K.S. Rangasamy College of Technology

(Autonomous Institution)

Curriculum & Syllabus

of

M.E. Engineering Design

(For the batch admitted in 2021 – 22)

R 2018

Courses Accredited by NBA, Accredited by NAAC, Approved by AICTE, Affiliated to Anna University, Chennai.

KSR Kalvi Nagar, Tiruchengode – 637 215.
Namakkal District, Tamil Nadu, India.

Rev. No.3/w.e.f. 01.08.22
Passed in BoS Meeting held on 20/07/22
Approved in Academic Council Meeting held on 23/07/2022

BoS - Chairman
Mechanical Engineering (UG & PG)
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

VISION

To be a leader in providing skill sets for globally competent Engineers, Researchers, Entrepreneurs and Managers in Mechanical Engineering domain.

MISSION

- To offer quality education through experiential learning using ICT tools and socially –relevant projects.
- To engage Faculty and Students in fundamental and applied research related to energy, environment and safety concerns.
- To groom students to venture into successful entrepreneurs and managers.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates of the programme will emerge as competent professionals in their chosen fields.
PEO2: Graduates of the programme will adapt to emerging technological challenges with their core competence in mechanical engineering domain
PEO3: Graduate of the programme will exhibit their knowledge and skills in multidisciplinary Environment

PROGRAMME OUTCOMES (POs)

Engineering Graduates will be able to:

PO1: Ability to individually carryout the STEM based (Science, Technology, Engineering, and Mathematics) research project
PO2: Ability to write, present and publish technical articles in reputed international/national conferences and journals.
PO3: The skill developed by the student should be at a level of higher than the requirements in the appropriate bachelor program.
PO4: Ability to acquire in depth knowledge of engineering design concepts and application of the same to solve complex engineering problems.
PO5: Ability to find optimum safe and cost effective solutions in the development of mechanical systems taking into consideration sustainability, societal, environmental and public health aspects.
PO6: Ability to support professional ethics and social responsibilities consistent with their roles as design engineers.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) WITH PROGRAMME OUTCOMES (POs)

The M.E. Engineering Design programme outcomes leading to the achievement of the objectives are summarized in the following Table.

Programme Educational Objectives	Programme Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
PEO 1	3	1	3	2	2	1
PEO 2	3	3	3	2	2	1
PEO 3	3	2	3	2	2	1

Contributions: 1- low, 2- medium, 3- high

SEMESTER I

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	50 PED 101	Computer Aided Design	PC	3	3	0	0	3
2.	50 PED 102	Concepts of Engineering Design	PC	3	3	0	0	3
3.	50 PED 103	Finite Element Method	PC	3	3	0	0	3
4.	50 PED E1*	Programme Elective – I	PE	3	3	0	0	3
5.	50 PED E2*	Programme Elective – II	PE	3	3	0	0	3
6.	50 AT 00*	Audit Course I	AC	2	2	0	0	0
PRACTICALS								
7.	50 PED 1P1	CAD Laboratory	PC	4	0	0	4	2
8.	50 PED 1P2	Computer Aided Analysis Laboratory I	PC	4	0	0	4	2
			Total	**25**	**17**	**0**	**8**	**19**

SEMESTER II

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	50 PED 201	Advanced Stress Analysis	PC	3	3	0	0	3
2.	50 PED 202	Advanced Vibrations and Acoustics	PC	3	3	0	0	3
3.	50 PED 203	Intellectual Property Rights	PC	2	2	0	0	2
4.	50 PED E3*	Programme Elective – III	PE	3	3	0	0	3
5.	50 PED E4*	Programme Elective – IV	PE	3	3	0	0	3
6.	50 AT 00*	Audit Course II	AC	2	2	0	0	0
PRACTICALS								
7.	50 PED 2P1	Computer Aided Analysis Laboratory II	PC	4	0	0	4	2
8.	50 PED 2P2	Technical Report Preparation and Presentation	EEC	4	0	0	4	2
9.	50 PED 2P3	Mini Project	EEC	4	0	0	4	2
			Total	**28**	**16**	**0**	**12**	**20**

SEMESTER III

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	50 PED E5*	Programme Elective –V	PE	3	3	0	0	3
2.	50 PED E6*	Programme Elective –VI	PE	3	3	0	0	3
3.	50 AT 009	Research Ethics	AC	1	1	0	0	0
PRACTICALS								
4.	50 PED 3P1	Project Work - Phase I	EEC	20	0	0	20	10
			Total	**27**	**7**	**0**	**20**	**16**

SEMESTER IV

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
PRACTICALS								
1.	50 PED 4P1	Project Work - Phase II	EEC	32	0	0	32	16
			Total	**32**	**0**	**0**	**32**	**16**

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 71

Note: PC-Professional Core Courses, PE-Programme Elective Courses, EEC-Employability Enhancement Courses & AC – Audit Courses

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PROFESSIONAL CORE (PC)

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 PED 101	Computer Aided Design	PC	3	3	0	0	3
2.	50 PED 102	Concepts of Engineering Design	PC	3	3	0	0	3
3.	50 PED 103	Finite Element Method	PC	3	3	0	0	3
4.	50 PED 1P1	CAD Laboratory	PC	4	0	0	4	2
5.	50 PED 1P2	Computer Aided Analysis Laboratory I	PC	4	0	0	4	2
6.	50 PED 201	Advanced Stress Analysis	PC	3	3	0	0	3
7.	50 PED 202	Advanced Vibrations and Acoustics	PC	3	3	0	0	3
8.	50 PED 203	Intellectual Property Rights	PC	2	2	0	0	2
9.	50 PED 2P1	Computer Aided Analysis Laboratory II	PC	4	0	0	4	2

PROGRAMME ELECTIVE (PE)

SEMESTER I, PROGRAMME ELECTIVE I

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 PED E11	Advanced Machine Design	PE	3	3	0	0	3
2.	50 PED E12	Design for Manufacturing and Assembly	PE	3	3	0	0	3
3.	50 PED E13	Mathematical Methods in Engineering	PE	3	3	0	0	3
4.	50 PED E14	Fuels and Combustion	PE	3	3	0	0	3
5.	50 PED E15	Research Methodology - Engineering and Management Studies	PE	3	3	0	0	3

SEMESTER I, PROGRAMME ELECTIVE II

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 PED E21	Advanced Engineering Materials	PE	3	3	0	0	3
2.	50 PED E22	Mechanics of Composite Materials	PE	3	3	0	0	3
3.	50 PED E23	Analysis and Synthesis of Mechanisms	PE	3	3	0	0	3
4.	50 PED E24	Instrumentation for Thermal Engineering	PE	3	3	0	0	3
5.	50 PED E25	Advanced Internal Combustion Engines	PE	3	3	0	0	3

SEMESTER II, PROGRAMME ELECTIVE III

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 PED E31	Tribology in Design	PE	3	3	0	0	3
2.	50 PED E32	Robotics	PE	3	3	0	0	3
3.	50 PED E33	Fracture Mechanics	PE	3	3	0	0	3
4.	50 PED E34	Engine Pollution and Control	PE	3	3	0	0	3
5.	50 PED E35	Computational Fluid Dynamics	PE	3	3	0	0	3

SEMESTER II, PROGRAMME ELECTIVE IV

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 PED E41	Multi-body Dynamics	PE	3	3	0	0	3
2.	50 PED E42	Condition Based Monitoring	PE	3	3	0	0	3
3.	50 PED E43	Optimization Techniques in Design	PE	3	3	0	0	3
4.	50 PED E44	Alternative Fuels for IC Engines	PE	3	3	0	0	3
5.	50 PED E45	Advanced Materials and Their Processing	PE	3	3	0	0	3

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SEMESTER III, PROGRAMME ELECTIVE V

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 PED E51	Advanced Finite Element Method	PE	3	3	0	0	3
2.	50 PED E52	Advanced Metallurgy	PE	3	3	0	0	3
3.	50 PED E53	Design of Material Handling Equipments	PE	3	3	0	0	3
4.	50 PED E54	Advances in Casting and Welding Processes	PE	3	3	0	0	3

SEMESTER III, PROGRAMME ELECTIVE VI

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 PED E61	Rapid Prototyping and Tooling	PE	3	3	0	0	3
2.	50 PED E62	Design of Hydraulic and Pneumatic Systems	PE	3	3	0	0	3
3.	51 PED E63	Applied Elasticity and Plasticity	PE	3	3	0	0	3
4.	50 PED E64	Theory of Plates and Shells	PE	3	3	0	0	3
5.	50 PED E65	Bearing Design and Rotor Dynamics	PE	3	3	0	0	3

AUDIT COURSES (I / II / III) (AC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 AT 001	English for Research Paper Writing	AC	2	2	0	0	0
2	50 AT 002	Disaster Management	AC	2	2	0	0	0
3.	50 AT 003	Sanskrit for Technical Knowledge	AC	2	2	0	0	0
4.	50 AT 004	Value Education	AC	2	2	0	0	0
5.	50 AT 005	Pedagogy Studies	AC	2	2	0	0	0
6.	50 AT 006	Stress Management by Yoga	AC	2	2	0	0	0
7.	50 AT 007	Personality Development through Life Enlightenment Skills.	AC	2	2	0	0	0
8.	50 AT 008	Constitution of India	AC	2	2	0	0	0
9.	50 AT 009	Research Ethics	AC	1	1	0	0	0

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	50 PED 2P2	Technical Report Preparation and Presentation	EEC	4	0	0	4	2
2.	50 PED 2P3	Mini Project	EEC	4	0	0	4	2
3.	50 PED 3P1	Project Work - Phase I	EEC	20	0	0	20	10
4.	50 PED 4P1	Project Work - Phase II	EEC	32	0	0	32	16

SUMMARY

S. No.	Category	Credits per semester				Total Credits	Percentage %
		I	II	III	IV		
1.	PC	13	10	-	-	**23**	**32.40**
2.	PE	6	6	6	-	**18**	**25.35**
3.	EEC	-	4	10	16	**30**	**42.25**
4.	AC	AC 1	AC II	AC III	-	**-**	**-**
Total		**19**	**20**	**16**	**16**	**71**	**100**

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED 101- Computer Aided Design								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To learn the basics of computer and systems in CAD aspects. • To get familiarized with the computer graphics application in design. • To introduce and work with discretized geometry in design of mechanical components and representations of shapes. • To create solid modeling using graphical knowledge. • To learn about Finite Element modeling and analysis.
Course Outcomes	**At the end of the course, the students will be able to** 1. Conceptualize the principles of CAD systems, implementation and its connections to CAM and CAE systems 2. Recognize 2D, 3D transformations and projection transformations 3. Get knowledge of various approaches of geometric modeling 4. Comprehend mathematical representation of 2D and 3D entities 5. Know basic fundamentals of FEM

Computers and Systems in CAD

CAD Hardware and Software, Types of systems and system considerations, input and output devices, hardware integration and networking, hardware trends, Software modules, Computer Communications, Principle of networking, classification networks, network wiring, methods, transmission media and interfaces, network operating systems. [9]

Introduction to Computer Graphics Fundamentals

Computer Graphics Introduction, transformation of geometric models: translation, scaling, reflection, rotation, homogeneous representation, concatenated transformations; mappings of geometric models, translational mapping rotational mapping, general mapping, mappings as changes of coordinate system; inverse transformations and mapping. [9]

Curves and Surfaces Modeling

Projections of geometric models, orthographic projections, Geometric Modeling, Curve representation: Parametric representation of analytic curves, parametric representation of synthetic curves, curve manipulations. Surface representation. [9]

Solid Modeling

Fundamentals of solid modeling, boundary representation (B-rep), Constructive Solid Geometry (CSG), sweep representation, Analytic Solid Modeling (ASM), other representations; solid manipulations, solid modeling based applications: mass properties calculations, mechanical tolerancing etc. [9]

Finite Element Modeling and Analysis

Finite Element Analysis, finite element modeling, mesh generation mesh requirements, semiautomatic methods, fully automatic methods, design and engineering applications, System Simulation, Need of simulation, areas of applications, when simulation is appropriate tool / not appropriate, concept of a system, components of a system, discrete and continuous systems, model of a system, types of models, types of simulation approaches. [9]

Total Hours: 45

Text book (s) :

1	William M Newman and Robert F Sproull., “Principles of Interactive Computer Graphics”, McGraw Hill Book Co. Singapore, 2010.
2	Ibrahim Zeid and Sivasubramanian, R., “CAD/CAM – Theory and Practice”, Tata McGraw Hill Education Private Ltd., New Delhi, 2010.

Reference(s) :

1	Donald Hearn and M Pauline Baker., “Computer Graphics”, Prentice Hall Inc, New Delhi, 2006.
2	David F. Rogers, James Alan Adams “Mathematical elements for computer graphics”, 2nd Edition, Tata McGraw-Hill edition, 2010.
3	Tirupathi R. Chandrupatla, “Introduction to Finite Elements in Engineering”, Fourth Edition, Pearson, 2012.
4	Bathe K.J., Cliffs, N.J. “Finite Element Procedures in Engineering Analysis”, PHI Learning, Eastern Economy Editions, 2009.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED 102 - Concepts of Engineering Design								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To impart knowledge on design process and its requirements • To learn mathematical modelling and geometric modelling techniques in design process • To acquire knowledge on materials and the material selection for design process • To learn various material processing techniques and their selection • To know the legal, environmental and safety issues in design process
Course Outcomes	**At the end of the course, the students will be able to** 1. Explain the various design process involved in engineering design. 2. Describe the various models and tools used in engineering design. 3. Discuss the methods of material selection and materials in design. 4. Analyze the various materials manufacturing process in design concepts. 5. Explain the legal, safety and environmental issues related with manufacturing and design.

