: Pearson Education, 2019.
[2] Krishna Kant, *Computer - Based Industrial Control*, 2nd ed. New Delhi: Prentice Hall, 2019.

References Books:

[1] Curtis D. Johnson, *Process Control Instrumentation Technology*, 8th ed. Pearson New International, 2019.
[2] Frank D. Petruzella, *Programmable Logic Controllers*, 5th ed. New York: McGraw Hill, 2016.
[3] Tiess Chiu Chang and Richard A. Wysk, *An Introduction to Automated Process Planning Systems*, Prentice Hall of India, 2015.
[4] Viswanandham, *Performance Modeling of Automated Manufacturing Systems*, Prentice Hall of India, 2017.

Course Learning Outcomes:

On completion of this Course, students will be able to…

CO1*: explain various automation technologies in manufacturing and process industries*
CO2*: describe automation tools and methods in manufacturing industry*
CO3*: elaborate various control systems and programmable logic controller in automation*
CO4*: draw and discuss LCU architecture, explain various automated inspection systems*

Course Articulation Matrix (CAM):
P20DE204A: INDUSTRIAL AUTOMATION

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	**P20DE204A.1**	2	1	2	2	1
CO2	**P20DE204A.2**	2	1	2	2	1
CO3	**P20DE204A.3**	2	1	2	2	1
CO4	**P20DE204A.4**	2	1	2	2	1
P20DE204A		**2**	**1**	**2**	**2**	**1**

P20DE204B DESIGN OF MACHINE COMPONENTS

Class: M. Tech. II-Semester **Specialization**: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Exam	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: processes for design of machine elements and static theories of failures
LO2: fatigue failure theories for different types of stresses
LO3: types of surface failures, stresses for different type of contacts
LO4: shaft design and bevel gear design

UNIT-I (9)

Engineering design: Selection of materials and processes for design of machine elements
Static failure theories: Failure of ductile and brittle material under static loading; fracture mechanics; case studies in static failure analysis

UNIT-II (9)

Fatigue failure theories: Mechanism of fatigue failure, fatigue failure models, machine-design considerations, fatigue loads, measuring and estimating fatigue failure criteria, notches and stress concentrations, Residual stress, designing for high-cycle fatigue, fully reversed uniaxial stress and fluctuating uniaxial stresses

UNIT-III (9)

Surface failure: Surface geometry, Mating surface, friction, adhesive wear, abrasive wear, corrosion wear, surface fatigue spherical contact, cylindrical contact, General contact, dynamic contact stresses; surface fatigue failure models-dynamic contact; surface fatigue strength

UNIT-IV (9)

Shaft design: General considerations, design for fully reversed bending and steady torsion, fluctuating bending and fluctuating torsion; shaft deflection- shafts as beams and bars
Bevel gear design: Bevel gear geometry and nomenclature, bevel gear mounting, forces and stress on bevel gears

Textbook:

[1] Norton L. R., *Machine Design – An Integrated Approach,* 6th ed. Pearson Education, 2019.

Reference Books:

[1] Robert C. Juvinall, Kurt M. Marshek, *Fundamentals of Machine Component Design*, 7th ed. John Wiley & Sons, 2019.
[2] Maitra G.M., *Hand Book of Gear Design*, 2nd ed. Tata McGraw Hill, 2013.
[3] Joseph E. Shigley, Charles R. Mischke, Richard G. Budynas, *Mechanical Engineering Design*, 10th ed. McGraw Hill, 2017.
[4] P.S.G. Tech., *Design Data Book*, Coimbatore, 2003.

Course Learning Outcomes (COs):
Upon completion of the course, students will be able to …

CO1: explain the design processes and determine the size of the machine components by static theories of failures
CO2: design machine elements by using fatigue failure theories
CO3: analyze the different types of surface failures and contact stresses
CO4: determine dimensions of shafts and bevel gears for different loading conditions

Course Articulation Matrix (CAM): P20DE204B MACHINE DESIGN						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DE204B.1	**2**	**1**	**2**	2	1
CO2	P20DE204B.2	**2**	**1**	**2**	2	1
CO3	P20DE204B.3	**2**	**1**	**2**	2	1
CO4	P20DE204B.4	**2**	**1**	**2**	2	1
P20DE204B		**2**	**1**	**2**	**2**	**1**

P20DE204C DESIGN OF PRESSURE VESSELS AND PIPING

Class: M. Tech. II - Semester

Specialization: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation:	60 marks
End Semester Exam :	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on
LO1: pressure vessels and stresses in pressure vessels
LO2: design of vessels and their supports
LO3: buckling analysis of vessels
LO4: design and analysis of piping

UNIT-I (9)

Pressure Vessels: Introduction, methods for determining stresses – strain gage, photo elastic, moire method; terminology and ligament efficiency

Stresses in Pressure Vessels: Stresses in a circular ring, cylinder and sphere; general theory of membrane stress in vessels under internal pressure - cylindrical, spherical, conical and elliptical vessels and its applications; thermal stresses; discontinuity stresses in pressure vessels

UNIT-II (9)

Design of Vessels: Localized stresses and their significance**,** stress concentration at a variable thickness transition section in a cylindrical vessel, stress concentration about a circular hole in a plate, elliptical openings, theory of reinforcement and pressure vessel design

Supports for Vessels: Introduction, bracket or lug supports, leg supports, skirt supports, saddle supports

UNIT-III (9)

Buckling of Vessels: Buckling phenomenon, elastic buckling of circular rings and thick walled cylinders under external pressure, effect of supports on elastic buckling of cylinders, buckling under combined external pressure and axial loading

UNIT-IV (9)

Design of Piping: Introduction, components, types, supports, codes and standards of piping

Piping Analysis: Flow diagram, piping layout and piping stress analysis, flexibility factor and stress intensification factor

Textbook:

[1] John F. Harvey, *Theory and Design of Pressure Vessels*, CBS Publishers and Distributors, 1987.

Reference Books:

[1] Peter. Smith, *Fundamentals of Piping Design*, Volume-1, Gulf Publishing Company Houston, Texas 2007.

[2] M.V. Joshi, *Process Equipment Design,* Macmillan India Ltd. 1976.

[3] Henry H. Bedner, *Pressure Vessels Design Hand Book,* 2nd ed. CBS Publishers and Distributors, 1991.

[4] Stanley, M.Wales, *Chemical process equipment, selection and Design, Butterworth's series in Chemical Engineering*, 1988.

[5] William J., Bees, *Approximate Methods in the Design and Analysis of Pressure vesselsand Piping*, Pre ASME Pressure Vessels and Piping Conference.

[6] S. Graham Kelly, *Fundamentals of Mechanical Vibrations,* 2nd ed. McGraw-Hill, Singapore, 2000.

Course Learning Outcomes (COs):
On completion of this course, students will be able to…

CO1: determine stresses in pressure vessels using different methods
CO2: analyze pressure vessels with different supports
CO3: determine buckling under combined external pressure and axial loading
CO4: analyze piping system based on codes and standards

Course Articulation Matrix (CAM): P20DE204C
DESIGN OF PRESSURE VESSELS AND PIPING

CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DE204C.1	2	1	2	2	1
CO2	P20DE204C.2	2	1	2	2	1
CO3	P20DE204C.3	2	1	2	2	1
CO4	P20DE204C.4	2	1	2	2	1
P20DE204C		**2**	**1**	**2**	**2**	**1**

P20DE 205 FEM LAB

Class: M. Tech. II – Semester **Specialization:** Design Engineering

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Exam	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in /on
LO1: static analysis of one-dimensional truss and pipe problems
LO2: modeling and stress analysis of plane stress and axi-symmetric problems
LO3: thermal and fluid flow analysis, topology optimization
LO4: failure analysis, transient structural simulation and simulation of composite material

LIST OF EXPERIMENTS

1. Static structural analysis- To determine the stresses in 1D element of pipe
2. Static structural analysis - To determine the deflections at each joint of the truss under given loading conditions
3. Static structural analysis – To compute the stresses in cylinder part using axisymmetric model
4. Static structural analysis – To determine the maximum deformation and distribution of von misses stresses under given distributed load and boundary conditions for a wrench
5. Modal and Harmonic Analysis: To find the first ten natural frequencies, plot the first five vibration modes and plotthe frequency response of the z displacement (along the surface normal direction) of the front surfaceof the guitar
6. Thermal analysis for base of the heat sink:
   (i) Steady state analysis
   (ii) Transient thermal analysis
7. Fluid flow analysis: To find the airflow pattern, pressure and velocity distributions of the flow field around the truck
8. Topology optimization for L-Shape structure to achieve for a given weight reduction.
9. Failure analysis: To examine a dog-bone shaped specimen for static and fatigue load
10. Explicit dynamics analysis of suspension system and turbomachinery cases.
11. Transient structural simulation of crank and slider mechanism.
12. Dimensioning and Simulation of Composite Material

Note: Exercises will be performed using ANSYS package during regular class work in each week.

Laboratory Manual:
[1] FEM Lab Manual, Faculty of Mechanical Engineering, Department of ME, KITSW.

Reference Books:

[1] Xiaolin Chen, Yijun Liu, *Finite Element Modeling and Simulation with ANSYS Workbench*, 2nd ed. Florida: Taylor & Francis group,2016.

[2] N. Nakasone, T. A. Stolarski and S. Yoshimoto., *Engineering Analysis with ANSYS Software*, New York: Elsevier Butterworth-Heinemann, 2006.