Design Process

The design process - need identification – design requirements – product life cycle– morphology of design steps of product design – conceptual design, embodiment design, detailed design – concurrent engineering – cad & cam, human factors in design. [9]

Tools in Engineering Design

Creativity and problem solving, decision theory, modeling – role of models in engineering design, mathematical modeling, geometric modeling, finite element modeling, rapid prototyping – simulation finite difference method, monte-carlo method – optimization – search methods, geometric programming, structural and shape optimization. [9]

Material Selection and Materials in Design

The classification and properties of engineering materials- material standards and specifications – methods of material selection – ashby chart and method of weight factors- derivation of material indices- use of material selection chart-Pugh selection method- selection with computed aided databases – design for brittle fracture-design for fatigue failure- design for corrosion resistance- designing with plastics. [9]

Material Processing in Design

Classification of manufacturing processes and their role in design- factors determining the process selection- use of process selection chart and computerized database – design for manufacturing- design for forging and sheet metal forming-design for casting-design for machining, welding and assembly- design for residual stresses and heat treatment. [9]

Legal, Environmental and Safety Issues in Design and Quality Engineering

The origin of laws- contracts - liability – tort law- product liability – design aspects of product liability- codes of ethics- solving ethical conflicts- design for environment – life cycle assessment – material recycling and remanufacture- design for safety – potential dangers and guidelines for design for safety-design for reliability failure mode effect analysis-robust design. [9]

Total Hours:45

Text book (s) :

1	George E. Dieter., "Engineering Design – A Materials and Processing Approach", McGraw Hill, International Edition, Singapore, 2010.
2	Karl T. Ulrich and Steven D. Eppinger., "Product Design and Development", McGraw Hill, International Edition, 2011.

Reference(s) :

1	Pahl G and Beitz W., "Engineering Design", 3rd Edition, Springer – Verlag, NY, 2007.
2	Ray M.S., "Elements of Engineering Design", Prentice Hall Inc., 1985.
3	Suh. N. P., "The Principles of Design", Oxford University Press, NY, 1990.
4	Atif Aziz, "Concepts in Engineering Design", New Age International Private Limited, 2017

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50 PED 103 - Finite Element Method								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To explore the mathematical theory involved in FEM • To apply the various steps involved in FEM for solving 1-D problems • To know the procedure and to solve two dimensional problems • To implement computer to solve problems involving higher order elements • To learn and solve linear, static and dynamic problems in Structural Mechanics.
Course Outcomes	**At the end of the course, the students will be able to** 1. Develop system level matrix equations from a given mathematical model of a problem following the Galerkin weighted residual method or principle of stationary potential. 2. Formulate 1D bar, beam elements and apply them to solve 1-D structural mechanics problems. 3. Apply FEM for solving 2D structural mechanics problems with plane stress, plane strain and axisymmetric conditions 4. Implement Gauss-Legendre scheme of numerical integration to evaluate integrals for iso-parametric elements 5. Obtain the fundamental frequency of natural vibration for bars and beams.

Fundamentals of FEM

Introduction, Classification of problems – Dimensionality, time dependence, Boundary value problems, Initial value problems, Linear/Non-linear, etc., - Differential equation as the starting point for FEM, Finite element formulation, variational, weighted residual and virtual work methods. [9]

1-D Elements

Steps in finite element method, discretization, Types of elements used, Shape functions, Linear Elements, Local and Global coordinates, Nodal degrees of freedom –1 D problems from Structural Mechanics -Bar and Beam problems. [9]

2-D Elements

2-D problems from Structural Mechanics –Plane stress and plane strain problems, Axisymmetric problems – Axi-symmetric forces and geometry. [9]

ISO-Parametric Elements

Computer implementation, higher order elements, Iso-parametric formulation- Coordinate transformation and Gauss-Legendre scheme of numerical integration. [9]

Dynamic Analysis

Eigen-value problems – Natural vibration of bars and beams, Methods to find Eigen values and Eigenvectors. [9]

Total Hours: 45

Text book (s) :

1	Chandrupatla and Belegundu “Introduction to Finite Elements in Engineering”, Prentice Hall of India Pvt. Ltd. New Delhi, 4th Edition, 2015.
2	Reddy J N, “Finite Element Method”, Tata McGraw Hill publishing Co Ltd, New Delhi, 3rdEdition, 2006.

Reference(s) :

1	Logan Deryl L., “A First Course in Finite Element Method”, Thomson Brook/Cole, 5th Ed.2012.
2	Cook R.D. “Concepts and Applications of Finite Element Analysis” Wiley, New York, 4th Ed. 2007.
3	Bathe K.J., Cliffs, N.J. “Finite Element Procedures in Engineering Analysis”, PHI Learning, Eastern Economy Editions, 2009.
4	Ross C T F., “Advanced Applied Finite Element Methods”, Horwood Publishing, 1998.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED 1P1 - CAD Laboratory								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	0	0	4	60	2	60	40	100

Objective(s)	• To apply basic concepts to develop construction (drawing) techniques • To manipulate drawings through editing and plotting techniques • To learn geometric construction and produce template drawings • To understand and demonstrate dimensioning concepts and techniques • To learn the use of Blocks, Design Center, and Tool Palettes.
Course Outcomes	**At the end of the course, the students will be able to** 1. Select conventional representation of threaded parts, springs and gears on drawing using Indian standard code of practice 2. Select fit, allowance, tolerance, and symbols for mechanical components based on requirement**.** 3. Demonstrate basic concepts of modeling software. 4. Ability to manipulate drawings through editing and plotting techniques. 5. Provide information of assembly drawing for manufacturing showing all parts, its dimensions, explanatory notes, relationship of each part and part list manually using computer software.

1. Part and Assembly of Flange Coupling
2. Part and Assembly of Universal Coupling
3. Part and Assembly of Bushed Bearing
4. Part and Assembly of Knuckle Joint
5. Part and Assembly of Plummer Block
6. Part and Assembly of Connecting rod
7. Part and Assembly of Screw Jack
8. Part and Assembly of Pipe Vice
9. Part and Assembly of Machine Vice
10. Part and Assembly of Swivel bearing

Text book (s) :

1	Butt N.D., “Machine Drawing”, Charotar Publishing house Pvt. Ltd., New Delhi, 2010.
2	Gopolakrishna K R., “Machine Drawing”, Subash Publishers, Bengaluru, 2012.

Reference(s) :

1	Siddeswar N., Kanniah P and Satry V V S., “Machine Drawing”, Tata McGraw Hill, New Delhi, 2010
2	Revised IS codes:10711, 10712, 10713, 10714, 10715, 10716, 10717, 10968, 11663, 11669, 17668, 8000, 8043, 9609, 1165

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50 PED 1P2 - Computer Aided Analysis Laboratory I								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	0	0	4	60	2	60	40	100

Objective(s)	• To develop the students to perform the structural analysis of 2D and 3D trusses • To learn the students to perform structural analysis of beams • To impart knowledge on torsion and bending analysis of bar and beam using CAE software. • To develop the students to perform the stress analysis of plate, corner bracket • To acquire skill to perform stress analysis of pressure vessel and cylinder using CAE software.
Course Outcomes	**At the end of the course, the students will be able to** 1. Perform the structural analysis of 2D and 3D trusses 2. Perform the structural analysis of beams 3. Perform the torsion and bending analysis of bar and beam 4. Perform the stress analysis of plate and corner bracket 5. Perform the stress analysis of cylindrical component.

1. Structural analysis of four bar truss under structural and thermal loading.
2. Structural analysis of 3D space truss.
3. Analysis of simply supported beam carrying uniformly distributed load and Oblique loading.
4. Analysis of continuous beam with overhang and multiple loading conditions.
5. Torsion analysis of a stepped cantilever bar.
6. Bending analysis of a simply supported I – beam.
7. Stress analysis of a rectangular plate with circular holes.
8. Stress analysis of corner bracket with plane stress condition.
9. Stress analysis of a long cylindrical pressure vessel using plane strain element.
10. Stress analysis of closed cylinder under pressure using axisymmetric element

Text book (s) :

1	Chandrupatla and Belegundu “Introduction to Finite Elements in Engineering”, Prentice Hall of India Pvt. Ltd. New Delhi, 4th Ed., 2015.
2	Reddy J N, “Finite Element Method”, Tata McGraw Hill publishing Co Ltd, New Delhi, 3rdEd., 2006.

Reference(s) :

1	Logan Deryl L., “A First Course in Finite Element Method”, Thomson Brook/Cole, 5th Ed.2012.
2	Cook R.D. “Concepts and Applications of Finite Element Analysis” Wiley, New York, 4th Ed. 2007.
3	Bathe K.J., Cliffs, N.J. “Finite Element Procedures in Engineering Analysis”, PHI Learning, Eastern Economy Editions, 2009.
4	Ross C T F., “Advanced Applied Finite Element Methods”, Horwood Publishing, 1998.

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50 PED 201 - Advanced Stress Analysis								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To enable the students to provide fundamental theory of elasticity and energy methods for stress and strain analysis. • To learn the theory of torsion and its analogies • To acquire the concept of shear center in symmetrical and unsymmetrical bending • To learn knowledge on pressurized cylinders and rotating disks • To impart knowledge on method of computing contact stresses.
Course Outcomes	**At the end of the course, the students will be able to** 1. Know the concept of elasticity, and the difference between stress and strain. 2. Apply basic field equations to torsion, bending and two dimensional energy methods. 3. Solve problems in unsymmetrical bending and shear center. 4. Calculate the stresses and deformation of the pressurized cylinders and rotating disc. 5. Apply principles of continuum mechanics to design a structure or component to achieve desired performance under realistic constraints.

Theory of Elasticity

Analysis of stress, Analysis of stain, Elasticity problems in two dimension and three dimensions, Mohr's circle for three dimensional stresses. Stress tensor, Air's stress function in rectangular and polar coordinates. [5]

Energy Methods

Energy method for analysis of stress, strain and deflection **T**he three theorem's -theorem of virtual work, theorem of least work, Castigliano's theorem, Rayleigh Ritz method, Galerkin's method, Elastic behavior of anisotropic materials like fiber reinforced composites. [6]

Theory of Torsion

Torsion of prismatic bars of solid section and thin walled section. Analogies for torsion, membrane analogy, fluid flow analogy and electrical analogy. Torsion of conical shaft, bar of variable diameter, thin walled members of open cross section in which some sections are prevented from warping, Torsion of noncircular shaft. [8]

Unsymmetrical Bending and Shear Centre

Concept of shear center in symmetrical and unsymmetrical bending, stress and deflections in beams subjected to unsymmetrical bending, shear center for thin wall beam cross section, open section with one axis of symmetry, general open section, and closed section. [8]

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 disc**.** [9]

Contact stresses

Geometry of contact surfaces, method of computing contact stresses and deflection of bodies in point contact, stress for two bodies in line contact with load normal to contact area and load normal and tangent to contact area. Introduction to Analysis of low speed impact. [9]

Total Hours: 45

Text book (s) :

1	Richard Budynas, R. G., "Advance Strength and Applied Stress Analysis", 2nd Edition, WCB/ McGraw Hill 2017.
2	Dally, J. W. and Riley W F., "Experimental Stress Analysis", 3rd Edition, McGraw Hill International, 1991.

Reference(s) :

1	Sadd, Martin H., "Elasticity: Theory, applications and Numeric", 3rd Edition, Academic Press 2014.
2	Boresi, A.P. and Chong K P., "Elasticity in Engineering Mechanics", 2nd Edition, John Wiley & Sons, 1987.
3	Stephen Timoshenko, Goodier J N., "Theory of Elasticity" 3rd edition, McGraw Hill publication, 2017..
4	Stephen Timoshenko, "Advanced Strength of Materials", Vol. 1 and 2, 3rd Edition, CBS Publishers and Distributors Pvt. Ltd., 2002.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED 202- Advanced Vibrations and Acoustics								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To impart knowledge on mechanical vibrations of single of freedom and continuous systems. • To design systems to achieve the vibratory response, analyze and predict vibratory behavior of mechanical systems using multiple degrees of freedom. • To interpret and solve acoustic engineering problems using analytical, modern computational and experimental methods. • To understand the fundamentals of acoustics in engineering applications. • To understand the principles in psychoacoustics used for Speech, mechanism of hearing, thresholds of the ear.
Course Outcomes	**At the end of the course, the students will be able to** 1. Predict response of a SDOF system, damped or undamped, subjected to simple arbitrary base or force excitations. 2. Write differential equations of motion for MDOF systems, and through the technique of decoupling and orthogonal properties of natural modes. 3. Obtain the Eigen-values and mode shapes of natural vibrations of beams and response to harmonic excitations using orthogonal properties of natural modes and to obtain natural frequencies and mode shapes. 4. Interpret and solve the acoustic engineering problems using analytical methods. 5. Apply principles of Psychoacoustics.

Fundamentals of Vibration

Transient Vibrations, Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel's) integral, impulse response function. [9]

Multi Degree of Freedom Systems

Multi degree of freedom systems, Free, damped and forced vibrations of two degree of freedom systems, Eigen values and Eigen vectors, normal modes and their properties, mode summation method, use of Lagrange's equations to derive the equations of motion. [9]

Vibration of Continuous Systems

Continuous Systems, Natural Vibrations of beams – Differential equation of motion, solution by the method of separation of variables, frequency parameter, natural frequencies and mode shapes, forced vibration of simply supported beam subjected to concentrated harmonic force at a point, Mode summation method, discretized models of continuous systems and their solutions using Rayleigh – Ritz method Vibration Control, Methods of vibration control, principle of superposition, Numerical and computer methods in vibrations: Rayleigh, Rayleigh-Ritz and Dunkerley's methods, matrix iteration method for Eigen-value calculations, Holzer's method. [9]

Fundamentals of Acoustics

Plane acoustic waves, Sound speed, characteristic acoustic impedance of elastic media, sound intensity, dB scale, Transmission Phenomena, transmission from one fluid medium to another, normal incidence, reflection at the surface of a solid, standing wave patterns, Symmetric Spherical waves, near and far fields, simple models of sound sources, sound power, determination of sound power and intensity levels at a point due to a simple source. [9]

Psychoacoustics

Speech, mechanism of hearing, thresholds of the ear – sound intensity and frequency, loudness, equal loudness levels, loudness, pitch and timbre, beats, masking by pure tones, masking by noise. [9]

Total Hours: 45

Text book (s) :

1	Rao, S.S., "Mechanical Vibrations", Addison Wesley Longman, New York, 2012.
2	Lawrence E. Kinsler and Austin R.Frey, "Fundamentals of acoustics", Wiley India Pvt. Ltd., New Delhi, 2009.

Reference(s) :

1	Thomson, W.T., "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 2002.
2	Iyengar, R.N., "Elements of Mechanical Vibration", I K International Pub. House Pvt. Ltd., New Delhi, 2007.
3	Graham S. Kelly and Shashidar K. Kudari., "Mechanical Vibrations", Tata McGraw Hill Pub. Ltd., ND, 2007.
4	Michael Rettinger, "Acoustic Design and Noise Control", Vol. I & II, Chemical Pub.Co., New York, 1977.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED 203 - Intellectual Property Rights								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	2	0	0	30	2	50	50	100

Objective(s)	• To understand the world international intellectual property law. • To gain the knowledge about copyrights and its related rights. • To understand the procedure of patent rights. • To gain the knowledge about trademarks and trade secret. • To enlighten the system of the international IP conventions and treaties.
Course Outcomes	**At the end of the course, the students will be able to** 1. Analyze the effects of intellectual property rights on society as a whole. 2. Gain the knowledge about the importance of copy rights. 3. Become expert in patent registration. 4. Acquire knowledge about the trademarks and trade secret. 5. Describe the importance of Geographical Indication in IPR.

Introduction to Intellectual Property

Intellectual Property-introduction, Need, Concept, Nature, Characteristics, Origin and Development - Justifications for protection of IP - Balancing the Protection of IPR and Public Policy Objective-Theories of IPR. [6]

Copy Rights

Overview of Copyright- Importance of Copyrights-Process for copyright- Related rights -Ownership of copyright -Term of copyright-Rights of owner-Assignment and license-Infringement of copyright-Exceptions of infringement. [6]

Patent Rights

Need for patent- Economic impact of the patent system -Scope of patent rights-Criteria for obtaining patents-Categories of Patent-Special Patents -Procedure for registration- Granting of patent- Rights of a patent-Compulsory license -Government use of patent-Infringement of patents. [6]

Trademarks& Trade Secret

Overview of Trademarks & Trade Secret – Importance- Rights - Types of Trademarks - Registration process – Duration - Rights of holder - Assignment and licensing of marks. [6]

Geographical Indication

Introduction and evolution of Geographical Indication- Importance of Geographical Indication Protection--Indication of Source and geographical Indication- International Convention and agreements- Procedure for Registration, Duration of Protection and Renewal - Infringement and Penalties. [6]

Total Hours: 30

Text Books

1	David I. Bainbridge, “Intellectual Property”, Longman, 9th Edition, 2012.
2	Steven D. Anderman, “Intellectual Property Rights Competition”, Cambridge University Press, 2007.

Reference(s)

1	Susan K. Sell, “Private Power, Public Law: The Globalization of Intellectual Property Rights”, Cambridge University Press, 2003.
2	Arun K. Narasani, Kankanala K.C., Radhakrishnan V., “Indian Patent Law and Practice”, Oxford University Press, 2010.
3	Chawla H S., “Introduction to Intellectual Property Rights”, CBS PUB & DIST PVT Limited, INDIA, 2019.
4	Richard Stim, “Patent, Copyright & Trademark - An Intellectual Property Desk Reference”, NOLO Publishers, 2020.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED 2P1 - Computer Aided Analysis Laboratory II								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	0	0	4	60	2	60	40	100

Objective(s)	• To learn to perform the modeling and meshing of machine component • To perform the analysis on helical spring deflection and modal analysis of beam • To acquire knowledge to perform transient analysis using CAE software. • To develop the students to perform the Design optimization of beam • To impart knowledge on contact analysis and heat transfer analysis using CAE software.
Course Outcomes	**At the end of the course, the students will be able to** 1. Create the modeling of bearing block and connecting rod 2. Perform the axial deflection analysis of an open – coiled Helical spring 3. Perform the modal and transient analysis of cantilever beam 4. Perform the design optimization, drop test and contact analysis 5. Perform the steady state and transient heat transfer analysis.

1. Modeling of a bearing block.
2. Modeling and Meshing of a connecting rod.
3. Analysis on axial deflection of an open – coiled helical spring.
4. Modal analysis of cantilever beam.
5. Transient analysis of cantilever beam.
6. Design optimization of cantilever beam cross section.
7. Drop test analysis of Aluminum container on steel plate.
8. Interference Fit and Pin Pull-Out Contact analysis.
9. Steady state heat transfer analysis on composite wall.
10. Transient heat transfer analysis of slab.

Text book (s) :

1	Chandrupatla and Belegundu “Introduction to Finite Elements in Engineering”, Prentice Hall of India Pvt. Ltd. New Delhi, 4th Ed., 2015.
2	Reddy J N, “Finite Element Method”, Tata McGraw Hill publishing Co Ltd, New Delhi, 3rdEd., 2006.

Reference(s) :

1	Logan Deryl L., “A First Course in Finite Element Method”, Thomson Brook/Cole, 5th Ed.2012.
2	Cook R.D. “Concepts and Applications of Finite Element Analysis” Wiley, New York, 4th Ed. 2007.
3	Bathe K.J., Cliffs, N.J. “Finite Element Procedures in Engineering Analysis”, PHI Learning, Eastern Economy Editions, 2009.
4	Ross C T F., “Advanced Applied Finite Element Methods”, Horwood Publishing, 1998.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED 2P2 - Technical Report Preparation and Presentation								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	0	0	4	60	2	100	-	100

Objective(s)	• To provide exposure to the students to refer and read the research articles in referred journals and conference proceedings • To learn to review the research articles and to find the research gap • To improve the technical report writing and presentation skills of the students. • To acquire strong communication skills to deliver their findings • To provide exposure to use latest IT tools for presentation
Course Outcomes	**At the end of the course, the students will be able to** 1. Collect the relevant literature such as national/international refereed journals selected topics of research. 2. Review the research articles of their interest 3. Write Technical reports to publish at national/international conference. 4. Develop strong communication skills to deliver their work in front of technically qualified audience. 5. Prepare and present report with latest IT tools
Methodology	• Each student is allotted to a faculty of the department by the HOD • By mutual discussions, the faculty guide will assign a topic in the general / subject area to the student • The students have to refer the Journals and Conference proceedings and collect the published literature • The student is expected to collect at least 20 such Research Papers published in the last 5 years • Using OHP/Power Point, the student has to make presentation for 15-20 minutes followed by 10 minutes discussion • The student has make two presentations, one at the middle and the other near the end of the semester • The student has to write a Technical Report for about 30-50 pages (Title page, One page Abstract, Review of Research paper under various subheadings, Concluding Remarks and List of References). The technical report has to be submitted to the HOD one week before the final presentation, after the approval of the faculty guide

Execution	Week	Activity
	I	Allotment of Faculty Guide by the HoD
	II	Finalizing the topic with the approval of Faculty Guide
	III-IV	Collection of Technical papers
	V-VI	Mid semester presentation
	VII-VIII	Report writing
	IX	Report submission
	X-XI	Final presentation

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50 PED 2P3 - Mini Project								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	0	0	4	60	2	100	-	100
Objective(s)	• To impart the practical knowledge to the students • To make them to carry out the technical procedures in their project work • To provide an exposure to the students to refer, read and review the research articles • To write technical papers relevant to their project work and placing this as their beginning stage for their final presentation. • To acquire strong communication skills to present among the audience.							
Course Outcomes	**At the end of the course, the students will be able to** 1. Get an opportunity to work in actual industrial environment if they opt for internship. 2. Solve a live problem using software/analytical/computational tools. 3. Collect the literature relevant to their chosen area of interest 4. Learn to write technical reports. 5. Develop skills to present and defend their work in front of technically qualified audience							
Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.								

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50 PED 3P1– Project Work - Phase I								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	0	0	20	60	10	100	-	100
Objective(s)	• To impart the practical knowledge to the students • To make them to carry out the technical procedures in their project work • To provide an exposure to the students to refer, read and review the research articles • To learn different computational/experimental techniques • To perform experiments/tests and to learn how to work in research environment							
Course Outcomes	**At the end of the course, the students will be able to** 1. Survey the relevant literature such as books, national/international refereed journals and contact resource persons for the selected topic of research. 2. Use different experimental techniques/different software/ computational/analytical tools. 3. Design and develop an experimental set up/ equipment/test rig. 4. Conduct tests on existing set ups/equipment and draw logical conclusions from the results after analyzing them. 5. Work in a research environment or in an industrial environment.							
The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. Seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M.E/M. Tech. The examination shall consist of the preparation of report consisting of a detailed problem statement and a literature review. The preliminary results (if available) of the problem may also be discussed in the report. The work has to be presented in front of the examiners panel set by Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.								

K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED 4P1– Project Work - Phase II								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
IV	0	0	32	60	16	50	50	100
Objective(s)	• To enable and strengthen the students to carry out the project on their own and to implement their innovative ideas • To forefront the risk issues and to retrieve the hazards by adopting suitable assessment methodologies and staring it to global • To make them to carry out the technical procedures in their project work • To learn different computational/experimental techniques • To perform experiments/tests and to learn how to work in research environment							
Course Outcomes	**At the end of the course, the students will be able to** 1. Develop attitude of lifelong learning and will develop interpersonal skills to deal with people working in diversified field will. 2. Design and develop an experimental set up/ equipment/test rig. 3. Conduct tests on existing set ups/equipment and draw logical conclusions from the results after analyzing them. 4. Write technical reports and research papers to publish at national and international level. 5. Develop strong communication skills to defend their work in front of technically qualified audience.							
It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.								

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E11 - Advanced Machine Design								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To impart knowledge on product development processes and organizations • To study design concepts in order to enhance the design process • To study behavior of engineering materials/components under fatigue and creep. • To study statistical techniques and its applications in mechanical design • To learn the Legal, Ethical Environmental and Safety Issues in Design and Quality Engineering
Course Outcomes	**At the end of the course, the students will be able to** 1. Realize that creativity, manufacturability, assembly, maintainability, emotions, reliability are also important aspects of design other than finding dimensions and stresses in the highly competitive, dynamic and customer centered market. 2. Demonstrate the ability to identify needs of the customer and convert them into technical specifications of a product. 3. Generate different ideas after identifying the need and determining the specifications and constraints of a product for a particular purpose. 4. Understand the principals used while designing for manufacture, assembly, emotions and maintenance. 5. Know various methods of rapid prototyping the products to test and modify the designs.

Introduction
Development processes and organizations, Product Planning [9]

The Design Process
Need Identification and problem definition, product specification, concept generation and selection, evaluation, creativity methods, Concept testing [9]

Material Processing and Design
Design for manufacture, assembly, maintenance, casting, forging, [9]

Reliability
Design for Reliability, strength based reliability, parallel and series systems, robust design. [9]

Legal, Ethical Environmental and Safety Issues in Design and Quality Engineering
Industrial design: Design for Emotion and experience, Introduction to retrofit and Eco design, Human behaviour in design, Rapid Prototyping. [9]

Total Hours: 45

Text book (s) :

1	George E Dieter, “Engineering Design”, McGraw Hill Company, New Delhi, 2016.
2	Prashant Kumar, “Product Design, Creativity, Concepts and Usability”, Eastern Economy Edition, PHI New Delhi. 2012

Reference(s) :

1	Woodson T.T., “Introduction to Engineering Design”, McGraw Hill Book Company, 1966.
2	John J.C. “Design Methods”, Wiley Inter science, 1970.
3	Averill M. Law and David Kelton W., “Simulation, modelling and analysis”, McGraw Hill Book Co., 1991.
4	Pahl, G and Beitz, W., “Engineering Design–A Systematic Approach”, Springer, 2nd Edition, 1996.

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50 PED E12 - Design for Manufacturing and Assembly								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To provide an overview of Design for Manufacturing and Assembly (DFMA) techniques • To minimize product cost through design and process improvements. • To introduce the concept and application for design for manufacturing and assembly to practicing designers and manufacturing engineers as well as design students • To discuss various fundamentals of assembly and design recommendations for product development • To learn how to reliability concepts to improve quality
Course Outcomes	**At the end of the course students will be able to** 1. Recognize the product development cycle 2. Know the manufacturing issues that must be considered in the mechanical engineering design process 3. Know the principles of assembly to minimize the assembly time 4. Know the effect of manufacturing process and assembly operations on the cost of product (not included by others) 5. Be familiar with tools and methods to facilitate development of manufacture mechanical designs

Introduction
Introduction Need Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Selection of Materials and Shapes. [9]

Material Consideration
Properties of Engineering Materials, Selection of Materials – I, Selection of Materials – II, Case Studies – I, Selection of Shapes, Co-selection of Materials and Shapes, Case Studies – II. [9]

Design for Manufacture
Selection of Manufacturing Processes, Review of Manufacturing Processes, Design for Casting, Design for Bulk Deformation Processes, Design for Sheet Metal Forming Processes, Design for Machining, Design for Powder Metallurgy, Design for Polymer Processing, Selection of Materials and Processes, Case-Studies – III. [9]

Design for Assembly
Design for Assembly, Review of Assembly Processes, Design for Welding – I, Design for Welding – II, Design for Brazing and Soldering, Design for Adhesive Bonding, Design for Joining of Polymers, Design for Heat Treatment, Case-Studies – IV [9]

Design for Reliability
Design for Reliability, Failure Mode and Effect Analysis and Quality, Design for Quality, Approach to Robust Design, Design for Optimization. [9]

Total Hours: 45

Text book (s) :

1	Courtney, T H., “Mechanical Behavior of Materials”, 2nd Edition, Waveland Press, 2005.
2	Dieter G E, “Engineering Design - A Materials and Processing Approach”, 4th Edition, McGraw Hill, NY, 2008.
3	Swift, K G and Booker, J D., “Process Selection: From Design to Manufacture”, 2nd Edition, Elsevier – London, 2003.