[3] S. Moaveni, *Finite element analysis, Theory and Application with ANSYS*, 4th ed. New York: Prentice Hall, 2014.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: demonstrate the steps involved in analyzing a given static analysis problem using ANSYS software

CO2: model and analyze plane stress and axi-symmetric problems

CO3: analyze 1d thermal & 2d fluid flow problems; predict failure for static & fatigue load

CO4: utilize the topology optimization to redesign the structure and analyze the composite materials

Course Articulation Matrix (CAM): P20DE205 FEM LAB

CO		PO1	PO2	PO 3	PSO1	PSO2
CO1	**P20DE205.1**	2	1	2	2	2
CO2	**P20DE205.2**	2	1	2	2	2
CO3	**P20DE205.3**	2	1	2	2	2
CO4	**P20DE205.4**	2	1	2	2	2
P20DE205		**2**	**1**	**2**	**2**	**2**

P20DE206 COMPOSITE MATERIALS LAB

Class: M. Tech. II -Semester **Specialization:** Design Engineering

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	60
End Semester Examination	40

Course Learning Objectives (LOs):

This course will develop student's knowledge in/on…

LO1: prepare polymer composites using hand layup technique
LO2: mechanical properties of polymer composite materials
LO3: wear characteristics of polymer composites
LO4: applications on polymer composite materials

LIST of EXPERIMENTS

1. To fabricate polymer composite using hand layup technique and evaluate the defects of fabrication
2. To prepare polymer composite using vacuum bagging technique and compare the defects with hand layup technique
3. To measure the true density of composite by Archimedes principle using pichnometer and compare theoretical density and experimental density of composite
4. To calculate void content of fabricated composite, compare and discuss the results
5. To characterize mechanical behavior (tensile at yield, tensile strength, modulus of elasticity, percentage of elongation) of the polymer composites. Compare the result and explain the difference
6. To determine flexural properties flexural strength, flexural modulus of polymer composite in accordance with ASTM D790
7. To determine inter laminar shear strength of polymer composite and compare results with neat polymers
8. To determine compression strength and impact strength of polymer composite material and compare results with neat polymers
9. To determine resistance to abrasive wear of polymer composite, measured in terms of weight loss in accordance with ASTM D1242 using pin on disc test rig
10. To investigate effect of load and abrasive surface on co-efficient of friction and wear rate of composites
11. To determine adhesive wear of polymer composite material by varying different test parameters
12. To investigate the effect of lubrication on wear rate of composite materials and compare the result with and without lubrication

Laboratory Manual:

1. Composite materials laboratory manual, prepared by faculty of Mechanical Engineering Department, KITSW

Reference Books:

1. Ronald F. Gibson, Principles of composite material mechanics, 3rd ed. CRC Press, 2011.
2. Robert M Jones, Mechanics of Composite Materials, Taylor & Francis, 2nd ed. 2000.
3. Stachowaik, G.W., Batchelor, A.W., Engineering Tribology, 3rd ed. Elsevier, 2010.
4. Neale MJ, Tribology Hand Book, CBS Publications, 2nd ed. 2012.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: prepare polymer composite materials using hand lay-up technique

CO2: test, evaluate and analyze the mechanical properties of polymer composite materials

CO3: analyze the effect of constituent material, load and interacting surface on wear rate of composite materials

CO4: test and analyze adhesive wear and lubricating wear rate in polymer composites

Course Articulation Matrix (CAM): P20DE206COMPOSITE MATERIALS LABORATORY

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DE206.1	2	2	2	2	2
CO2	P20DE206.2	2	2	2	2	2
CO3	P20DE206.3	2	2	2	2	2
CO4	P20DE206.4	2	2	2	2	2
P20DE206		2	2	2	2	2

P20DE207: MINI PROJECT WITH SEMINAR

Class: M. Tech. II - Semester **Branch:** Design Engineering

Teaching Scheme:

L	T	P	C
-	-	4	2

Examination Scheme:

Continuous Internal Evaluation	100 marks
End Semester Examination	---

Course Learning Objectives (LOs):

This course will develop students' knowledge on /in…

LO1: implementing a project independently by applying knowledge to practice
LO2: literature review and well-documented report writing
LO3: creating PPTs and effective technical presentation skills
LO4: writing technical paper in scientific journal style & format and creating video pitch

Continuous Internal Evaluation (CIE) for Mini Project with Seminar:

1) The *Post Graduate Mini Project Evaluation Committee (PGMPEC)* shall be constituted with HoD as a Chairman, M.Tech. Coordinator as a Convener and three to five other faculty members representing various specializations in that particular programme as members.
2) Student has to take up independent mini project on innovative ideas, innovative solutions to common problems using their knowledge relevant to courses offered in their program of study, which would supplement and complement the program assigned to each student.
3) *PGMPEC* shall allot a faculty supervisor to each student for guiding on
   (a) Selection of topic
   (b) Literature survey and work to be carried out
   (c) Preparing a report in proper format
   (d) Right conduct of research and academic activity to promote academic integrity
   (e) Use of anti-plagiarism software to detect plagiarism in the report and submission of Mini project report within acceptable plagiarism levels
   (f) Effective mini project oral presentation before the PGMPEC

   There shall be only Continuous Internal Evaluation (CIE) for seminar
4) The CIE for mini project is as follows:

Assessment	Weightage
Mini project Supervisor Assessment	**20%**
PGMPEC Assessment: *(i) Registration presentation* ***(10%)*** *(ii) Working model / process / software package / system developed* ***(20%)*** *(iii) Mini project report* ***(20%)*** *(iv) Mini project paper* ***(10%)*** *(v) Mini project video pitch* ***(10%)*** (vi) *Final presentation (with PPT) and viva-voce* ***(10%)***	**80 %**
Total Weightage:	**100%**

Note: It is mandatory for the student to
   (i) appear for final presentation (with PPT) and viva-voce to qualify for course evaluation
   (ii) write mini project paper in given journal format
   (ii) create a good video pitch to present mini project

(a) **Mini Project Topic**: The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals/Technical Magazines on the topics of potential interest

(b) **Working Model**: Each student is requested to develop a working model/ process/ software package /system on the chosen work and demonstrate before the *PGMPEC* as per the dates specified by *PGMPEC*

(c) **Mini Project Report:** Each student is required to submit a well-documented mini project report as per the format specified by *PGMPEC*

(d) **Anti-Plagiarism Check:** The mini project report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(e) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the *PGMPEC* as per the schedule notified by the department

(f) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her mini project. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include key points about his / her business idea / plan (*if any*) and social impact

5) The student has to register for the Mini project as supplementary examination in the following cases:
   i) he/she is absent for oral presentation and viva-voce
   ii) he/she fails to submit the report in prescribed format
   iii) he/she fails to fulfill the requirements of Mini project evaluation as per specified guidelines

6) (a) The CoE shall send a list of students registered for supplementary to the HoD concerned

(b) The PGMPEC, duly constituted by the HoD, shall conduct Mini project evaluation and send the award list to the CoE within the stipulated time

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: apply knowledge to practice to design and conduct experiments and utilize modern tools for developing working models / process / system leading to innovation and entrepreneurship

CO2: demonstrate the competencies to perform literature survey, identify gaps, analyze the problem and prepare a well-documented Mini project report

CO3: make an effective oral presentation through informative PPTs, showing knowledge on the subject and sensitivity towards social impact of the Mini project

CO4: write a "Mini project paper" in scientific journal style and format from the prepared Mini project report and create a video pitch on Mini project

Course Articulation Matrix (CAM): P20DE207 MINI PROJECT WITH SEMINAR						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	**P20DE207.1**	2	-	2	2	2
CO2	**P20DE207.2**	2	-	2	2	2
CO3	**P20DE207.3**	-	2	-	1	1
CO4	**P20DE207.4**	-	2	-	1	1
P20DE207		**2**	**2**	**2**	**1.5**	**1.5**

P20AC208A: STRESS MANAGEMENT BY YOGA

Class: M. Tech. II–Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC &CSP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop student's knowledge in/on

LO1: awareness about different types of stress
LO2: yoga in the management of stress
LO3: positive health and overall wellbeing
LO4: prevention of stress related health problems by yoga practice

UNIT – I (6)

Stress: Definition of stress, types of stress - acute and chronic; stressors; definition of yoga from various sources, types of yoga – karma yoga, gnana yoga, bhakti yoga and raja yoga; concept of bhagavad gita; yoga versus exercise; basics of physiology and psychology; brain and its parts – central nervous system (CNS), peripheral nervous system (PNS), hypothalamic pituitary adrenal (HPA) axis; sympathetic and parasympathetic nervous systems; fight and flight mechanism; relationship between stress and yoga.

UNIT –II (6)

Ashtanga Yoga: Do's and don'ts in life; yamas – ahimsa, satya, asteya, bramhacharya and aparigraha; niyama – shaucha, santosha, tapa, svadhyaya, ishvarapranidhana; asana; pranayama; pratyahara; dharana; dhyana; samadhi

UNIT– III (6)

Asana and Stress: Definition of asana from patanjali; origin of various names of asanas; various yoga poses and their benefits for mind and body; sequence of performing asanas - standing, sitting, lying down on stomach, lying down on back and inverted postures; activation of annamaya kosha; effect on various chakras, systems and glands thereby controlling the stress levels through the practice of asanas

UNIT - IV (6)

Pranayama: Anulom and vilom pranayama, nadi shudhi pranayama, kapalabhati pranayama, bhramari pranayama, nadanusandhana pranayama
Meditation Techniques: Om meditation; cyclic meditation; instant relaxation technique (IRT); quick relaxation technique (QRT); deep relaxation technique (DRT)

Textbook:

[1] "*Yogic Asanas for Group Training - Part-I*", Nagpur: Janardhan Swami Yogabhyasi Mandal.

[2] Swami Vivekananda, "*Rajayoga or Conquering the Internal Nature*", Kolkata: Advaita Ashrama (Publication Department).

Reference Books:

[1] Nagendra H.R and Nagaratna R, "*Yoga Perspective in Stress Management*", Bangalore: Swami Vivekananda Yoga Prakashan.

Course Learning Outcomes (COs):
On completion of this course, students will be able to ...

CO1: differentiate yoga and exercise
CO2: explain eight steps of Ashtanga yoga
CO3: describe different yogasanas, and their benefits for mind and body
CO4: discuss the benefits of pranayama and meditation as an effective tool for stress management

Course Articulation Matrix (CAM): P20AC208A STRESS MANAGEMENT BY YOGA						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20AC208A.1	1	1	-	-	-
CO2	P20AC208A.2	1	1	-	-	-
CO3	P20AC208A.3	1	1	-	-	-
CO4	P20AC208A.4	1	1	-	-	-
P20AC208A		**1**	**1**	**-**	**-**	**-**

P20AC208B: VALUE EDUCATION

Class: **M**.Tech. II – Semester

Specializations: SCE, DE, VE, PE, SE, DS & CSP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):

This course will develop students' knowledge on/in…

LO1: value of education and self-development
LO2: importance of cultivation of values
LO3: personality and behavior development
LO4: character and competence

UNIT – I (6)

Values and self-development: Social values and individual attitudes; work ethics; Indian vision of humanism; moral and non-moral valuation; standards and principles; value judgments

UNIT – II (6)

Importance of cultivation of values: Sense of duty, devotion, self-reliance, confidence, concentration, truthfulness, cleanliness, honesty, humanity, discipline, power of faith; national unity, patriotism; love for nature

UNIT – III (6)

Personality and behavior development: Soul and scientific attitude; positive thinking; integrity, discipline and punctuality; love and kindness; avoid fault thinking, free from anger; dignity of labor

Universal brotherhood and religious tolerance: True friendship, love for truth, happiness vs suffering; aware of self-destructive habits; association and cooperation; doing best for saving nature

UNIT – IV (6)

Character and competence: Holy books vs blind faith; self-management and good health; science of reincarnation; equality, non-violence, humility, role of women; all religions and same message; mind your mind, self-control, honesty, studying effectively

Textbook:

[1] S. K. Chakroborty, *Values and Ethics for organizations: Theory and practice*, New Delhi: Oxford University Press, 2000.

Reference Books:

[1] D. N. Grose, *A text book of Value Education,* New Delhi: Dominant Publishers and Distributors, 2005.

[2] Yogesh Kumar Singh and Ruchika Nath, *Value Education*, New Delhi: A. P. H. Publishing Corporation, 2005.

[3] S. P. Ruhela, *Human Values and Education*, New Delhi: Sterling Publishers Pvt. Ltd., 1986.
[4] V. Narayan Karan Reddy, *Man, Education and Values,* New Delhi: B. R. Publishing Corporation, 1979.
[5] Bharatwaj Tilak Raj, *Education of Human Values,* New Delhi,: 2nd Ed., Mittal Publications, 2001.

Course Learning Outcomes (COs):
On completion of this course, students will be able to…

CO1: illustrate social & moral values and inculcate Indian vision of humanism
CO2: develop sense of duty, national unity and love for nature
CO3: utilize positive thinking and develop universal brotherhood
CO4: build character & competence through holy books

Course Articulation Matrix (CAM): P20AC208B : VALUE EDUCATION						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20AC208B.1	-	1	-	-	-
CO2	P20AC208B.2	-	2	-	-	-
CO3	P20AC208B.3	-	1	-	-	-
CO4	P20AC208B.4	-	2	-	-	-
	P20AC208B		1.5		-	-

P20AC208C: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Class: M. Tech. II-Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CSP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):

This course will develop students' knowledge on/in…

LO1: holistic development of personality

LO2: accomplishment of day to day responsibilities and to achieve the highest goal

LO3: basic knowledge to maintain a stable mind, pleasing personality and determination

LO4: personality building towards becoming a role model

UNIT – I (6)

Holistic development of personality: Neetisatakam - verses-19, 20, 21, 22(wisdom), verses-29, 31, 32 (pride& heroism), verses-26, 28, 63, 65(virtue), verses-52, 53, 59(don'ts), verses-71, 73, 75, 78(do's)

UNIT – II (6)

Approach to day to day work and duties: Shrimad bhagwad geeta - chapter2-verses 41, 47, 48 chapter3-verses 13, 21, 27, 35; shrimad bhagwad geeta - chapter6-verses 5, 13, 17, 23, 35, chapter18-verses 45, 46, 48

UNIT – III (6)

Statements of basic knowledge: Shrimad bhagwad geeta - chapter2-verses 56, 62, 68 chapter12-verses 13, 14, 15, 16, 17, 18

UNIT – IV (6)

Personality of role model: Shrimad bhagwad geeta - chapter 2-verses 17, chapter 3-verses 36, 37, 42 chapter 4-verses 18, 38, 39, chapter 18-verses 37, 38, 63

Textbook:

[1] Swami Swarupananda, *Shrimad Bhagavad Geeta*, Advaita Ashram (Publication Department), Kolkata: Printed in Sharada Press, Car Street, Mangalore

Reference Books:

[1] Prof. Satyavrata Siddhantalankar, *Bhagavad Geeta* , New Delhi: Oriented Publishing

[2] P.Gopinath, *Bhartrihari's Three Satakam (Niti-sringar-vairagya),* New Delhi: Rashtriya Sanskrit Sansthanam

[3] Maharaja Bhadrihari , *Nithishatakam Translated by P.Jwala Dutta Sharma*, Dharm Diwakar Press, Moradabad, 1909, 1st Ed. *world.com/section_personality_development.html*

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: build an holistic personality

CO2: develop himself to accomplish his responsibilities and achieve his highest goal in life

CO3: perceive basic knowledge to maintain stable mind, pleasing personality and determination

CO4: originate himself to become a role model thus leading mankind to peace and prosperity

Course Articulation Matrix (CAM): P20AC208C PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTEMENT SKILLS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20AC208C.1	1	1	1	-	-
CO2	P20AC208C.2	1	1	1	-	-
CO3	P20AC208C.3	1	1	1	-	-
CO4	P20AC208C.4	1	1	1	-	-
P20AC208C		**1**	**1**	**1**	**-**	**-**

P20AC208D: DISASTER MANAGEMENT

Class: M. Tech. II – Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CSP

Teaching Scheme:

L	T	P	C
2	-	-	1

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: disaster management cycle and relation between disaster & development
LO2: risk / vulnerability assessment and reduction strategies
LO3: management strategies, approaches, frameworks and governance
LO4: disaster mitigation aspects and recovery strategies

UNIT – I (6)

Introduction to Disaster: Concepts of hazard, vulnerability & risks; natural and manmade disasters- earthquake, cyclone, floods , volcanoes; famine, displaced populations, industrial & transport accidents; slow and rapid onset disasters - famine, draught , epidemics , air crash, tidal waves & tsunami

Mitigation and Management techniques of Disaster: Basic principles of disasters management, disaster management cycle, political, social, economic impacts of disasters, gender and social issues during disasters, principles of psychosocial issues and recovery during emergency situations, Impact of disaster on development, different stake holders in disaster relief, refugee operations during disasters, human resettlement and rehabilitation issues during and after disasters, intersectorial coordination during disasters, models in disasters

UNIT –II (6)

Disaster Risk and Vulnerability: Introduction to disaster risk and vulnerability, risk analysis techniques, process of risk assessment, analytical systems for risk assessment, natural hazard/ risk assessment, understanding climate risk, mapping of risk assessment, decision making for risk reduction, problems in risk assessment, strategies for risk reduction, community-based risk reduction; observation and perception of vulnerability, vulnerability identification, vulnerability types and dimensions, vulnerability and social and economic factors

Preparedness and Response:Disaster preparedness significance & measures, institutional mechanism for disaster preparedness, disaster preparedness policy & programmes, concept and significance of disaster preparedness plan, community based disaster preparedness plan, prediction, early warnings and safety measures of disaster, resource mobilization, post disaster reliefs & logistics management, emergency support functions and coordination mechanism

UNIT– III (6)

Disaster Management and Governance: Institutional arrangements, disaster management strategies & approaches, Community Based Disaster Preparedness (CBDP) - components, teams, preparedness, linkages with development programmes

Disaster Response in India: Legal framework, National disaster management Act, 2005, institutions for disaster management – NDMA, NIDM, role of government agencies, NCMC committee, crisis management group, need, media, community resilience, social & economic problems, funding mechanism

UNIT - IV (6)

Disaster Risk Mitigation: Background, strengthening, Sendai framework and strengthening disaster risk governance, responsibility matrix

Disaster Recovery: Scope, approach, recovery process, steps involved in recovery process, early, mid& long-term recovery, reconstruction; coordination–central, state, & private sectors and voluntary organizations;rehabilitation–economical and psychological

Textbooks:

[1] Manual on *Natural Disaster Management in India*, M C Gupta, NIDM, New Delhi, 2016*(Chapters 1- 5,7,9 &10)*

[2] N. G. Dhawan, A. S. Khan, *Disaster Management and Preparedness*, 1st ed., New Delhi: CBS Publication, 2014.*(Chapters 1,2,3,4,6,7,8 &10)*

Reference Books:

[1]Ashok Kumar and Vipul Anekant, *Challenges to internal security of India*, Tata McGraw hill, 2020

[2] Larry R. Collins, *Disaster management and Preparedness*, CRC Press, 2004

[3]Tony Moore and Raj Lanka, *Hand book of Disaster and Emergency Management*, 3rd ed., Elsevier, 2006.

[4]R. K. Dave, *Disaster Management in India: Challenges and Strategies*, Prowess Publishing, 2018

[5] M. M. Sulphey, *Disaster Management*, 1st ed., Prentice Hall of India, 2016.

[6] M. Pandey, *Disaster Management*, 1st ed., Wiley India, 2014.