Reference(s) :

1	Rao, S S. “Engineering Optimization: Theory and Practice”, 4th Edition, John Wiley, NY, 2009.
2	Boothroyd G, Dewhurst P and Knight W, “Product Design for Manufacture and Assembly, 3rd Edition, John Wiley, NY: Marcel Dekkar, 2010.
3	Bralla J G, “Handbook of Product Design for Manufacture”, McGraw Hill, NY, 1998.
4	Ashby M F and Johnson K, “Materials and Design - The Art and Science of Material Selection in Product Design”, 3rd Edition, Butterworth-Heinemann, 2014.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E13 - Mathematical Methods In Engineering								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To introduce the basic concepts of probability and explain about standard distributions. • To familiarize the students with various methods in hypothesis testing • To design and analyse the statistical experiments • To solve initial value problems for ordinary differential equations numerically. • To Solve numerically partial differential equations of parabolic, elliptic and hyperbolic types with appropriate boundary and initial conditions encountered in engineering design
Course Outcomes	**At the end of the course, the students will be able to** 1. Comprehend the concept of probability and apply the concepts of standard distributions and central limit theorem. 2. Test the statistical hypothesis using t, Fand χ^2 distributions. 3. Analyze the design of experiments using different methods. 4. Compute the solution for initial value problem using single step and multi-step methods. 5. Find the solution of PDE using boundary condition.

Introduction to Probability Theory

Probability theory and sampling distributions: basic probability theory – standard discrete and continuous distributions like Binomial, Poisson, Geometric distributions – Uniform, Exponential, Gamma and Normal distributions – central limit theorem and its significance. [9]

Testing of Hypothesis

Small sample tests based on t, F and χ^2 distributions – Contingency table (Test for Independency) – Goodness of fit – large sample. [9]

Design of Experiments (ANOVA)

One way classification – Completely randomized design – Two way classification – Randomized block design – Latin square design – 2n factorial design. [9]

Ordinary Differential Equations

Single step methods: Taylor's series method – Euler's and modified Euler's methods – Fourth order Runge – Kutta method for solving first order equations – Multistep methods: Milne's and Adam's predictor and corrector methods. [9]

Partial Differential Equations and Concepts in Solution to Boundary Value Problems

Finite different solution of one dimensional heat equation by explicit method: Bender-Schmidt method – implicit method: Crank –Nicholson method – one dimensional wave equation – Laplace equation: Leibmann's iteration processes – Poisson equations. [9]

Total Hours: 45

Text book (s) :

1	Gupta, S.C, and Kapur, J.N., "Fundamentals of Mathematical Statistics", Sultan Chand, 9th Edition, New Delhi, 1996.
2	Grewal B.S and Grewal J.S., "Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.

Reference(s) :

1	Gupta, S.C, and Kapur, J.N., "Fundamentals of Mathematical Statistics", Sultan Chand, 9th Edition, New Delhi, 1996.
2	Kandasamy P., Thilakavathy K. and Gunavathy K., "Numerical Methods", 3rd Edition, S.Chand and Co., New Delhi, 2003.
3	Dr. Ameeya Kumar Nayak, Dr.Sanjeev Kumar, "Numerical methods", NPTEL online video courses.
4	Probability and distributions – Nptel: nptel.ac.in/courses/105103140/2

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50 PED E14- Fuels and Combustion								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To study the types of fuels and its properties analysis methods. • To study the various solid and liquid fuels and its purification methods. • To analyze the properties of gases fuels. • To understand the combustion characteristics of solid, liquid and gaseous fuels. • To understand the working principle coal burning equipment.
Course Outcomes	**At the end of the course students will be able to** 1. Acquire knowledge about the types of fuels and its properties analysis methods. 2. Categorize the types of solid and liquid fuels from various sources. 3. Estimate on gaseous fuel properties and Wobbe index. 4. Categorize the gaseous fuels based on composition, properties and combustion stoichiometry. 5. Categorize the types of coal burning equipments and burner combustion.

Introduction

Fuels-Types And Characteristics Of Fuels-Determination Of Properties Of Fuels-Fuels Analysis- Proximate and Ultimate analysis-Moisture Determination-Calorific Value- Gross & Net Calorific Values – Calorimetry- Dulong's Formula for Cv Estimation-Flue Gas Analysis –Orsat Apparatus- Fuel & Ash Storage & Handling. [9]

Solid and Liquid Fuels

Solid fuels Types – Coal Family – Properties – Calorific Values – ROM, DMMF, DAG AND Bone DryBasis– Ranking – Bulk & Apparent Density – Storage – Washability –Coking & Caking Coals –Renewable Solid Fuels – Biomass – Wood Waste – Agro Fuels– Manufactured Solid Fuels. Liquid Fuels Types –Sources – Petroleum Fractions-Classification – Refining – Properties Of Liquid Fuels – Calorific Value, Specific Gravity, Flash & Fire Point, Octane Number, Cetane Number Etc., - Alcohols – Tar Sand Oil –Liquefaction Of Solid Fuels. [9]

Gaseous Fuels

Classification – Composition & Properties – Estimation Of Calorific Value – Gas Calorimeter. Rich and Lean Gas – Wobbe Index – Natural Gas – Dry & Wet Natural Gas Stripped NG – Foul & Sweet NG – LPG –CNG – Methane – Producer Gas Gasifiers Water Gas – Town Gas – Coal Gasification –Gasification Efficiency – Non – Thermal Route – Biogas – Digesters – Reactions – Viability – Economics. [9]

Combustion

Stoichiometry – Mass Basis & Volume Basis – Excess Air Calculation – Fuel and Flue Gas Compositions – Calculations – Rapid Methods – Combustion Processes – Stationary Flame Combustion Explosive Combustion. Mechanism Of Combustion – Ignition & Ignition Energy – Spontaneous Combustion- Flame Propagation – Solid, Liquid & Gaseous Fuels Combustion – Flame Temperature. [9]

Coal Preparation System

Coal Burning Equipment's – Types – Pulverized Coal Firing – Fluidized Bed Firing – Fixed Bed and Recycled Bed– Cyclone Firing – Spreader Stokers – Vibrating Grate Stokers Sprinkler Stokers, Traveling Grate Stokers. Oil Burners – Vaporizing Burners –Air Aspiration Gas Burners – Burners Classification According To Flame Structures –Factors Affecting Burners & Combustion. [9]

Total Hours: 45

Text book(s):

1	Samir S, "Fuels and Combustion", 3rd Edition, CRC Press, 2010.
2	Maximilian L, Franz W and Avinash Kumar A, "Handbook of Combustion", Volume 4 (Solid fuels), Wiley-VCH, 2010.

Reference(s) :

1	Bhatt B I, and Vora S M, "Stoichiometry", Tata McGraw-Hill Education, 2004.
2	Gajendra Babu M K and Subramanian K A, "Alternative Transportation Fuels: Utilisation in Combustion Engines", CRC Press, 2013.
3	Arora, S. C., and Domkundwar, S., "A course in Power Plant Engineering", 8th Edition, Dhanpatrai Publications Ltd., New Delhi, 2016.
4	Rai,G.D. "Introduction to Power Plant Technology", 11th reprint, Khanna Publishers, 2013.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E15- Research Methodology -Engineering and Management Studies								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To understand the basic framework of research process and techniques. • To understand the measurement and sampling techniques for research work. • To develop the hypothesis for carryout research problem. • To develop a sample test for efficient research work. • To prepare the report and presentation techniques for the research work.
Course Outcomes	**At the end of the course students will be able to** 1. Explain the basic framework of research process and techniques. 2. Describe to conduct research (advanced project) in a more appropriate manner with different methods. 3. Discuss the ethical dimensions of conducting applied research. 4. Explain the basic sampling tests for research process. 5. Discuss the various sources of information for literature review and data collection.

Research Methodology

Research methodology – definition, mathematical tools for analysis, Types of research, exploratory research, conclusive research, modelling research, algorithmic research, Research process- steps. Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design. Secondary data- internal sources of data, external sources of data. [9]

Scales and Measurements

Scales – measurement, Types of scale – Thurstone's Case V scale model, Osgood's Semantic Differential scale, Likert scale, Q- sort scale. Sampling methods- Probability sampling methods – simple random sampling with replacement, simple random sampling without replacement, stratified sampling, cluster sampling. Non-probability sampling method – convenience sampling, judgment sampling, quota sampling. [9]

Hypotheses Testing

Hypotheses testing – Testing of hypotheses concerning means (one mean and difference between two means - one tailed and two tailed tests), concerning variance – one tailed Chi-square test. [9]

Sample Tests

Nonparametric tests- One sample tests – one sample sign test, Kolmogorov-Smirnov test, run test for randomness, Two sample tests – Two sample sign test, Mann-Whitney U test, K-sample test – Kruskal Walls test (H-Test). [9]

Analysis and Report

Introduction to Discriminant analysis, Factor analysis, cluster analysis, multidimensional scaling, conjoint analysis. Report writing- Types of report, guidelines to review report, typing instructions, oral presentation.[9]

Total Hours: 45

Text book (s) :

1	Panneerselvam R., "Research Methodology", 2nd Revised edition, Prentice-Hall of India, New Delhi, 2014.
2	Larry B. Christensen, R. Burke Johnson and Lisa A. Turner, "Research Methods, Design and Analysis", 12th edition, Pearson Education, Inc., New Jersey, 2014.

Reference(s) :

1	Kothari, C.R., "Research Methodology –Methods and techniques", 3rd Edition, New Age Publications, New Delhi, 2014.
2	Bhattacharyya D K, "Research Methodology", Excel Books, New Delhi 2006
3	Gupta M, "Research Methodology", Prentice-Hall of India, New Delhi, 2012.
4	Ranjit Kumar, "Research Methodology: A Step by Step Guide for beginners", 2014.
5	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science and engineering students", 1996.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E21 - Advanced Engineering Materials								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To impart the basic concepts and difference between composite materials with conventional materials. • To apply knowledge for finding failure envelopes and stress-strain plots of laminates. • To analyse engineering materials such as polymers, metals, ceramics and composites • To equip the students with the organizational, practical and computational skills necessary to carry out research in advanced materials engineering. • To learn the economic consideration and recycling of materials
Course Outcomes	**At the end of the course, the students will be able to** 1. Demonstrate an understanding of mechanics, physical and chemical properties of materials including metals, ceramics, polymers and composites. 2. Comprehend existence of imperfections and their effects on mechanical properties of materials and cause of failure. 3. Recognize and predict various types of failures using concept of fracture mechanics, creep and effect of impact. 4. Know Electrical, Thermal, Optical and Magnetic Properties of metals, ceramics, polymers and composites. 5. Know the economic considerations in usage and recycling of materials in human use.

Solids

Historical perspective of Materials Science. Classification of materials. Advanced Materials, Future materials and modern materials, Atomic structure. Atomic bonding in solids, Crystal structures, Crystalline and non-crystalline materials. Miller indices. Anisotropic elasticity. Elastic behavior of composites. Structure and properties of polymers. Structure and properties of ceramics. [9]

Imperfections in Solids and Mechanical Properties of Metals, Dislocations and Strengthening Mechanisms

Point defects. Theoretical yield point. Line defects and dislocations. Interfacial defects. Bulk or volume defects. Atomic vibrations; Elastic deformation. Plastic deformation. Interpretation of tensile stress-strain curves Yielding under multi-axial stress. Yield criteria and macroscopic aspects of plastic deformation. Property variability and design factors, Diffusion mechanisms. Steady and non-steady state diffusion. Factors that influence diffusion. Non-equilibrium transformation and microstructure, Dislocation and plastic deformation. [9]

Failure

Fracture. Ductile and brittle fracture. Fracture mechanics. Impact fracture. Ductile brittle transition. Fatigue. Crack initiation and propagation. Crack propagation rate. Creep. Generalized creep behavior. Stress and temperature effects. [9]

Applications and Processing of Metals and Alloys, Polymers, Ceramics, and composites

Types of metals and alloys. Fabrication of metals. Thermal processing of metals. Heat treatment. Precipitation hardening. Types and applications of ceramics. Fabrication and processing of ceramics, Mechanical behaviour of polymers. Mechanisms of deformation and strengthening of polymers. Crystallization, melting and glass transition. Polymer types. Polymer synthesis and processing, Particle reinforced composites. [9]

Electrical, Thermal, Optical and Magnetic Properties and economic Considerations

Electrical conduction - Semi conductivity - Super conductivity. Electrical conduction in ionic ceramics and in polymers - Dielectric behaviour – Ferro electricity - Piezoelectricity - Heat capacity - Thermal expansion - Thermal conductivity – Thermal stresses - Diamagnetism and Para magnetism – Ferromagnetism - Anti-ferromagnetism and ferrimagnetism. Influence of temperature on magnetic behaviour - Domains and Hysteresis, Basic concepts. Optical properties of metals and non-metals. Application of optical phenomena. Economic, Environmental and Social Issues of material usage - Economic considerations - Environmental and societal considerations - Recycling issues. [9]

Total Hours: 45

Text book (s) :

1	William D. Callister, “Materials Science and Engineering”, John Wiley & sons, 10th Edition, 2018
2	Courtney, T H., “Mechanical Behavior of Materials”, 2nd Edition, Waveland Press, 2005.