[7] R. B. Singh, *Natural Hazards and Disaster Management: Vulnerability and Mitigation*, Noida: Rawat Publications, 2006

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1:categorize disasters, analyse the phases of disaster management cycle and relation between disaster & development

CO2: perform risk / vulnerability assessment and devise response & preparedness strategies for risk / vulnerability reduction

CO3: identify the role of government and private agencies involved in disaster assistance

CO4: analyse the mitigation measures and recovery strategies to inculcate a culture of resilience

Course Articulation Matrix (CAM): P20AC208D : DISASTER MANAGEMENT						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20AC208D.1	2	1	1	1	1
CO2	P20AC208D.2	2	1	1	1	1
CO3	P20AC208D.3	1	1	-	-	-
CO4	P20AC208D.4	2	1	-	1	1
P20AC208D		**1.75**	**1**	**1**	**1**	**1**

DEPARTMENT OF MECHANICAL ENGINEERING
KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL – 15
(An Autonomous Institute under Kakatiya University, Warangal)
SCHEME OF INSTRUCTION & EVALUATION FOR TWO YEAR POSTGRADUATE PROGRAMME

PRR-20

M.TECH. (DESIGN ENGINEERING)

SEMESTER-III

Sr. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
								CIE - TA							ESE	Total Marks
								I²RE				Minor	MSE	Total		
				L	T	P		ATLP	CRP	CP	PPT					
1	PE	P20DE301	Professional Elective-5/ MOOCs-V	3	-	-	3	8	8	8	6	10	20	60	40	100
2	OE	P20OE302	Open Elective / MOOCs-VI	3	-	-	3	8	8	8	6	10	20	60	40	100
3	PROJ	P20DE303	Dissertation Phase – I/Industrial Project *(to be continued in IV – Semester also as Dissertation Phase – II)*	-	-	18	9	-	-	-	-	-	-	100	-	100
4	PROJ	P20DE304	Internship Evaluation	-	-	2	-	-	-	-	-	-	-	100	-	100
			Total:	6	-	20	15							320	80	400

[L= Lecture, T = Tutorials, P = Practicals, C = Credits, ATLP = Assignments, CRP = Course Research Paper, CP = Course Patent, PPT = Course Presentation, Minor=Minor Examination, MSE=Mid Semester Examination and ESE=End Semester Examination]

Professional Elective-5 / MOOCs–V	Open Elective/MOOCs
P20DE301A: Condition Monitoring P20DE301B: MEMS & Nanotechnology P20DE301C: Artificial Intelligence and Machine Learning P20DE301D: MOOCs	P20OE302A: Business Analytics P20OE302B: Industrial Safety P20OE302C: Operations Research P20OE302D: Cost Management of Engineering Projects P20OE302E: Composite Materials P20OE302F: Waste to Energy P20OE302G: Renewable Energy Sources P20OE302H: MOOCs

Total Contact Periods/Week: 26 **Total Credits: 15**

P20DE301A CONDITION MONITORING

Class: M. Tech. III-Semester

Specialization: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Exam	40 marks

Course Learning Objectives (LOs):

This course will develop students' knowledge in/on…

LO1: condition monitoring and failures

LO2: causes of failure, fault detection monitoring sensors and transducers

LO3: vibration monitoring analysis, contaminant analysis and monitoring techniques

LO4: performance trend monitoring and monitoring systems in operation

UNIT-I (9)

Condition monitoring: Need and importance, online/off-line monitoring, common monitoring techniques, commonly measured operating characteristics, condition monitoring used in industry and various methods of maintenance

Failures: System failure, component failure**,** failure decisions, failure classifications, types of failures, failure investigations and hazard rate curve

UNIT-II (9)

Causes of failure: Fatigue failure, wear failure, service failures; human factors failure case studies - marine steam turbine, power station commissioning faults and boiler failures

Fault detection monitoring sensors and transducers: Contaminant, corrosion, force, gas leakage, air pollution, temperature, proximity, sound; vibration transducers and non-destructive testing techniques

UNIT-III (9)

Vibration monitoring and analysis: Vibration –simple harmonic motion concept, Fourier analysis, frequency analysis techniques; discrete frequencies-gear excitation; vibration signature of active systems, vibration monitoring equipments, system monitors and vibration limit detectors, vibration severity criteria

Contaminant analysis and monitoring techniques: Contaminants in used lubricating oils, oil degradation analysis; contaminant monitoring techniques- wear processes, spectrometric oil analysis procedure and Ferro graph particle precipitation

UNIT-IV (9)

Performance trend monitoring: Primary and secondary performance parameters, performance trend analysis, performance monitoring systems; case studies-steam turbine

Monitoring systems in operation: Marine monitoring systems, marine condition monitoring requirements, aircraft condition monitoring

Textbook:

[1] Collacott R.A, *Mechanical Fault Diagnosis and Condition Monitoring,* Chapman and Hall, London, 1977.

Reference Books:

[1] JohnS.Mitchell,*Introduction to Machinery Analysis and Monitoring,* 2nded.Pennwell Books, Oklahama,1981.

[2] Trever M. Hunt, *Condition Monitoring of mechanical & Hydraulic Plant*.A concise Introduction and guide, Chapman & Hall, Madras,1996.

[3]Philip Wild, *Industrial Sensors and applications for Condition Monitoring*,2nded. Mechanical Engineering Publications Ltd., London 1987.

[4]Joseph Mathew, *Common Vibration Monitoring Techniques – handbook of Condition Monitoring*, 2nd ed. Chapman & Hall, 1998.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: describe different types of failures, condition monitoring techniques and maintenance methods

CO2: elaborate various causes of failures, explain fault detection using sensors and transducers

CO3: analyze the frequency of vibration, describe different monitoring techniques for contaminant analysis in lubricating oils

CO4: identify variousperformance parameters in monitoring system and apply on aircraft, marine condition monitoring

Course Articulation Matrix (CAM) : Mapping of COs with POs and PSOs

P20DE301A CONDITION MONITORING						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20DE301A.1	2	1	2	2	1
CO2	P20DE301A.2	2	1	2	2	1
CO3	P20DE301A.3	2	1	2	2	1
CO4	P20DE301A.4	2	1	2	2	1
P20DE301A		2	1	2	2	1

P20DE301B MEMS AND NANOTECHNOLOGY

Class: M. Tech. III – Semester **Specialization**: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: MEMS and microsystems, their working principles and application
LO2: microsystems Design and Micro-system Fabrication Processes
LO3: materials for MEMS and Microsystems and scaling laws in miniaturization.
LO4: Nanotechnology and summarize synthesis of Nano Materials and device fabrication methods

UNIT – I (9)

MEMS and Microsystems: Typical MEMS and Microsystems products, evolution of micro-fabrication, Microsystems and miniaturization, application of Microsystems in industrial products and telecommunications

Working Principles of Microsystems: Micro-sensors, micro-actuation, MEMS with micro-actuators, Micro-accelerators, Micro-fluidics

UNIT –II (9)

Microsystems Design: Ions and ionization, doping of semiconductors, diffusion process, plasma physics, electrochemistry and quantum physics

Microsystem Fabrication Processes: Photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition-sputtering, deposition by epitaxy, etching; micro manufacturing - bulk micro manufacturing, surface micromachining and LIGA process

UNIT– III (9)

Materials for MEMS and Microsystems: Substrates and wafers, active substrate materials, silicon compounds, silicon piezoresistors, gallium arsenide, quartz, piezoelectric crystals, polymers, packaging materials

Scaling Laws in Miniaturization: Scaling in geometry, scaling in rigid-body dynamics, scaling in electrostatic forces, scaling of electromagnetic forces, scaling in electricity, scaling in fluid mechanics, scaling in heat transfer

UNIT - IV (9)

Nanotechnology: History of Nano science, Nanometer, Nanometerials and Nanotechnology, Classification of Nanometerials

Synthesis of Nano Materials and Device Fabrication: Synthesis of bulk poly crystalline samples, synthesis techniques for preparation of nano particles-bottom up approach-sol-gel synthesis, hydro thermal growth, thin film growth, physical vapor deposition and chemical vapor deposition; top down approach-ball milling, micro fabrication, lithography and ion-beam lithography; applications of nanotechnology in different fields

Textbooks:

[1] Tai-Ran Hsu, *MEMS and Microsystems: Design, Manufacture and nanoscale engineering,* 2nd ed., New Jersey: John Wiely & Sons, 2008. (Chapters 1, 2, 3, 6 & 7)

[2] M. S. Ramachandra Rao, Shuba Singh, *Nanoscience and Nanotechnology: Fundamentals to Frontiers,* 1st ed., New Delhi: Wiley India Pvt Ltd., 2013. (Chapters 1, 4 & 10)

Reference Books:

[1] M. Elwenspoek and R. Wiegerink, *Mechanical Microsensors*, Germany: Springer-Verlag Berlin Heidelberg, 2001

[2] Charles P. Poole, Jr., Frank J. Owens, *Introduction to Nanotechnology*, New Jersey: John Wiley & Sons, 2003.

[3] G.T.A. Kovacs, *Micromachined Transducers Source Book,* McGraw-Hill, 1998.

[4] S.D. Senturia, *Microsystem Design*, New York: Kluwer, 2001.

[5] K. Eric Drexler, *Nanosystems: Molecular Machinery, Manufacturing, and Computation*, New York: John Wiley & Sons, 2002.