Reference(s) :

1	Smallman R E and Bishop R J, “Modern Physical Metallurgy and Material Engineering-Science, Process, Application”, Elsevier, 6th Edition, 1999
2	Budinski, “Engineering Materials: Properties and Selection”, 9th Edition, Prentice Hall India Learning Private Limited, 2009.
3	Ashutosh Tiwari, Arul Murugan N, Rajeev Ahuja, “Advanced Engineering Materials and Modeling”, Wiley-Scrivener Publishers, 2016.
4	Srinivasan R., “Engineering Materials and Metallurgy”, McGraw Hill Education, 2009.

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K.S.Rangasamy College of Technology – AutonomousR2018								
50 PED E22 - Mechanics of Composite Materials								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To comprehend the mechanics of composite materials on macroscopic and microscopic level • To know the elastic behaviour and stress-strain plots of composite lamina • To apply knowledge for finding failure mechanism based on failure theories in a lamina • To know the elastic behaviour and stress-strain plots of composite laminates • To know the design methodology for structural composite materials.
Course Outcomes	**At the end of the course, the students will be able to** 1. Interpret the basic concepts and difference between composite materials with conventional materials. 2. Recognize role of constituent materials in defining the average properties and response of composite materials on macroscopic level. 3. Develop the macro-mechanical failure theories for unidirectional Lamina 4. Apply knowledge for finding failure envelopes and stress-strain plots of laminates. 5. Design the structural composite materials against laminate failure

Introduction and Characteristics
Classification of composite materials, Characteristics of composites, Overview of advantage and limitations of composite materials, Significance and objectives of composite materials, Science and technology, current status and future prospectus. Structural performance of conventional material, Geometric and physical definition, Material response, Scale of analysis. [9]

Elastic Behavior of Unidirectional Lamina
Micromechanics, Basic lamina properties, Constituent materials and properties, Properties of typical composite materials, Stress-strain relations, Relation between mathematical and engineering constants, transformation of stress, strain and elastic parameters. [9]

Strength of Unidirectional Lamina
Micromechanics of failure; failure mechanisms, Macro-mechanical strength parameters, Macro mechanical Failure theories, Applicability of various failure theories. [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. [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. [9]

Total Hours: 45

Text book (s) :

1	Kaw and Autar K, “Mechanics of Composite Materials”, CRC Press, 2nd Edition, 2006.
2	Robert M Jones, “Mechanics of Composite Materials ", CRC Press, 2nd Edition, 2015.

Reference(s) :

1	Madhujit Mukhopadhyay, “Mechanics of Composite Materials and Structures”, University Press, 2004.
2	Isaac M. Daniels, Orilshai, “Engineering Mechanics of Composite Materials”, Oxford University Press, 2006.
3	Bhagwan D. Agarwal, Lawrence J. Broutman, “Analysis and Performance of Fiber Composites”, John Wiley and Sons, Inc. 2017.
4	Krishnan K. Chawla., “Composite materials: Science and Engineering”, Springer Publishers, 2010

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50 PED E23 - Analysis and Synthesis of Mechanisms								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To develop a thorough understanding of the various mechanisms and its design and simulation with ability to effectively use the various mechanisms in real life problems. • To impart knowledge on configuring and synthesizing mechanical systems • To learn how to use kinematic geometry to design linkages • To analyze the motion of planar and spherical four bar linkages • To know the concepts of synthesizing coupler curve mechanism
Course Outcomes	**At the end of the course, the students will be able to** 1. Develop analytical equations describing the relative position, velocity and acceleration of all moving links. 2. Select, configure, and synthesize mechanical components into complete systems. 3. Use kinematic geometry to formulate and solve constraint equations to design linkages for specified tasks. 4. Formulate and analyze the movement of planar and spherical four-bar linkages. 5. Apply modern computer-based techniques in the selection, analysis and synthesis of components and their integration into complete mechanical systems.

Introduction

Basic Concepts; Definitions and assumptions; planar and spatial mechanisms; kinematic pairs; degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Review of graphical and analytical methods of velocity and acceleration analysis of kinematically simple mechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods. [9]

Path Curvature Theory

Curvature Theory: Fixed and moving centrodes, inflection circle, Euler-Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell mechanisms. [9]

Kinematic Analysis

Kinematic Synthesis of planar mechanisms, accuracy (precision) points, Chebesychev spacing, 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, Analytical synthesis of four-bar and slider-crank mechanisms. [9]

Synthesis of Four Bar Mechanisms

Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers, three accuracy point synthesis using complex numbers. [9]

Synthesis of Coupler Curve Based Mechanisms

Coupler Curves: Equation of coupler curve, Robert-Chebychev theorem, double points and symmetry. Kinematic Analysis of Spatial Mechanisms, Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms. [9]

Total Hours: 45

Text book (s) :

1	Hartenberg, R S and Denavit J, "Kinematic Synthesis of Linkages", McGraw-Hill, NewYork, 1980.
2	Hamilton H.Mabie,"Mechanisms and Dynamics of Machinery", John Wiley and sons NewYork, 1982

Reference(s) :

1	Tuttle S B, "Mechanisms for Engineering Design" John Wiley and sons New York, 1998
2	Ghosh A and Mallik A K, "Theory of Machines and Mechanisms", Affiliated East-West Press, New Delhi, 1988.
3	Erdman A G and Sandor G N, "Mechanism Design – Analysis and Synthesis", (Vol. 1and 2), Prentice Hall India, 1988.
4	Shigley J E and Uicker J J, "Theory of Machines and Mechanisms", 2nd Edition, McGraw-Hill, 1995.
5	Robert L.Nortan ,"Design of Machinery", Tata McGraw Hill Edition,2001

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K.S.Rangasamy College of Technology – AutonomousR2018								
50 PED E24- Instrumentation for Thermal Engineering								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To provide knowledge on various measuring instruments for thermal engineering. • To gain the knowledge on Microprocessor and data acquisition system. • To understand the various steps involved in error analysis and uncertainty analysis. • To provide knowledge on advance measurement techniques. • To understand the working principles of various types of analysis techniques.
Course Outcomes	**At the end of the course students will be able to** 1. Acquire knowledge the static and experimental error on analysis on the measurement and reliability of instruments. 2. Describe the working principle of data logger used in data acquisition system and interfacing of hardware with software using microcomputer and intelligent instruments. 3. Categorize the types of instruments and sensors used for measurement of thermo physical properties. 4. Become skilled in telemetry in measurements and data analyst. 5. Become skilled in chromatography analysis.

Measurement Characteristics
Instrument Classification, Characteristics of Instruments – Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments. [9]

Microprocessors and Computers in Measurement
Data logging and acquisition – use of sensors for error reduction, elements of microcomputer interfacing, intelligent instruments in use. [9]

Measurement of Physical Quantities
Measurement of thermo-physical properties, instruments for measuring temperature, pressure and flow, use of sensors for physical variables. [9]

Advance Measurement Techniques
Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, heat flux sensors, Telemetry in measurement. [9]

Measurement Analysis
Chemical thermal, magnetic and optical gas analysers, measurement of smoke, Dust and moisture, gas chromatography, spectrometry, measurement of pH, Review of basic measurement techniques. [9]

Total Hours: 45

Text book(s)

1	Kumar D.S, “Mechanical Measurements and Control” 4thEdition, Metro politan book company Pvt. Ltd, New Delhi, 2016.
2	Thomas G. Beckwith and Roy D. Marangoni, "Mechanical Measurements ", 6thEdition, Pearson Education India, Noida, 2007

Reference(s) :

1	Jain R.K., “Engineering Metrology”, 21st Revised Edition, Khanna publishers, New Delhi, 2015.
2	Nakra, B.C., Choudhry K.K., “Instrumentation, Measurements and Analysis”, Tata McGraw Hill, New Delhi, 2nd Edition, 2003.
3	Gupta S.C., “Engineering Metrology”, 20thEdition, Dhanpat Rai Publications, New Delhi, 2007.
4	Sawhney A.K., “A Course in Mechanical Measurements and Instrumentation” Dhanpat Rai Publications, 2004.
5	Donald P. Eckman, "Industrial Instrumentation ", Wiley Eastern, 2004.

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50 PED E25- Advanced Internal Combustion Engines								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	50	50	100

Objective(s)	• To understand the principles of operation in IC engines and its components. • To study the various stages of combustion in CI engines. • To understand the concepts of engine simulation. • To identify the alternative fuels in the existing IC engines. • To study the latest technologies in engine management system.
Course Outcomes	**At the end of the course students will be able to** 1. Calculate optimum fuel air mixture and application of electronic injection system for complete combustion and stages of combustion in S.I engine. 2. Explain the different types of combustion chamber working principles in C.I engine and analysis the fuel spry and air motion in turbo charger and super charger. 3. Explain the simulation of various engine processes for S.I and C. engines using governing equations. 4. Apply the thermodynamic and fluid mechanic based models in engine simulation. 5. Describe the working principle of recent trends in I.C engine.

Fundamentals of I.C Engine

Spark Ignition Engines, mixture requirements – Fuel – Injection systems – Monopoint, Multipoint injection, Direct injection – Stages of combustion – Normal and abnormal combustion – factors affecting knock – Combustion chambers. [9]

Combustion Techniques in C.I. Engine

Compression ignition engines, Stages of combustion in C.I. Engine – Direct and indirect injection systems – Combustion chambers – Fuel spray behaviour – spray structure, spray penetration and evaporation – air motion – Introduction to turbo charging and supercharging. [9]

Concepts of Engine Simulation

Combustion modeling, Basic concepts of engine simulation, governing equations, simulation of various engine processes for SI and CI Engines. Thermodynamic and fluid mechanic based models. [9]

Alternative Fuels

Alternative fuels, Alcohol, Hydrogen, Natural Gas Bio diesel, fuel cell. Other possible fuels and Liquefied Petroleum Gas- Properties, Suitability, Merits and Demerits as fuels, Engine Modifications. Dual fuel operation. [9]

Recent Trends in I.C. Engine

Recent trends, Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition engines –Plasma Ignition – Zero Emission Vehicles, Engines for special applications – Mining, Defence, Off-highway -Tractor, Bulldozer etc. Submarines, Race car Engine systems, Flexible fuel systems. Surface ignition. [9]

Total Hours: 45

Text book (s) :

1	Ganesan V. “Internal Combustion Engines”, Tata McGraw-Hill, New Delhi, 4th Edition, 2017.
2	John B Heywood, “Internal Combustion Engine Fundamentals”, 2nd Edition, McGraw Hill, 2018.

Reference(s) :

1	Crouse W. H., Anglin D. L., “Automotive Mechanics”, McGraw Hill Education Private Limited, New Delhi, 10th edition, 2017.
2	Ramalingam K K, “Internal Combustion Engine Fundamentals”, 3rd Edition, Scitech Publications, 2015.
3	Heisler H., “Advanced Engine Technology”, SAE International Publications, USA, 1998.
4	Kirpal Singh, “Automobile Engineering”, Vol. 1 & 2, Standard Publishers, New Delhi, 13th Edition, 2017.
5	Srinivasan S., “Automotive Mechanics” McGraw Hill Education Private Limited, New Delhi, 2nd Edition, 2017.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50PED E31- Tribology in Design								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To impart knowledge on theories of friction and wear • To acquire the concept of surface interaction and measurement. • To understand the properties of bearing material and lubricants. • To understand the analytical behavior of hydrostatic and squeeze film lubrication • To learn the different types of hydrodynamic bearings and design of bearings based on analytical /theoretical approach.
Course Outcomes	**At the end of the course, the students will be able to** 1. Apply theories of friction and wear to various practical situations by analysing the physics of the process. 2. Explain the various surface measurement techniques and effect of surface texture on tribological behavior of a surface. 3. Select materials and lubricants to suggest a tribological solution to particular situation. 4. Explain the hydrostatic and squeeze film lubrication. 5. Design a hydrodynamic bearing using various bearing charts.

Friction and Wear

Friction, theories of friction, Wear, types of wear, theories of wear, genesis of friction, instabilities and stick-slip motion. [9]

Surface Interaction and Measurement

Friction control, Surface texture and measurement, wear prevention, Surface treatments, surface modifications, surface coating. [9]

Lubrication of Bearings

Tribological properties of bearing materials and lubricants. Reynolds's equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution), Finite Bearings. [9]

Hydrostatic and Squeeze Film Lubrication

Hydrostatic, squeeze film Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings. [9]

Elasto Hydrodynamic Lubrication

Elasto-hydrodynamic lubrication – pressure viscosity term in Reynolds's equation, Hertz' theory, Ertel-Grubin equation, Design of hydrodynamic journal bearings lubrication of spheres, gear teeth and rolling element bearings, Air lubricated bearings, Tilting pad bearings. [9]

Total Hours: 45

Text book (s) :

1	Alastair, C. and McEttles, C M., "Basic Lubrication Theory", Ellis Horwood, 1981.
2	Basu, S K., Sengupta, S N & Ahuja, B B., "Fundamentals of Tribology", Prentice –Hall of India Pvt Ltd, New Delhi, 2005

Reference(s) :

1	Stachowiak, G W. and Batchelor, A W., "Engineering Tribology", Butterworth- Heinemann, UK, 2005
2	Majumdar, B C., "Introduction to Tribology of Bearings", S.Chand& Company Ltd.,New Delhi,2008.
3	Stolarski, T A., "Tribology in Machine Design", Butterworth-Heinemann, UK, 2000.
4	Cameron, A., "Basic Lubrication Theory", 3rd Edition, Ellis Hardwoods Ltd., UK., 1983.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E32- Robotics								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To understand the basic concepts associated with the design and functioning and applications of Robots. • To learn about design of grippers, drives and control system in robots • To impart knowledge on robot kinematics and robot programming. • To understand the machine vision system in a robot • To learn about the modelling and simulation for the automation of manufacturing plant
Course Outcomes	**At the end of the course, the student will be able to** 1. Apply knowledge of mathematics, sciences and engineering 2. Identify the electrical, electronic and mechanical components and use of them design or machine elements and transmission system. 3. Know about the basic kinematics of robot and the different types of sensors used. 4. Understand the characteristics of robot languages and concept of robot cell layout 5. Study the different industrial applications of robot.