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: describe MEMS and Microsystems, working principles and their applications

CO2: develop micro devices, microsystems using the MEMS fabrication process

CO2: select materials for MEMS and Microsystems and explain different scaling laws in miniaturization

CO4: describe Nanomaterials, Nanotechnology and summarize synthesis of Nano Materials and device fabrication methods

Course Articulation Matrix (CAM): P20DE301B MEMS AND NANOTECHNOLOGY

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DE301B.1	2	1	2	2	1
CO2	P20DE301B.2	2	1	2	2	1
CO3	P20DE301B.3	2	1	2	2	1
CO4	P20DE301B.4	2	1	2	2	1
P20DE301B		**2**	**1**	**2**	**2**	**1**

P20DE301C ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Class: M. Tech. III Semester **Specialization**: Design Engineering

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation:	60 marks
End Semester Exam :	40 marks

Course Learning Objectives (LOs):

This course will develop students' knowledge in/on…

LO1: artificial intelligence and heuristic search techniques
LO2: Knowledge representation and reasoning
LO3: machine learning, association learning and clustering
LO4: reinforcement learning and AI & ML in design engineering

UNIT-I (9)

Artificial Intelligence (AI): Definition, AI programs; learning systems, knowledge representation and reasoning, planning, knowledge acquisition; timelines of AI, production systems, state space representation, branches and applications of AI

Heuristic Search Techniques: Generate and test, hill climbing; search techniques-depth first search, breadth first search, greedy method, breadth first search algorithm, A*Algorithm; problem reduction and constraints satisfaction

UNIT-II (9)

Knowledge Representation: Management, types of knowledge, approaches & issues of knowledge representation, knowledge base; knowledge representation structures-first-order logic, frames, conceptual dependency, scripts and semantic network

Reasoning: Types of reasoning, non-monotonic inference methods, non-monotonic reasoning, truth maintenance systems, reasoning with fuzzy logics, rule-based reasoning and diagnosis reasoning

UNIT-III (9)

Machine Learning (ML): Types of learning, types of problems, history of machine learning, aspects of inputs to training, learning systems, quantification of classification and intelligent agents

Association Learning: Basics of association, Apriori algorithm, Eclat algorithm, FP growth algorithm and Tertius algorithm

Clustering: K-means clustering, Fuzzy clustering, hierarchical clustering and cluster similarities

UNIT-IV (9)

Reinforcement Learning: Markov decision problem, Q-learning, temporal difference learning and learning automata

AI and ML in Design Engineering: Applications of AI and ML in robotics, fault diagnosis system, predicting mechanical failure and autonomous vehicle design

Text book:

[1] Vinod Chandra S.S and Anand Hareendran S *Artificial Intelligence and Machine Learning*, Delhi, PHI Learning Private Limited, 2014. *(chapters:1 to 11)*

Reference Books:

[1] Winston Patrick Henry, *Artificial Intelligence*, 3rd ed. Tata McGraw-Hill, 2010.
[2] Stuart Rusell and Peter Norvig, *Artificial Intelligence: A modern approach,* 3rd ed. New Delhi: Prentice hall series in AI, 2010.
[3] Peter Flach , *Machine Learning*, 2nd ed. Cambridge University Press,2012.
[4] Kevin P. Murphy, "*Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.
[5] Jason Bell, *Machine Learning: Hands-On for Developers and Technical Professionals*, John Wiley & Sons, 2014.

Course Learning Outcomes (COs):
On completion of this course, students will be able to…

CO1: explain AI and discuss different heuristic search techniques
CO2: analyze knowledge representation and appraise different methods of reasoning
CO3: explain the concepts and procedure of machine learning, association learning and clustering
CO4: develop reinforcement learning methods and AI & ML models to solve various complex engineering design problems

Course Articulation Matrix (CAM):
P20DE301CARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20DE301C.1	2	1	2	2	1
CO2	P20DE301C.2	2	1	2	2	1
CO3	P20DE301C.3	2	1	2	2	1
CO4	P20DE301C.4	2	1	2	2	1
P20DE301C		**2**	**1**	**2**	**2**	**1**

P20OE302A : BUSINESS ANALYTICS

Class: M. Tech. III –Semester

Specialization: SCE, DE, VE, PE, SE DS, DC & CSP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):

This course will develop student's knowledge in/on

LO5: fundamental concepts of business analytics and descriptive analytics
LO6: data collection and data visualization methods
LO7: text analysis and simulation methods in business analytics
LO8: social media, web and health care analytics

UNIT-I (9)

Introduction to Business Analytics: Introduction to business analytics, why analytics, business analytics: the science of data-driven decision making, business context, technology data science, descriptive analytics, predictive analytics, prescriptive analytics descriptive, predictive, and prescriptive analytics techniques, big data analytics, web and social media analytics, machine learning algorithms, framework for data-driven decision making, analytics capability building, roadmap for analytics capability building, challenges in data-driven decision making and future

Descriptive Analytics: Introduction to descriptive analytics, data types and scale, structured and unstructured data, cross-sectional, time series, and panel data, types of data measurement scales, population and sample, measures of central tendency, percentile, decile, and quartile, measures of variation

UNIT-II (9)

Data Collection: introduction, the value of data, data collection preliminaries, data collection methods, data types, problem formulation preliminaries, challenges in data collection, data collation, validation and presentation, data collection in the retailing industry

Data Visualization: introduction, motivating example, methods of data visualization, software and data visualization

UNIT-III (9)

Text Analytics: Introduction, motivating text analysis, methods of text analysis, natural language processing

Simulation: Introduction, motivating examples, simulation modeling method and case studies

UNIT-IV (9)

Applications of Business Analytics: introduction, what is social media and web analytics, display advertising in real time, A/B experiments for measuring value of digital media and handling e-retailing challenges, strategies for mobile devices, the future of social media analytics

Health Care Analytics: Introduction, methods of health care analytics

Textbooks:

[1]. U Dinesh Kumar, Business Analytics: The Science of Data-Driven Decision Making, 1st ed., 2017. (Units-I)

[2]. Bhimasankam Pochiraju, Sridhar S, Essentials of Business Analytics: A Textbook,1st ed. Springer Nature Switzerland, 2019. (Units-II, III, IV).

Reference Books:

[1]. R N Prasad, Seema Acharya, Fundamentals of Business analytics: Big Data, 2nd ed. Wiley Publications, 2017.

[2]. Foster Provest, Tom Fawcett Data Science for Business:, 1st ed. USA: O'Reilly, 2013.

Course Learning Outcomes (COs):

On completion of this course, the students will be able to

CO5: describe the concepts of business analytics and descriptive analytics

CO6: apply the data collection and data visualization methods in business analytics

CO7: categorize text analysis and simulation methods in business analytics

CO8: apply social media & web analytics and health care analytics in real world problems

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20OE302A.1	-	-	-	-	-
CO2	P20OE302A.2	1	1	-	1	1
CO3	P20OE302A.3	1	1	-	1	1
CO4	P20OE302A.4	2	2	-	2	1
P20OE302A		**1.33**	**1.33**	-	1.33	1

P20OE302B : INDUSTRIAL SAFETY

Class: M. Tech. III –Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CSP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives(LOs):

This course will develop students' knowledge in/on

LO1: need for safety in industries

LO2: fundamentals of maintenance engineering

LO3: causes for wear& corrosion and method of lubrication

LO4: faults tracing in equipments and importance of preventative maintenance

UNIT –I (9)

Industrial Safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948; for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, safety color codes, fire prevention and firefighting, equipment and methods

UNIT –II (9)

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, primary and secondary functions and responsibility of maintenance department, types of maintenance, types and applications of tools used for maintenance, maintenance cost & its relation with replacement economy, service life of equipment

UNIT –III (9)

Prevention of Wear and Corrosion : Wear- types, causes, effects, wear reduction methods, lubricants; types and applications, lubrication methods, general sketch, working and applications- screw down grease cup, pressure grease gun, splash lubrication, gravity lubrication, wick feed lubrication, side feed lubrication, ring lubrication, definition, principle and factors affecting the corrosion, types of corrosion, corrosion prevention methods

UNIT –IV (9)

Fault tracing and Preventative Maintaince : Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic,

pneumatic, automotive, thermal and electrical equipment - machine tool, pump, air compressor, internal combustion engine, boiler, electrical motors, types of faults in machine tools and their general causes, periodic and preventative maintenance; advantages of preventative maintenance, Repair cycle importance

Textbook:

[1] John Ridley and John Channing., *Safety at work*, 6th ed., UK: Elsevier Butterworth-Heinemann,2003.[Unit 1& Unit 2] chapter [2,3,5,6,7,8]

[2] Amit Gupta., "Industrial Safety and environment" Laxmi Publications (P) LTD., New Delhi., 2006., 1973., [Unit3 & Unit 4] chapters [10,11,12,13,14,15,16,17]

Reference Books:

[1] R. Keith Mobley Editor, Lindley R. Higgins Darrin J. Wikoff, *Maintenance Engineering Handbook*, 7th ed., New York: Mc Graw Hill International, 2008

[2] Mohammed Ben–Daya, Uday Kumar, Prabhakar Murthy D.N., *Introduction to Maintenance Engineering*, New Delhi: Wiley India Pvt. Ltd., 2016.

Course Learning Outcomes(COs):

Upon completion of this course, students will be able to….

CO1: summarize the principles of industrial safety and maintenance

CO2: describe the functions of maintenance department and list the types of maintenance & tools used for maintenance

CO3: identify the causes for wear ,tear& corrosion and suitable lubrication method for a given application

CO4: describe the significance of decision-tree and apply it for problems in equipment to detect and classify the faults and need of preventative maintenance.

Course Articulation Matrix (CAM) : P20OE302B : INDUSTRIAL SAFERTY

COs		PO1	PO2	PO3	PSO 1	PSO 2
CO1	P20OE302B.1	1	1	1	2	1
CO2	P20OE302B.2	1	1	1	2	1
CO3	P20OE30B.3	1	1	1	2	1
CO4	P20OE302B.4	1	1	1	2	1
P20OE302B		**1**	**1**	**1**	**2**	**1**

P20OE302C: OPERATIONS RESEARCH

Class: M. Tech. III –Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CSP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge in/on

LO1: linear programming problems
LO2: non linear optimization problem
LO3: sequencing, scheduling and network model
LO4: decision making theory and queuing models

UNIT – I (9)

Linear Programming Problem (LPP): Mathematical formulation of LPP, solution of linear programming problems-simplex method, artificial variable technique, duality in LPP and dual simplex method; sensitivity analysis

UNIT –II (9)

Non-Linear Programming Problem (NLPP): Classification of NLPP, unconstrained optimization techniques- iterative methods - random search methods, steepest decent method, conjugate gradient method, Fibonacci method and golden section method.