Introduction

Basic Concepts such as Definition, three laws, DOF, Misunderstood devices etc., Elements of Robotic Systems i.e. Robot anatomy, Classification, Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device, etc. Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity. [6]

Robot Grippers

Types of Grippers, Design aspect for gripper, Force analysis for various basic gripper system. Sensors for Robots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot. [6]

Drives and control systems

Types of Drives, Actuators and its selection while designing a robot system. Types of transmission systems, Control Systems -Types of Controllers, Introduction to closed loop control - Control Technologies in Automation:- Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Control System Components such as Sensors, Actuators and others. [7]

Kinematics

Transformation matrices and their arithmetic, link and joint description, Denavit – Hartenberg parameters, frame assignment to links, direct kinematics, kinematics redundancy, kinematics calibration, inverse kinematics, solvability, algebraic and geometrical methods. Velocities and Static forces in manipulators:-Jacobians, singularities, static forces, Jacobian in force domain. Dynamics:- Introduction to Dynamics , Trajectory generations [9]

Machine Vision System

Vision System Devices, Image acquisition, Masking, Sampling and quantisation, Image Processing Techniques, Noise reduction methods, Edge detection, Segmentation. Robot Programming: Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VAL II etc., Features of type and development of languages for recent robot systems. [9]

Modeling and Simulation for manufacturing Plant Automation

Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation. Artificial Intelligence: Introduction to Artificial Intelligence, AI techniques, Need and application of AI. Other Topics in Robotics:- Socio-Economic aspect of robotisation, Economical aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics [8]

Total Hours: 45

Text book (s) :

1	Groover, M P., "Industrial Robotics-Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill Education, New Delhi, 2012.
2	John J. Craig, "Introduction to Robotics (Mechanics and Control), Addison-Wesley, 3rd Edition, 2008

Reference(s) :

1	Richard D.K, Thomas A.C., and Michael, N., "Robotic Engineering: An Integrated Approach", Prentice Hall India, 2nd edition, 2002
2	Dorf, R C., "Handbook of Design, Manufacturing & Automation", John Wiley and Sons.
3	David, W P., "Industrial Automation", John Wiley and Sons. 1989.
4	Ashitava Ghoshal, "Robotics-Fundamental Concepts and Analysis", Oxford University Press, Sixth impression, 2010

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Mechanical Engineering (UG & PG)
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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E33 - Fracture Mechanics								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To impart knowledge on mechanics of cracked components of different modes by which these components fail under static load conditions. • To acquire knowledge on mechanics of cracked components of different modes under fatigue load conditions • To know the crack tip plasticity and their characteristics • To learn the test methods for critical energy release rate, and stress iintensity factor • To understand the mechanism of fatigue failure
Course Outcomes	**At the end of the course, the students will be able to** 1. Identity different modes of fracture failure and evaluate the crack resistance and their growth 2. Identity different cracks with their stress intensity 3. Manage singularity at crack tip using complex variable. 4. Determine critical energy release rate, critical stress intensity factor andJ-Integral 5. Calculate the fatigue life of a component with or without crack in it.

Fracture failure
Modes of fracture failure, Brittle and ductile fracture, Energy release rate: crack resistance, stable and unstable crack growth. [9]

Crack growth
Stress intensity factor: Stress and displacement fields, edge cracks, embedded cracks. [9]

Crack tip plasticity
Shape and size of plastic zone, effective crack length, effect of plate thickness, J-Integral. Crack tip opening displacement. [9]

Test methods
Test methods for determining critical energy release rate, critical stress intensity factor, J-Integral. [9]

Fatigue failure
Crack propagation, effect of an overload, crack closure, variable amplitude fatigue load. Environment-assisted cracking. Dynamic mode crack initiation and growth, various crack detection techniques. [9]

Total Hours: 45

Text book (s) :

1	David Broek, “Elementary Engineering Fracture Mechanics”, Martinus Nijhoff Publisher, 3rd revised edition, 2013.
2	Kare Hellan, “Introduction of Fracture Mechanics”, McGraw-Hill Book Company, 2005.

Reference(s) :

1	Preshant Kumar, “Elements of Fracture Mechanics”, Wheeler Publishing, 2013.
2	Tribikram Kundu, “Fundamentals of Fracture Mechanics”, Ane Books Pvt. Ltd. New Delhi/ CRC Press, 1st Indian Reprint, 2013.
3	Prasant Kumar, “Elements of Fracture Mechanics”, Mc Graw Hill Education, 2009.
4	Meguid S A., “Engineering Fracture Mechanics”, Elsevier Applied Science, 1989.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E34- Engine Pollution and Control								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To create an awareness on the various environmental pollution aspects and issues. • To analyses the comprehensive insight into the pollution in engine and gas turbines. • To impart knowledge on pollutant formation and control. • To impart knowledge on various emission instruments and techniques. • To understand the different types of driving cycles.
Course Outcomes	**At the end of the course students will be able to** 1. Acquire knowledge about the atmospheric pollution due to automobile and stationary engines and effect of global warming. 2. List out the types of pollutant and formation, to design the engine reducing the low emissions and noise. 3. List out the types of measuring instruments used to measure engine exhaust emissions. 4. Categorize the different types of emission control techniques used in IC engines. 5. Describe the driving cycle with standard test procedure and national and international emissions standards.

Pollution - Engines and Turbines

Atmospheric pollution from Automotive and Stationary engines and gas turbines, Global warming– Greenhouse effect and effects of I.C. Engine pollution on environment. [9]

Pollutant Formation

Formation of oxides of nitrogen, carbon monoxide, hydrocarbon, aldehydes and Smoke, Particulate emission. Effects of Engine Design -operating variables on Emission formation –Noise pollution. [9]

Emission Measurement

Non dispersive infrared gas analyser, gas chromatography, chemiluminescent analyser and flame ionization detector, smoke meters –Noise measurement and control. [9]

Emission Control

Engine Design modifications, fuel modification, evaporative emission control, EGR, air injection, thermal reactors, Water Injection, catalytic converters, application of microprocessor in emission control. Common rail injection system, Particulate traps, NOx converters, SCR systems. GDI and HCCI concepts. [9]

Driving Cycles and Emission Standards

Transient dynamometer, Test cells, Driving cycles for emission measurement, chassis dynamometer, CVS system, National and International emission standards. [9]

Total Hours: 45

Text book (s) :

1	Ganeshan V, “Internal Combustion Engines”, Tata McGraw-Hill, 2015.
2	Guy B.Martin, “Automotive Emission Control”, Academic Press, 2007

Reference(s) :

1	James D.Halderman and James Linder, “Automotive Fuel and Emission Control Systems”, 2011.
2	Crouse W. H., Anglin D. L., “Automotive Mechanics”, McGraw Hill Education Private Limited, New Delhi, 10th edition, 2017.
3	Springer and Patterson, “Engine Emission”, Plenum Press, 1990.
4	Paul Degobert – Automobiles and Pollution – SAE International ISBN-1-56091-563- 3, 1991.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E35 - Computational Fluid Dynamics								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To develop the governing differential equation with boundary conditions. • To develop conduction heat transfer for 1D, 2D and 3D governing equations. • To solve the pressure of viscous flow through vorticity method. • To formulate explicit & implicit algorithms for solving the Euler equations and Navier-Stokes equations. • To understand the different types of models in fluid dynamics.
Course Outcomes	**At the end of the course students will be able to** 1. Formulate the governing differential equation and apply it for solving boundary value problems. 2. Solve the one dimensional conduction problem using study state condition 3. Estimate the pressure of viscous flow through Vorticity method. 4. Solve the one dimensional and two dimensional conduction problem by using finite element method. 5. Describe the different types of models in fluid dynamics.

Governing Differential Equation and Finite Difference Method
Classification, Initial and Boundary conditions, Initial and Boundary value problems. Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test. [9]

Conduction Heat Transfer
Steady one-dimensional conduction, Two and Three dimensional steady state problems, Transient one dimensional problem, Two-dimensional Transient Problems. [9]

Incompressible Fluid Flow
Governing Equations, Stream Function – Vorticity method, Determination of pressure for viscous flow, Simple Procedure of Patankar and spalding, Computation of Boundary layer flow, Finite difference approach. [9]

Convection Heat Transfer and FEM
Steady One-Dimensional and Two-Dimensional Convection – dimensional convection – Diffusion, Unsteady two-dimensional Introduction to finite element method – Solution of steady heat Incompressible flow– Simulation by FEM. [9]

Turbulence Models
Algebraic Models – One equation model, K-Models, Standard and High and Low Reynolds number models, prediction of fluid flow and heat transfer using standard codes. [9]

Total Hours: 45

Text book (s) :

1	Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2013.
2	Ghoshdastidar, P.S., "Computational Fluid Dynamics and Heat Transfer" Cengage India Private Ltd., 1st Edition, 2017.

Reference(s) :

1	Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational Fluid Mechanic and Heat Transfer" Hemisphere Publishing Corporation, Newyork, USA, 2011.
2	Fletcher, C.A.J. "Computational Techniques for Fluid Dynamics -1: Fundamental and General Techniques", Springer – Verlag, 2006.
3	Fletcher, C.A.J. "Computational Techniques for Fluid Dynamics -2: Specific Techniques for Different Flow Categories", Springer – Verlag, 2006.
4	Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.

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K.S.Rangasamy College of Technology – Autonomous R 2018								
50 PED E41 - Multi-body Dynamics								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To present the basic theoretical knowledge of the Foundations of Multi-body Dynamics with applications to machine and structural dynamics. • To build capability to carry out multi-body dynamic analysis of complex mechanisms • To compute and assembly of mass matrix of planar system • To acquire knowledge on kinematic analysis of rigid bodies and spatial system • To know the procedure to compute the reaction forces
Course Outcomes	**At the end of the course students will be able to** 1. Derive equations of motion for interconnected bodies in multi-body systems with three dimensional motion. 2. Implement and analyze methods of formulating equations of motion for interconnected bodies. 3. Write programs to solve constrained differential equations for analyzing multi-body systems. 4. Simulate and analyze all types of static and dynamic behaviors of the multi-body systems including the kineto-static analysis. 5. Lead team projects in academic research or the industry that require modeling and simulation of multi-body systems.

Introduction
The method of constraints for planar kinematic analysis. Revolute, prismatic, gear and cam pairs are considered together with other 2 degrees-of-freedom types of constraints. [4]

Basic Principles for Analysis of Multi-Body Systems
The automatic assembly of the systems of equations for position, velocity and acceleration analysis. Iterative solution of systems of non-linear equations. Geometry of masses. The principle of virtual work and Lagrange's equations.[5]

Dynamics of Planar Systems
Dynamics of planar systems. Systematic computation and assembly of mass matrix. Computation of planar generalized forces for external forces and for actuator-spring-damper element. Simple applications of inverse and forward dynamic analysis. Numerical integration of first-order initial value problems. The method of Baumgarte for the solution of mixed differential-algebraic equations of motion. The use of coordinates partitioning, QR and SVD decomposition for the orthogonalization of constraints. [9]

Kinematics of Rigid Bodies in Space
Reference frames for the location of a body in space. Euler angles and Euler parameters. The formula of Rodrigues. Screw motion in space. Velocity, acceleration and angular velocity. Relationship between the angular velocity vector and the time derivatives of Euler parameters. [9]

Kinematic Analysis of Spatial Systems
Basic kinematic constraints. Joint definition frames. The constraints required for the description in space of common kinematic pairs (revolute, prismatic, cylindrical, and spherical). Equations of motion of constrained spatial systems.[9]

Computation of Forces
Computation of spatial generalized forces for external forces and for actuator-spring-damper element. Computation of reaction forces from Lagrange's multi- pliers [9]

Total hours: 45

Text book (s) :

1	Wittenburg, J., "Dynamics of Systems of Rigid Bodies", Springer, 1977.
2	Kane, T.R, Levinson, D.A., "Dynamics: Theory and Applications", McGraw-Hill Book Co., 2005.

Reference(s) :

1	Donald T. Greenwood, "Principles of Dynamics", 2nd Edition, Prentice Hall, 1987.
2	ERoberson, R.E., Schwertassek, R., "Dynamics of Multibody Systems", Springer-Verlag, Berlin, 1988.
3	Huston, R.L., "Multibody Dynamics", Butterworth-Heinemann, 1990.
4	De Jalo n, J.C., Bayo, E., "Kinematic and Dynamic Simulation of Multibody Systems", Springer-Verlag, 1994.
5	Nikravesh, P.E., "Computer Aided Analysis of Mechanical Systems", Prentice-Hall Inc, 1988.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E42 - Condition Based Monitoring								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To understand the vibration condition monitoring techniques • To learn the steps in signal processing and analysis • To know the interpretation and application of Fourier transform • To understand the use, selection and procedure for vibration monitoring • To learn the design principles & applications, dynamic balancing and alignment of machinery.
Course Outcome(s)	**At the end of the course, the students will be able to** 1. Know and be able to explain the aim and the basics of CM and be aware of some methods and procedures applied for general CM; 2. Appreciate and understand the basic idea behind vibration-based structural health, monitoring and vibration-based condition monitoring, know the general stages of CM; 3. Know the basics of Vibration of Linear Systems: time and frequency response, resonance; 4. Aware of some basic instrumentation used for machinery and structural vibration-based monitoring; 5. Aware of some basic faults in rotating machinery, their manifestation and methods for detection and recognition: low frequency, medium frequency and high frequency

Introduction
The basic idea of health monitoring and condition monitoring of structures and machines. Some basic techniques. [9]

Basics of Signal Processing
Study of periodic and random signals, probability distribution, statistical properties, auto and cross correlation and power spectral density functions of commonly found systems, spectral analysis. [9]

Fourier Transform
Basic idea of Fourier transforms, interpretation and application to real signals. Response of linear systems to stationary random signals: FRFs, resonant frequencies, modes of vibration, [9]

Vibration Based Monitoring
Introduction to vibration-based monitoring, Machinery condition monitoring by vibration analysis: Use and selection of measurements, analysis procedures and instruments, [9]

Applications of Vibration Based Monitoring
Typical applications of condition monitoring using vibration analysis to rotating machines, Some other health monitoring techniques, acoustic emission, oil debris and temperature analysis, Applications. [9]

Total Hours: 45

Text book (s) :

1	Hartog, J.O. Den., “Mechanical Vibrations”, McGraw-Hill, New York, 1985.
2	Rao, J.S., “Vibratory Condition Monitoring of Machines”, CRC Press, London, 2000.

Reference(s) :

1	Iyengar, R.N., “Elements of Mechanical Vibration”, I K International Pub. House Pvt. Ltd., New Delhi, 2007.
2	Adams, M., “Rotating Machinery Analysis - From Analysis to Troubleshooting”, New York, ISBN 0-8247-0258-1.
3	Cornelius Scheffer Paresh Girdhar, “Practical Machinery Vibration Analysis and Predictive Maintenance”, Newnes, 1st Edition, 04, Paperback ISBN: 9780750662758.
4	“Hand Book of Condition Monitoring”, Elsevier Science, Amsterdam, 1996.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E43 - Optimization Techniques in Design								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To enable the students to learn various optimization techniques. • To know the techniques of linear programming • To learn the procedures to solve Non-linear programming problems • To apply the optimization techniques to design engineering components. • To acquire knowledge on Genetic Algorithms to solve engineering problems
Course Outcomes	**At the end of the course, the students will be able to** 1. Classify optimization problems. 2. Apply linear programming techniques to solve engineering problems. 3. Solve Non-Linear Programming problems. 4. Design mechanical elements like beams, columns, gears, shafts using optimization techniques. 5. Discuss Genetic Algorithms and solve engineering optimization problems.

Introduction
Introduction to optimization, classification of optimization problems, classical optimization techniques. [9]

Linear Programming
Simplex method and Duality in linear programming, sensitivity or post-optimality analysis, Karmarkar's methods. [9]

Non-Linear Programming
One dimensional minimization, unconstrained and constrained minimization, direct and indirect methods. [9]

Geometric Programming and Optimum Design
Geometric programming, Optimum design of mechanical elements like beams, columns, gears, shafts. [9]

Genetic Algorithms
Introduction to Genetic Algorithms, Operators, applications to engineering optimization problems. [9]

Total Hours: 45

Text book (s) :

1	Rao Singiresu, S., "Engineering Optimization: Theory and Practice", New Age International (P) Limited, Publishers New Delhi, 2010.
2	Deb Kalyanamoy., "Optimization for Engineering Design: Algorithms and Examples", Prentice Hall of India, Pvt. Ltd., New Delhi, 2009.

Reference(s) :

1	Johnson Ray, C., "Optimum Design of Mechanical Elements", John Wiley & Sons, New York, 1990.
2	Goldberg, D.E., "Genetic Algorithms in Search, Optimization and Machine", Barnen, Addison-Wesley, New York, 2005.
3	R.C. Johnson, "Optimum Design of Mechanical Elements", Willey, New York, 1980.
4	J. S. Arora, "Introduction to Optimum Design", McGraw Hill, New York, 4th Edition, 2012.
5	Duffin, R J., Peterson E L., and Zener, C., "Geometric Programming-Theory and Applications", Willey, New York, 2007.

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50 PED E44 - Alternative Fuels for IC Engines								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To understand the availability, suitability and properties for various alternative fuels. • To gain the knowledge on types of liquid alternative fuels used for S.I. Engines. • To understand the knowledge on types of liquid alternative fuels used for C.I. Engines. • To analyse the performance and emission characteristics of various gaseous alternative fuels used for S.I. Engines. • To investigate the performance and emission characteristics of various gaseous alternative fuels used for C.I. Engines.
Course Outcomes	**At the end of the course students will be able to** 1. Gain the knowledge about the availability and suitability of alternative fuels for IC engines. 2. Categorize the liquids fuels for SI engines and types of emission levels. 3. Categorize the fuels for diesel engine and types of fuel additives for low emissions. 4. Categorize the types of gaseous of fuels used in SI and CI engine and safety precautions. 5. Analyse the engine performance and emissions levels operated in duel fuel mode.

Introduction

Availability, Suitability, Properties, Merits and Demerits of Potential Alternative Fuels – Ethanol, Methanol, Diethyl ether, Dimethyl ether, Hydrogen, Liquefied Petroleum Gas, Natural Gas, Bio-gas and Bio-diesel. [9]

Liquid Fuels for S.I. Engines

Requirements, Utilisation techniques – Blends, Neat form, Reformed Fuels, Storage and Safety, Performance and Emission Characteristics. [9]

Liquid Fuels for C.I. Engines

Requirements, Utilisation techniques - Blends, Neat fuels, Reformed fuels, Emulsions, Dual fuelling, Ignition accelerators and Additives, Performance and emission characteristics. [9]

Gaseous Fuels for S.I. Engines

Hydrogen, Compressed Natural gas, Liquefied Petroleum gas, and Bio gas in SI engines – Safety Precautions – Engine performance and emissions. [9]

Gaseous Fuels for C.I. Engines

Hydrogen, Biogas, Liquefied Petroleum gas, Compressed Natural gas in CI engines. Dual fuelling, Performance and emission characteristics. [9]

Total Hours: 45

Text book (s) :

1	GajendhraBabu, M K., Subramaniyan, K A., “Alternative Transportation Fuels, Utilisation in Combustion Engine”, CRC press, Taylor and Francis Group, 2013.
2	Ramadhas, A. S., “Alternative Fuels for Transportation”, CRC Press, 2012.

Reference(s) :

1	Roger F. Haycock and John E. Hillier, “Automotive Lubricants Reference Book”, 2nd Edition, SAE International Publications, 2004.
2	Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
3	Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.
4	Ayhan Demirbas, ‘Biodiesel A Realistic Fuel Alternative for Diesel Engines’, Springer- Verlag London Limited 2008, ISBN-13: 9781846289941.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E45 - Advanced Materials and Their Processing								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	50	50	100

Objective(s)	• To impart knowledge on the structure, properties of engineering materials • To acquire concept of fracture mechanism and its associated theories • To select the suitable materials for various applications • To know the significance of modern metallic materials and their application. • To identify polymeric material structure and its properties
Course Outcomes	**At the end of the course students will be able to** 1. Gain the knowledge about the behaviour of materials and strengthening mechanisms. 2. Understand the fracture behaviour and failure analysis of metallic materials. 3. Analyse the properties and select the materials for intended application. 4. Acquire knowledge on modern metallic materials and smart materials. 5. Describe polymeric material structure, production, properties and application.

Behaviour of Materials

Elasticity in metals and polymers - Mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals - Strengthening mechanisms, work hardening, solid solution hardening, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviors - Super plasticity - Deformation of non- crystalline material. [9]

Fracture Behaviour

Griffith's theory, stress intensity factor and fracture toughness - Toughening mechanisms - Ductile, brittle transition in steel - High temperature fracture, creep - Larson-Miller parameter - Deformation and fracture mechanism maps - Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law - Effect of surface and metallurgical parameters on fatigue - Fracture of non-metallic materials – Failure analysis, sources of failure, procedure of failure analysis. [9]

Selection of Materials

Motivation for selection, cost basis and service requirements - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing - Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications. [9]

Modern Metallic Materials

Dual phase steels, Micro alloyed, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) steel, Maraging steel - Intermetallics, Ni and Ti aluminides - Smart materials, shape memory alloys - Metallic glass - Quasi crystal and nano crystalline materials. [9]

Non Metallic Materials

Polymeric materials - Formation of polymer structure - Production techniques of fibres, foams, adhesives and coatings - Structure, properties and applications of engineering polymers - Advanced structural ceramics, WC, TiC, TaC, Al_2O_3, SiC, Si_3N_4, CBN and diamond - properties, processing and applications. [9]

Total hours: 45

Text book (s) :

1	Thomas H.Courtney, “Mechanical Behaviour of Materials ", McGraw-Hill, 2nd Edition, 2005.
2	George E.Dieter, “Mechanical Metallurgy ", McGraw Hill, 1988.

Reference(s) :

1	Flinn, R.A. and Trojan, P.K., "Engineering Materials and their Applications ", 4thEdition, Jaico, 1999.
2	Charles J.A., Crane, F.A.A and Furness, J.A.G., "Selection and use of Engineering Materials”, Butterworth-Heiremann, 1997.
3	William D. Callister, “Materials Science and Engineering”, John Wiley & sons, 10th Edition, 2018
4	Ashutosh Tiwari, Arul Murugan N, Rajeev Ahuja, “Advanced Engineering Materials and Modeling”, Wiley-Scrivener Publishers, 2016.
5	“Failure Analysis and Prevention", Metals Hand Book, Vol.10, 10thEdition, 2002.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E51 - Advanced Finite Element Method								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	• To formulate the advanced FE Plate and Shell elements • To demonstrate use of FE formulation to solve dynamic problems • To learn the concept of material and geometric Non-linearity • To acquire knowledge and solve contact problems. • To apply the h-refinement technique for convergence of results
Course Outcomes	**At the end of the course, the students will be able to** 1. Formulate the Plate and Shell elements and solve the appropriate problems 2. Solve dynamic vibration problems using various numerical methods 3. Solve the non-linear problems in Metal Forming Process 4. Model and solve 2D frictionless contact problems 5. Estimate the errors in FE model and apply the adaptive refinement

Bending of Plates and Shells

Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non-Conforming Elements –C_0 and C_1 Continuity Elements – Application and Examples. [9]

Dynamic Problems

Direct Formulation – Free, Transient and Forced Response – Solution Procedures –Subspace Iterative Technique – Houbolt, Wilson, Newmark Methods – Examples. [9]

Non-Linear Problems

Introduction – Iterative Techniques – Material non-linearity – Elasto Plasticity – Plasticity– Visco Plasticity – Geometric Non linearity – large displacement Formulation –Application in Metal Forming Process. [9]

Contact Problems

Condition of impenetrability - Gap elements for modelling contact -Tangent stiffness matrix and force vectors for 2D frictionless contact problems. [9]

Error Estimates and Adaptive Refinement

Error norms and Convergence rates – h-refinement with adaptivity – Adaptive refinement. [9]

Total Hours: 45

Text book (s) :

1	Bathe K.J., and Cliffs, N.J. “Finite Element Procedures in Engineering Analysis”, PHI Learning, Eastern Economy Editions, 2009.
2	Reddy J N, “Finite Element Method”, Tata McGraw Hill publishing Co Ltd, New Delhi, 3rdEdition, 2006.

Reference(s) :

1	Zienkiewicz, O.C., and Taylor, R.L., “Finite Element Method: Volume 2 Solid Mechanics”, 5th Edition, Butterworth-Heinemann, Oxford, 2000.
2	Belytschko T and Liu W K., and Moran, B., “Nonlinear Finite Elements for Continua and Structures”, 2nd Edition, John Wiley & Sons Ltd., England, 2014.
3	Robert D.Cook., David.S, Malkucs Michael E Plesha, “Concepts and Applications of Finite Element Analysis” 4thEdition, Wiley Publication, 2013.
4	Logan Deryl L., “A First Course in Finite Element Method”, Thomson Brook/Cole, 5th Ed.2012.
5	Ross C T F., “Advanced Applied Finite Element Methods”, Horwood Publishing, 1998.

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BoS - Chairman
Mechanical Engineering (UG & PG)
K.S.Rangasamy College of Technology,
Tiruchengode - 637 215.

K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E52 – Advanced Metallurgy								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	• To analyze the Structure of materials at different levels, basic concepts of crystalline materials. • To explain the concept of phase, phase diagram and understand the basic terminologies associated with metallurgy. • To learn the heat treatment processes and its effects on material properties • To explain features, classification, applications of newer class materials like smart materials, piezoelectric materials, biomaterials, composite materials etc. • To learn the methods of fabrication of composite materials
Course Outcomes	**At the end of the course, the students will be able to** 1. Demonstrate understanding of various aspects of crystal and lattice structure and their imperfection. 2. Recognize and identify the phases in metallic materials and their effect on their properties. 3. Comprehend the process of heat treatment of different nonferrous alloys and tool steel and decide a heat treatment to acquire their desired properties. 4. Demonstrate acquisition of knowledge of composites, ceramics, orthodental and biomaterials. 5. Know the recent developments in the field and understand modern research material.