Constrained Optimization Techniques-- Lagrange's method and Kuhn-Tucker method

UNIT– III (9)

Sequencing and Scheduling: Sequencing and scheduling of n jobs one, two and three machine problems, scheduling of *'n'* jobs through k machines problem.

Project Network: Network construction-CPM and PERT; resource analysis in network problems

UNIT - IV (9)

Decision Analysis and Game Theory: Introduction, decisions under uncertainty- Laplace criterion, max-min criterion, savage criterion and Hurwitz criterion; game theory-introduction, two person zero sum games and the maximin-minimax principle; mixed strategy games- graphical method and linear programming method, dominance property

Queuing Theory- Elements and operating characteristics of a queuing system, Poisson queuing systems, study of single server queuing model with infinite capacity

Textbooks:

[1] Kanti swarup, P.K.Gupta, Man Mohan, *Operations Research,* S. Chand & Sons, New Delhi. 16th edn., 2013. (Chapters: 2, 4, 5, 6, 12, 16, 17, 21, 25, 27)

[2] S.S. Rao, *Optimization Techniques,* New Age International, New Delhi, 3rd edn., 2013. (Chapters: 6)

Reference Books:

[1] H.A. Taha, *Operations Research an Introduction,* Prentice Hall of India, 6th Edn., 2006

[2] N.D Vohra, *Quantitative Techniques in Management*, 3rd edn, TMH, 2010

Course Learning Outcomes (COs):

On completion of this course, students will be able to ...

CO1: model engineering real time problems and solve them using various LPP techniques

CO2: optimize the engineering problems using NLPP methods

CO3: apply the tools and techniques to solve sequencing and scheduling problems and project network models

CO4: analyze conflicting situations using game theory and solve various queuing model parameters

Course Articulation Matrix (CAM): P20OE302C: OPERATIONS RESEARCH						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20OE302C.1	2	1	1	2	1
CO2	P20OE302C.2	2	1	1	2	1
CO3	P20OE302C.3	2	1	1	2	1
CO4	P20OE302C.4	2	1	1	2	1
P20OE302C		**2**	**1**	**1**	**2**	**1**

P20OE302D: COST MANAGEMENT OF ENGINEERING PROJECTS

Class: M. Tech. III-Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CSP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):
This course will develop students' knowledge on /in…

LO1: cost concepts, objectives of costing system, project management
LO2: standard costing, cost control and reduction
LO3: cost behavior, profit planning and types of budgets
LO4: quantitative techniques for cost management

UNIT-I (9)

Overview of Cost Accounting: Cost concepts in decision making, objectives of a costing system, different costs of projects - relevant cost, differential cost, incremental cost, opportunity cost, activity based costing.
Project: Meaning, types of projects, benefits of project management, project life cycle.

UNIT-II (9)

Standard Costing: Meaning, advantages and limitations, standard costing in manufacturing and process industries, standard costing and standardized costing, standard cost and estimated cost.
Cost Control and Reduction: Cost control meaning, distinction between cost control and cost reduction, advantages and disadvantages of cost control and cost reduction, cost control techniques, essential for success of cost controls and cost reduction programme, areas of cost reduction, tools and techniques of cost reduction.

UNIT-III (9)

Cost Behavior and Profit Planning: Marginal cost, absorption cost, break-even analysis, cost-volume-profit (CVP) analysis, profit-volume (PV) ratio, sales ratio, margin of safety.
Budgets: Budgetary control, flexible budget, performance based budgets, zero based budgets.

UNIT-IV (9)

Quantitative Techniques for Cost Management: linear programming problems (LPP includes graphic method and simplex method), transportation problems, assignment problems.

Textbooks:

[1] S.P. Jain, K.L.Narang, *Advanced Cost Accounting*, New Delhi: Kalyani Publishers, 2014 (Chapter 7, 10 ,11 13, 14, 16 &27)

[2] N.D. Vohra, *Quantitative Techniques in Management*, 3rd ed. New Delhi: Tata McGraw Hill Book Co. Ltd. 2007 (Chapter 2,3, 5 and 6)

Reference Books:

[1] Ashish K. Bhattacharya, *Principles & Practices of Cost Accounting*, 3rd ed. New Delhi: Prentice Hall India Learning Private Limited, 2004.

[2] Harold Kerzner, *Project Management: A systems approach to Planning, Scheduling and Controlling,* 10th ed. New Delhi: John Wiley & Sons Inc., 2009.

[3] V K Kapoor, *Operations Research,* New Delhi: Sultan Chand & Sons, 2013.

[4] Charles T. Horngren and George Foster, *Cost Accounting A Managerial Emphasis*, New Delhi: Prentice Hall of India, 1991.

Course Learning Outcomes (Cos):

Upon completion of this course, the student will be able to…

CO1: interpret overview of cost accounting and project management

CO2: distinguish standard costing in manufacturing and process industries, estimate cost control and reduction

CO3: estimate cost behavior, profit planning and budget

CO4: apply quantitative techniques for linear programming, transportation and assignment problems

Course Articulation Matrix (CAM): P20OE302D : COST MANAGEMENT OF ENGINEERING PROJECTS

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20OE302D.1	1	1	1	1	1
CO2	P20OE302D.2	1	1	1	2	1
CO3	P20OE302D.3	2	1	1	1	1
CO4	P20OE302D.4	2	1	1	2	1
P20OE302D		**1.5**	**1**	**1**	1.5	1

P20OE302E: COMPOSITE MATERIALS

Class: M. Tech. III –Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CSP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives(LOs):

This course will develop students'knowledge in/on…

LO1: composite material properties and applications
LO2: properties and applications of fibers and rule of mixture
LO3: manufacturing and applications of metal matrix, ceramic matrix and carbon-carbon composites
LO4: polymer matrix composites, manufacturing and applications

UNIT- I (9)

Composite Materials: Definition, classification, characteristics, advantages, applications, functional requirements of reinforcement and matrix, effect of reinforcement on composite performance - size, shape, distribution and volume fraction

UNIT-II (9)

Reinforcements: Preparation - layup, curing, fibers-glass, carbon, Kevlar, boron, properties and applications- fibers, whiskers, particle reinforcements, mechanical behavior of composites, rule of mixtures, inverse rule of mixtures, isostrain and isostress conditions

UNIT-III (9)

Manufacturing of Metal Matrix Composites: Casting – solid state diffusion technique, cladding – hot isostatic pressing, properties and applications

Manufacturing of Ceramic Matrix Composites: Liquid metal infiltration – liquid phase sintering, properties and applications

Manufacturing of Carbon/carbon Composites: Knitting, braiding, weaving; properties and applications

UNIT-IV (9)

Manufacturing of Polymer Matrix Composites: Preparation of molding compounds and prepregs, manufacturing of polymer matrix composites - hand layup, autoclave, filament winding, compression molding and reaction injection molding, properties and applications

Textbook:

[1] Chawla K.K., *Composite Materials*, 4th ed., New York: Springer, Verlag, 2019. (*Chapters 1, 2, 5, 6, 7 & 8*)

Reference Books:

[1] Agarwal, B.D. and Broutman, L. J., *Analysis and Performance of Fiber Composites*, 4th ed., USA: John Wiley & Sons, 2017.
[2] Strong A.B., *Fundamentals of Composite Manufacturing*, 2nded., SME, 2007.
[3] Sharma S.C., *Composite materials*, 1sted., New Delhi: Narosa Publications, 2000.
[4] Mathews F.L. and Rawlings R.D., *Composite materials: Engineering and Science*, 1st ed., England: Chapman and Hall, 1994.
[5] Krishnan K., Chawla *Composite Materials Science and Engineering*, India: Springer Private Limited, 2009.
[6] P.K. Mallick, *Fiber Reinforced Composite materials, Manufacturing and Design*, New York: CRC Press, Taylor and Francis Group, 2010.

Course Learning Outcomes (COs):
On completion of this course, students will be able to…

CO1: classify composite materials and explain their applications
CO2: outline properties and applications of reinforcements.
CO3: categorize manufacturing methods for metal matrix composite, ceramic matrix composite, carbon/carbon composite and their properties.
CO4: compare manufacturing methods of polymer matrix composites.

Course Articulation Matrix (CAM) P20OE302E : COMPOSITE MATERIALS						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	P20OE302E.1	1	1	1	**1**	**-**
CO2	P20OE302E 2	1	1	1	**1**	**1**
CO3	P20OE302E.3	1	1	1	**1**	**1**
CO4	P20OE302E.4	1	1	1	**1**	**1**
P20OE302E		**1**	**1**	**1**	**1**	**1**

P20OE302F: WASTE TO ENERGY

Class: M. Tech. III–Semester

Specialization(s): SCE, DE, VE, PE, SE, DS, DC & CSP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):

This course will develop students' knowledge on/in…

LO1: concept of waste to energy
LO2: production of energy form waste.
LO3: technologies for waste to energy.
LO4: standards for waste to energy plants and carbon credits.

UNIT – I (9)

Introduction: Principles of waste management and waste utilization, waste management hierarchy and 3R principle of reduce, reuse and recycle, waste as a resource and alternate energy source

Waste Sources and Characterization: Waste production in different sectors such as domestic, industry and agriculture, classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous), characterization of waste for energy utilization

UNIT – II (9)

Technologies for Waste to Energy: Biochemical conversion – energy production from organic waste through anaerobic digestion and fermentation, thermo-chemical conversion – combustion, incineration and heat recovery, pyrolysis, gasification, plasma arc technology

Waste to Energy Options: Landfill gas, collection and recovery, refuse derived fuel (RDF) – fluff, briquettes, pellet, alternate fuel resource (AFR) – production and use in cement plants, thermal power plants and industrial boilers, conversion of wastes to fuel resources for other useful energy applications, energy from plastic wastes – non-recyclable plastic waste for energy recovery, energy recovery from wastes and optimization of its use, benchmarking and standardization, energy analysis

UNIT – III (9)

Energy production: Waste activities – collection, segregation, transportation and storage requirements, location and siting of 'waste to energy' plants, industry specific applications – in-house use – sugar, distillery, pharmaceuticals, pulp and paper, refinery and petrochemical industry

Centralized and Decentralized Waste to Energy Plants: Centralized and decentralized energy production, distribution and use, comparison of centralized and decentralized systems and its operations

UNIT-IV (9)

Waste to Energy & Environmental Implications: Environmental standards for waste to energy plant operations and gas clean-up, savings on non-renewable fuel resources
Carbon Credits: carbon foot print calculations and carbon credits transfer mechanisms

Textbook:

[1] *Waste to Resources: A Waste Management Handbook*, New Delhi: TERI Press, 2014. (Unit – I, III & IV)

[2] Sunil Pandey, *Industrial and Urban Waste Management in India*, New Delhi : TERI Press, 2015 (Unit –II)

Reference Books:

[1] Banwari Lal and Patwardhan, *Wealth from Waste: Trends and Technologies*, New Delhi: TERI Press, 2014.

[2] S.N Mukhopadhyay, *Fundamentals of waste and Environmental Engineering*, New Delhi: TERI Press, 2016.

[3] Gazette Notification on Waste Management Rules 2016.

[4] CPCB Guidelines for Co-processing in Cement/Power/Steel Industry.

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: outline the operations of waste sources and alternate energy sources
CO2: adopt waste to energy technologies
CO3: list the stages of waste to energy production
CO4: appraise environmental standards and estimate carbon foot print.

Course Articulation Matrix: P20OE302F : WASTE TO ENERGY						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	**P20OE302F.1**	1	1	1	1	1
CO2	**P20OE302F.2**	1	1	1	1	1
CO3	**P20OE302F.3**	1	1	1	1	1
CO4	**P20OE302F.4**	1	1	1	1	1
P20OE302F		1	1	1	1	1

P20OE302G: RENEWABLE ENERGY SOURCES

Class: M. Tech. III – Semester

Specialization(s): SCE, DE, VE, SE, DS, DC & CSP

Teaching Scheme:

L	T	P	C
3	-	-	3

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):

This course will develop student's knowledge in/on

LO1: different types of renewable energy sources and principles of solar energy systems
LO2: principles of wind energy and geothermal energy systems
LO3: harnessing energy from oceans and biomass
LO4: working of fuel cells and different types of energy storage systems

UNIT-I (9)

Introduction: Conventional and non-conventional sources of energy – brief description of different renewable energy sources

Solar energy: Introduction to prospects of solar PV systems: photovoltaic effect and electrical equivalent circuit of a PV cell, dependence of a PV cell characteristic on temperature, Solar cell output characteristics, flat plate and concentrating collectors, solar applications-solar heating/cooling technique, solar distillation, drying, street lighting, domestic lighting, solar PV pumping systems

UNIT-II (9)

Wind energy: Principles of wind power, evaluation of wind intensity, operation of a wind turbine and wind power curve, different types of wind turbine generators, topography and classification of wind turbines and its applications.

Geothermal Energy: Origin and types of geothermal energy, operational difficulties, liquid dominated systems

UNIT-III (9)

Energy from Oceans: Ocean temperature differences, ocean waves, energy from the waves; Introduction of tidal power, basic principle of tidal power, components of tidal power plants

Bioenergy: Introduction, bio-mass conversion technologies, photo synthesis, biogas generation, biogas from power plant wastes, methods of maintaining biogas production, utilization of biogas, biogas gasification

UNIT-IV (9)

Chemical energy sources: Introduction to fuel cells, principle of operation of fuel cell, classification of fuel cells, advantages, disadvantages and applications of fuel cells

Types of energy storage systems: Introduction, mechanical energy storage systems, batteries, ultra-capacitors, super conducting magnetic storage, applications
Case study on present scenario of energy generation in India

Textbook:

[1] Rai G.D, *Non-Conventional Energy Sources*, 4th ed., New Delhi: Khanna Publishers, 2010.

Reference books:

[1] B.H. Khan, *Non-conventional Energy Resources*, 2nd ed., New Delhi: McGraw Hill Publishers, 2006.
[2] Felix A. Farret, M. Godoy Simoes, *Integration of Alternative Sources of Energy*, New York: John Wiley & Sons, 2006.
[3] Bansal N. K. Kaleeman and M. Miller, *Renewable Energy Sources and Conversion Technology*, New Delhi: Mc Graw-Hill Publishers, 2006.
[4] Duffie and Beckman, *Solar Energy Thermal Process*, New York: John Wiley & Sons, 2006.

Course Learning Outcomes (COs):
Upon completion of this course, the student will be able to…

CO1: compare conventional and non-conventional energy resources; describe solar cell characteristics and discuss applications of solar energy
CO2: compute power output of wind and describe principle of geothermal energy system
CO3: describe harnessing of electric power from oceans and biomass
CO4: describe principle of operation of fuel cells and list different types of energy storage systems

Course Articulation Matrix: P20OE302G RENEWABLE ENERGY SOURCES

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	P20OE302G.1	2	1	1	2	1
CO2	P20OE302G.2	2	1	1	2	1
CO3	P20OE302G.3	2	1	1	2	1
CO4	P20OE302G.4	2	1	1	2	1
P20OE302G		**2**	**1**	**1**	2	1

P20DE303: DISSERTATION PHASE-I /INDUSTRIAL PROJECT

Class: M. Tech. III - Semester **Branch:** Design Engineering

Teaching Scheme:

L	T	P	C
-	-	18	9

Examination Scheme:

Continuous Internal Evaluation	100 marks
End Semester Examination	--

Course Learning Objectives (LOs):

This course will develop students' knowledge on /in…

LO1:selecting problem based Dissertation title in one of the areas of specialization
LO2:literature review and well-documented report writing
LO3:effective technical presentation skills with creating PPTs and speaking with technical knowledge
LO4:creating video pitch

Registration Presentation: The Registration Dissertation Presentation shall include a brief report and presentation focusing the identified topic, literature review, time schedule indicating the main tasks, and expected outcome.

Progress Presentation-I: At the end of first stage (third semester), student shall be required to submit a preliminary report of work done for evaluation to the project coordinator and present the same before the *Department Post Graduate Review Committee* (DPGRC).

Evaluation for Dissertation / Industrial Project:

Dissertation work shall be normally conducted in two stages: Dissertation *Phase-I* in third semester and Dissertation *Phase-II* in fourth semester.

Dissertation *Phase-I*:

(i) The Department *Post Graduate Review Committee (DPGRC)* shall be constituted with HoD as a Chairman, M.Tech. Coordinator as a Convener and three to five other faculty members representing various specializations in that particular programme as members.

(ii) (a) Student shall take up independent Dissertation Phase-I on innovative ideas, innovative solutions to common problems using their knowledge relevant to courses offered in their programme of study, which would supplement and complement the program assigned to each student

(OR)

(b) Student shall take up industrial project (in any industry) relevant to the courses offered in their programme of study, which would supplement and complement the program assigned to each student

(iii) DPGRC shall allot a faculty supervisor to each student for guiding on

(a) Selection of topic
(b) Literature survey and 50% work to be carried out during phase-I
(c) Preparing a report in proper format
(d) Effective oral presentation on dissertation phase-I before the DPGRC
(e) Right conduct of research and academic activity to promote academic integrity
(f) Use of anti-plagiarism software to detect plagiarism in the report and submission of dissertation report within acceptable plagiarism levels

(iv) In case of students with industrial projects, internal guide shall be there to track the progress from time to time

(v) There shall be only Continuous Internal Evaluation (CIE) for Dissertation Phase-I

(vi) CIE for the Dissertation Phase-I in third semester is as follows:

Assessment	Weightage
Dissertation Phase-I Supervisor Assessment	**50%**
DPGRC Assessment: *(i) Registration Presentation* ***(10%)*** *(ii) Progress Report on Phase-I* ***(10%)*** *(iii) Video pitch on Phase-I* ***(10%)*** *(iv) Progress Presentation -I and viva voce* ***(20%)***	**50%**
Total Weightage:	**100%**

Note: It is mandatory for the student to

(i) appear for progress presentation -I and viva voce to qualify for course evaluation

(ii) create a good video pitch on dissertation phase-I

(a) **Dissertation Topic:** The topic should be interesting and conducive to discussion. Topics may be found by looking through recent issues of peer reviewed Journals/Technical Magazines on the topics of potential interest

(b) **Working Model:** Each student is required to develop a working model/ process/software package/system, on the chosen work and demonstrate before the DPGRC as per the dates specified by DPGRC at the end of dissertation phase-II

(c) **Progress Report:** Each student is required to submit a well-documented progress report on dissertation phase-I as per format specified by DPGRC

(vii) The student has to register for the Dissertation Phase-I as supplementary examination in the following cases:

(a) he/she is absent for oral presentation and viva-voce

(b) he/she fails to submit the report in prescribed format

(c) he/she fails to fulfill the requirements of Dissertation Phase-I evaluation as per specified guidelines

(viii) (a) The CoE shall send a list of students registered for supplementary to the HoD concerned

(b) The DPGRC, duly constituted by the HoD, shall conduct Dissertation Phase-I evaluation and send the award list to the CoE within the stipulated time

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: select current topics in their specialization and allied areas from peer reviewed journals / technical magazines/ conference proceedings

CO2: demonstrate the skills for performing literature survey, identify gaps, analyze the technical content and prepare a well-documented Dissertation report

CO3: create informative PPTs with effective oral presentation, showing knowledge on the subject and sensitivity towards social impact of the Dissertation

CO4: demonstrate Dissertation through effective video pitch

Course Articulation Matrix (CAM): P20DE303 DISSERTATION PHASE-I /INDUSTRIAL PROJECT						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	**P20DE303.1**	2	-	2	2	2
CO2	**P20DE303.2**	2	-	2	2	2
CO3	**P20DE303.3**	-	2	-	1	1
CO4	**P20DE303.4**	-	2	-	1	1
P20DE303		**2**	**2**	**2**	**1.5**	**1.5**

P20DE304: INTERNSHIP EVALUATION

Class: M. Tech. III - Semester **Branch:** Design Engineering

Teaching Scheme:

L	T	P	C
-	-	2	-

Examination Scheme:

Continuous Internal Evaluation	100 marks
End Semester Examination	--

Course Learning Objectives (LOs):

This course will develop students' knowledge on /in…

LO1: selection of internship in one of the areas of course specialization

LO2: practical and real time subject application

LO3: writing well-documented report

LO4: effective technical presentation skills with creating PPTs

Guidelines for Internship:

(1) The students shall undergo 6-8 weeks internship during summer/winter vacation at industry/R&D organization / Academic Institutes like IITs & NITs.

(2) The students preferably shall undergo internship at one organization only. In case of any difficulty, the stipulated period of internship shall be completed at different organizations with minimum of two weeks internship at every stage.

(3) The internship evaluation shall be done in the III semester of study and hence the students shall complete the prescribed period of internship before start of III semester (from end of I semester to commencement of III semester).

(4) The internship evaluation shall be done by *Department Post Graduate Evaluation Committee (DPGRC)*.

Evaluation for Internship:

There shall be only Continuous Internal Evaluation (CIE) for Internship Evaluation

(i) CIE for the Internship in third semester is as follows:

Assessment	Weightage
Internship Supervisor's Evaluation: *a) Completion of Internship Assignment* ***(10%)*** *b) Quality of work in completing the Internship Assignment* ***(10%)*** c) *Attendance, punctuality and work hours* ***(10%)***	***30%***
DPGRC Assessment: *a) Duration (8 /6 weeks)* ***(15% / 10%)*** *b) Internship Report* ***(35%)*** *c) Oral Presentation (with PPT) and viva voce* ***(20%)***	***70%***
Total Weightage:	***100%***

Note: It is mandatory for the student to

(i) appear for oral presentation (with PPT) and viva voce to qualify for course evaluation

(a) Internship Report: Each student is required to submit a well-documented internship report as per format specified by DPGRC

(b) Anti-Plagiarism Check: The internship report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(c) Presentation: Each student should prepare PPT with informative slides and make an effective oral presentation before the DPGRC as per the schedule notified by the department

(ii) The student has to register for the Internship as supplementary examination in the following cases:

(a) he/she is absent for oral presentation and viva-voce

(b) he/she fails to submit the report in prescribed format

(c) he/she fails to fulfill the requirements of Internship evaluation as per specified guidelines

(iii) (a) The CoE shall send a list of students registered for supplementary to the HoD concerned

(b) The DPGRC, duly constituted by the HoD, shall conduct Internship evaluation and send the award list to the CoE within the stipulated time

Course Learning Outcomes (COs):

On completion of this course, students will be able to…

CO1: learn new concepts and apply them to the solution of engineering problems

CO2: function effectively on multidisciplinary teams and interface with other areas of organization

CO3: clearly communicate their ideas in writing and prepare a well-documented internship report

CO4: create informative PPTs and clearly communicate their ideas orally demonstrating technical knowledge

Course Articulation Matrix (CAM): P20DE304 INTERNSHIP EVALUATION						
CO		**PO1**	**PO2**	**PO3**	**PSO1**	**PSO2**
CO1	**P20DE304.1**	2	-	2	2	2
CO2	**P20DE304.2**	2	-	2	2	2
CO3	**P20DE304.3**	-	2	-	1	1
CO4	**P20DE304.4**	-	2	-	1	1
P20DE304		**2**	**2**	**2**	**1.5**	**1.5**

DEPARTMENT OF MECHANICAL ENGINEERING
KAKATIYA INSTITUTE OF TECHNOLOGY & SCIENCE, WARANGAL – 15
(An Autonomous Institute under Kakatiya University, Warangal)
SCHEME OF INSTRUCTION & EVALUATION FOR TWO YEAR POSTGRADUATE PROGRAMME

PRR-20

M.TECH. (DESIGN ENGINEERING)

SEMESTER-IV

Sr. No.	Course Type	Course Code	Course Name	Teaching scheme			Credits	Evaluation Scheme								
								CIE - TA							ESE	Total Marks
								I²RE				Minor	MSE	Total		
				L	T	P		ATLP	CRP	CP	PPT					
1	**PROJ**	**P20DE401**	**Dissertation Phase - II**	**-**	**-**	**30**	15	**-**	**-**	**-**	**-**	**-**	**-**	**60**	**40**	**100**
			Total:	**-**	**-**	**30**	**15**							**60**	**40**	**100**

[L= Lecture, T = Tutorials, P = Practicals, C = Credits, ATLP = Assignments, CRP = Course Research Paper, CP = Course Patent, PPT = Course Presentation, Minor=Minor Examination, MSE=Mid Semester Examination and ESE=End Semester Examination]

Total Contact Periods/Week: 30 **Total Credits: 15**

P20DE401: DISSERTATION PHASE-II

Class: **M.Tech. IV - Semester** Branch: **Design Engineering**

Teaching Scheme:

L	T	P	C
-	-	30	15

Examination Scheme:

Continuous Internal Evaluation	60 marks
End Semester Examination	40 marks

Course Learning Objectives (LOs):

This course will develop students' knowledge on /in…

LO1: recognize and formulate a problem to analyze, synthesize, evaluate, simulate and create a their project

LO2: design an innovative product by applying current knowledge and adopt to emerging applications of engineering and technology

LO3: creating PPTs and effective technical presentation and knowledge skills

LO4: writing technical paper in scientific journal style & format

Progress Presentation -II shall be conducted during the 5th /6th week of IV semester.

Progress Presentation -III shall be conducted during the 12th /13th week of IV semester.

Evaluation for Dissertation Work:

Dissertation *Phase-II*:

(i) Student has to continue the Dissertation work in 4th semester as Dissertation Phase-II

(ii) There shall be Continuous Internal Evaluation (CIE) for 60 marks and End Semester Examination for 40 marks.

(iii) The evaluation for Dissertation Phase-II is as follows:

Assessment	Weightage
Dissertation Supervisor Assessment (10%) *DPGRC* Assessment: *(i) Progress Presentation -II (10%)* *(ii) Progress Presentation -III (10%)* *(iii) Working model/process/software package/system developed (10%)* *(iv) Dissertation Video pitch (10%)* *(v) Dissertation Paper (10%)*	**60%**
End Semester Examination: *(i) Dissertation Report (20%)* *(ii) Oral presentation with PPT and viva-voce (20%)*	**40%**
Total Weightage	**100%**

Note: It is mandatory for the student to

(i) appear for oral presentation (with PPT) and viva-voce to qualify for course evaluation

(ii) write dissertation paper in given journal format

(ii) create a good video pitch on dissertation phase-I & II

(a) **Working Model:** Each student is required to develop a working model/ process/system on the chosen work and demonstrate before the DPGRC as per the dates specified by DPGRC at the end of dissertation phase-II

(b) **Dissertation Report:** Each student is required to submit a well-documented dissertation report as per the format specified by DPGRC

(c) **Anti-Plagiarism Check:** The dissertation report should clear plagiarism check as per the Anti-Plagiarism policy of the institute

(d) **Presentation:** Each student should prepare PPT with informative slides and make an effective oral presentation before the DPGRC as per the schedule notified by the department

(e) **Video Pitch:** Each student should create a pitch video, which is a video presentation on his / her dissertation Phase-I & II. Video pitch should be no longer than 5 minutes by keeping the pitch concise and to the point, which shall also include key points about his / her business idea / plan (if any) and social impact

(iv) **Dissertation Synopsis Presentation (DSP):**

(a) Students, with the consent of supervisor, shall apply to the DPGRC for conduct of dissertation synopsis presentation (DSP). This shall normally happen when the supervisor feels that the student has done significant work to qualify for M.Tech. dissertation.

(b) Those students who clear DSP shall only be allowed to submit the dissertation report for end semester examination

(v) **Dissertation Report:**

After clearing DSP, student shall be required to submit two bound copies of dissertation report, one for the department and other for the Dissertation Supervisor. The Dissertation report shall be evaluated by the DPGRC and external examination shall be conducted on a pre-notified date.

Course Learning Outcomes (COs):
On completion of this course, students will be able to…

CO1: apply knowledge to practice to design & conduct experiments and utilize modern tools for developing working models / process / system leading to innovation and entrepreneurship

CO2: design the hardware/software to demonstrate the principle of working to correlate the analytical simulation and experimental results

CO3: create informative PPT and demonstrate communication skills through effective oral presentation showing knowledge on the subject and sensitivity towards social impact of the Dissertation

CO4: write a "Dissertation paper" in scientific journal style and format from the prepared Dissertation report and create a video pitch on Dissertation

Course Articulation Matrix (CAM): P20DE401 DISSERTATION PHASE-II

CO		PO1	PO2	PO3	PSO1	PSO2
CO1	**P20DE401.1**	**2**	**-**	**2**	**2**	**2**
CO2	**P20DE401.2**	**2**	**-**	**2**	**2**	**2**
CO3	**P20DE401.3**	**-**	**2**	**-**	**1**	**1**
CO4	**P20DE401.4**	**-**	**2**	**-**	**1**	**1**
P20DE401		**2**	**2**	**2**	**1.5**	**1.5**