Physical State of Metals
Aspects of Physical Metallurgy: Crystal structure, systems and Barvias lattices, Indexing of lattice planes (Miller's Indices), Indexing of lattice directions, Co-ordination Number (Ligency), Density calculations and imperfections in crystals. [9]

Phases of Metals
Study of Equilibrium diagrams for Fe-C systems, Cu - Bronze alloys i.e. Cu:Zn, Cu:Sn, Cu:Al etc., Developments in metallic materials like HSLA state, maraging steels, dual phased steels, creep resisting steels, materials for high and low temperature applications, Nimerics, Inconels, Haste Alloys etc., Al, Ni alloys, Ti, Mg alloys. [9]

Heat Treatment
Heat Treatment of Nonferrous alloys, Heat Treatment of Tool steels. [9]

Modern Materials
Orthodental materials, Bio material, Prosthetic materials, Nano materials, superconducting materials, sports materials. [9]

Fabrication of Composites
Composites, ceramics, cermets, shape memory alloys their manufacturing techniques, advantages and limitations. Surface coatings and their tribological aspects. PVD, CVD, IVD ion implantation method. [9]

Total Hours: 45

Text book (s) :

1	Khanna, O.P., "A Text Book of Material Science and Metallurgy", Dhanpat Rai and Sons, New Delhi, 2000.
2	William F. Smith, "Principles of Material Science and Engineering", McGraw-Hill Book Co., New Delhi, 1995

Reference(s) :

1	Gupta, R.B., "Material Science", Satya Publications, 4th Edition, New Delhi, 1980.
2	William D. Callister, Jr, "Material Science and Engineering an Introduction", John Wiley and Sons Inc.1989.
3	Brandes, E.A., and Brook, G.B., "Smithells Metals Reference Book", Butterworth Heinemann.
4	Lawrence H. Van Vlack, "Elements of Material Science and Engineering", Addison Wesley Publishing Company.1989.
5	Donald L. Wise, "Biomaterials and Bioengineering Handbook", 1st edition, Marcel Dekker Inc.2000

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E53 - Design of Material Handling Equipments								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	• To impart knowledge on the need and application of different material handling techniques, equipment's used in common use and in industrial sector. • To prepare the students to design the hoist • To learn the mechanism of hoisting gears, design and its application • To acquire knowledge on conveyors, types and application • To know the design procedures of elevators for material transport.
Course Outcome(s)	**At the end of the course, the students will be able to** 1. Classify various types of material handling equipment and their applications. 2. Design the chain drive, rope drive systems and their attachments in material handling equipment. 3. Design various hoisting gear mechanisms and to select the motor ratings for power drive in the material handling equipment. 4. Design the belt, screw conveyor, pneumatic and vibratory conveyor for material transportation. 5. Design the bucket, cage elevators, escalators and fork lift truck.

Materials Handling Equipment
Intraplant transporting facilities - types - Principle groups of material handling equipment – Types of material handling equipment – Choice of material handling equipment - General characteristics - applications. [9]

Design of Hoist
Welded and roller chains - Hemp and steel wire ropes - pulleys, pulley systems, sprockets and drums - Load handling attachments - Forged hooks and eye hooks - Crane grabs – Electric lifting magnets - Grabbing attachments – Ladles - Arresting gear and Brakes. [9]

Hoisting Gear
Drives of Hoisting gear - Hand and power drives – Traveling gear - Rail traveling mechanism - Cantilever and monorail cranes – Trackless travelling mechanisms - Slewing, jib and luffing gear - Selecting the motor ratings - Cogwheel drive. [9]

Conveyors
Types - Belt conveyor - Pneumatic conveyor - Screw conveyor - apron conveyor - Vibratory conveyor – Design and applications. [9]

Elevators
Bucket elevators - design - Loading and bucket arrangements - Cage elevators - Shaft way, guides, counter weights, hoisting machine, safety devices – Fork lift truck – Escalators. [9]

Total Hours: 45

Text book (s) :

1	Rudenko, N., "Materials handling equipment", Peace publications, Mascow, 2000.
2	Spivakovsy, A.O and Dyachkov, V.K., "Conveying Machines", Volumes I and II, MIR Publishers, 1985.

Reference(s) :

1	Alexandrov, M., "Materials Handling Equipments", MIR Publishers, 1981.
2	Ray Siddhartha., "Introduction to Material Handling", New age International, 2007.
3	Arora, K.C and Vikas V. Shinde., "Aspects of Material handling", First edition, Laxmi publications,2007.
4	Fayed, M.E., and Thomas S.S., "Mechanical conveyors", Selection and operation", 1st edition, CRC press, 1996.
5	"Design Data Book", Compiled by P.S.G. College of Technology, Kalaikathir Achchagam, Coimbatore, 2011.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 PED E 54 - Advances in Casting and Welding Processes								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	• To impart knowledge on foundry layout and design characteristics. • To study the metallurgical concepts and applications of casting process. • To acquire knowledge on advancements in casting and CAD of casting • To learn the welding metallurgy and heat treatment effects • To understand the recent welding process and their application
Course Outcome(s)	**At the end of the course, the students will be able to** 1. Demonstrate the principle and design considerations in casting. 2. Identify the phases in metallic materials, castability and their defects. 3. Comprehend the trends and layout in foundry. 4. Demonstrate the weldability of metals, heat treatment and their effects. 5. Describe the recent welding techniques and their application.

Casting Design

Heat transfer between metal and mould –Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering [9]

Casting Metallurgy

Solidification of pure metal and alloys – shrinkage in cast metals – progressive and directional solidification — Degasification of the melt-casting defects – Castability of steel , Cast Iron, Al alloys , Babbit alloy and Cu alloy. [9]

Recent Trends in Casting and Foundry Layout

Shell moulding, precision investment casting, CO_2 moulding, Centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry – Computer aided design of casting. [9]

Welding Metallurgy and Design

Heat affected Zone and its characteristics – Weldability of steels, cast iron, stainless steel, aluminium, Mg , Cu ,Zirconium and titanium alloys – Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects – Testing of weldment. [9]

Recent Trends in Welding

Friction welding, friction stir welding – explosive welding – diffusion bonding – high frequency induction welding – ultrasonic welding – electron beam welding – Laser beam welding –Plasma welding – Electro slag welding narrow gap, hybrid twin wire active TIG – Tandem MIG- modern brazing and soldering techniques – induction, dip resistance, diffusion processes – Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding. [9]

Total Hours: 45

Text book (s) :

1	Jain P.L., “Principles of Foundry Technology”, Tata McGraw-Hill Publishers, 2013.
2	Carrry B., “Modern Welding Technology”, Prentice Hall Pvt Ltd.6th Edition, 2004

Reference(s) :

1	“Casting - ASM Handbook”, Vol 15, 2011.
2	“Welding Brazing & Soldering - ASM Handbook” Vol.6, 2003.
3	Srinivasan N.K., “Welding Technology”, Khanna Tech Publishers, 2002.
4	Heineloper & Rosenthal, “Principles of Metal Casting”, Tata McGraw Hill, 2005.
5	Parmer R.S., “Welding Engineering and Technology”, Khanna Publishers, 2002.
6	Cornu. J., “Advanced welding systems”, Volumes I, II and III, Jaico Publishers, 2011.

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K.S. Rangasamy College of Technology – Autonomous R2018								
50 PED E61- Rapid Prototyping and Tooling								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	• To describe product development, conceptual design and classify rapid prototyping systems. • To learn the operating principles, capabilities and limitations of liquid and solid based systems. • To learn the operating principles of powder based additive manufacturing system. • To learn the concepts of reverse engineering. • To select and use correct CAD formats in rapid tooling.
Course Outcomes	**At the end of the course, the student will be able to** 1. Realize the application of Rapid prototyping and rapid tooling technologies for product development. 2. Explain the concepts, types and applications of liquid solid based rapid prototyping systems. 3. Categorize the types of powder based rapid prototyping systems. 4. Describe the concepts of reverse engineering CAD modelling techniques. 5. Describe rapid tooling technologies, types and its fabrication process.

Introduction

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping and Tooling on Product Development – Benefits- Applications – Digital prototyping - Virtual prototyping. [9]

Liquid Based and Solid Based Rapid Prototyping Systems

Stereolithography Apparatus, Fused deposition Modeling, Laminated object manufacturing, Three dimensional printing: Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies. [9]

Powder Based Rapid Prototyping Systems

Selective Laser Sintering, Direct Metal Laser Sintering, Three Dimensional Printing, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations – Case Studies. [9]

Reverse Engineering and CAD Modeling

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation. [9]

Rapid Tooling

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies - automotive, aerospace and electronics industries. [9]

Total Hours: 45

Text book (s):

1. Chua C.K., Leong K.F. and Lim C.S,"Rapid Prototyping: Principles and Applications", 3rd Edition, World Scientific, New Jersey, 2010.
2. Peter D. Hilton, Hilton/Jacobs, Paul F. Jacobs, "Rapid Tooling: Technologies and Industrial Applications" CRC press, 2000

Reference(s):

1. Jacobs P.F,"Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography", McGraw-Hill, New York, 1993.
2. Liou W.Liou, Frank W.Liou ,"Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
3. Frank W. Liou, "Rapid Prototyping and Engineering Applications", CRC Press, 2008.
4. Rafiq I. Noorani, Rapid Prototyping, "Principles and Applications", Wiley & Sons, 2006.

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K.S. Rangasamy College of Technology – Autonomous R2018								
50 PED E62- Design of Hydraulic and Pneumatic Systems								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	• To impart knowledge on the science, use and application of hydraulics system as fluid power in Industry. • To acquire the concept of control and regulation elements in hydraulic system • To learn the procedure to design hydraulic circuits for different application • To study the fundamentals of pneumatic system and circuits • To understand the procedure for installation, maintenance and design of special circuits
Course Outcomes	**At the end of the course, the student will be able to** 1. Select and apply the use of rotary and linear actuators. 2. Choose the different types of control and regulation elements. 3. Design the various industrial circuits in hydraulic systems. 4. Design the various pneumatic system and circuits. 5. Diagnose the faults and implement the maintenance measures.

Oil Hydraulic Systems and Hydraulic Actuators
Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics. [9]

Control and Regulation Elements
Pressure - Direction and Flow control valves - Relief valves, non-return and safety valves – actuation systems. [9]

Hydraulic Circuits
Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits – industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits- design and selection of components - safety and emergency mandrels. [9]

Pneumatic Systems and Circuits
Pneumatic fundamentals - control elements, pneumatic sensors - logic circuits – switches – fluidic logic circuits - Sequential circuits – Cascade methods – K-V Mapping methods - Step counter method – Classic methods.[9]

Installation, Maintenance and Special Circuits
Pneumatic equipments- selection of components - design calculations – application -fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits. [9]

Total Hours: 45

Text book (s):

1. Antony Espossito, “Fluid Power with Applications”, Pearson Education, 2011.
2. Srinivasan, R., “Hydraulic and Pneumatic Controls”, Tata McGraw Hill, 2009.

Reference(s):

1. Dudley A. Pease and John J. Pippenger., “Basic fluid power”, Prentice Hall, 1987.
2. Andrew Parr, “Hydraulic and Pneumatics” (HB), Jaico Publishing House, 1999.
3. Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth –Heinemann, 1997.
4. Majumdar S.R., “Pneumatic Systems, Principles and Maintenance” Tata Mc Graw Hill, 2010.

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K.S. Rangasamy College of Technology – Autonomous R2018								
51 PED E63- Applied Elasticity and Plasticity								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	• To understand the concept of stress, strain analysis and its applications. • To learn constitutive equations to solve two dimensional problems • To impart knowledge on computation of membrane and contact stresses • To acquire the concept of plasticity under microscopic and macroscopic descriptions • To analyse the effect of plastic strain in hydrostatic and deviatoric components
Course Outcomes	**At the end of the course, the student will be able to** 1. Express the various stresses and strains. 2. Resolve the problems related with constitutive equations. 3. Discuss the membrane stresses and method of computing contact stresses. 4. Describe the microscopic and macroscopic plastic flow and stress strain curves. 5. Explain the various effects on the plastic strain analysis.

Analysis of Stress and Strain

Stress at a point, stress tensor, stress transformations, principal stresses, octahedral stress, equations of equilibrium, strain tensor, principal strains, strain-displacement relations, compatibility conditions, measurement of surface strains using strain gauges. [9]

Constitutive Equations

General theory, generalized Hooke's law, equations of elasticity, formulation of the general elasticity problem, boundary conditions, two dimensional problems in rectangular and polar co-ordinates, Airy's stress function.[9]

Membrane and Contact Stresses

Membrane stresses in axisymmetric shells, meridonial stress and circumferential stress, Introduction, geometry of contact surfaces, notation and meaning of terms, expressions for principal stresses and method of computing contact stresses. [9]

Plasticity

Plastic flow and its microscopic and macroscopic descriptions, stress-strain curves of real materials, definition of yield criterion, concept of a yield surface in principal stress space, yield criteria, Tresca, Von Mises. Linear work – hardening, Elastic Perfectly plastic, Elastic Linear work hardening materials. [9]

Plastic Strain Analysis

Prandtl-Reuss and Levy-Mises equations, deformation in plane stress-yielding of thin sheet in biaxial and uniaxial tension. Plane strain deformation-stress tensor, hydrostatic and deviatoric components, plastic potential, plastic instability, effect of strain rates and temperature effects on flow stress. Introduction to slip line theory. [9]

Total Hours: 45

Text book (s):

1.	Timoshenko, S. P., and Goodier, J. N., "Theory of Elasticity", McGraw Hill International Editions, 3rd Edition, 1970.
2.	Chakrabarthy, J., "Theory of Plasticity", McGraw Hill Co, 1987.

Reference(s):

1.	Durelli, A. J., Phillips, E. A and Tsao, C. H, "Introduction to the Theoretical and Experimental Analysis of Stress and Strain", McGraw Hill, New York, 1958.
2.	Sadhu Singh. "Theory of Elasticity", Khanna Publishers, New Delhi 1988.
3.	Dieter G. E., "Mechanical Metallurgy", McGraw Hill, 1988.
4.	Johnson, W. and Mellor, P. B., "Engineering Plasticity", Van Nostrant Reinhold, 1983.
5.	Boresi, A. P, Schmidt, R. J and Sidebottom, O. M., "Advanced Mechanics of Materials", John Wiley and Sons, Inc., 5th Edition, 1993.

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K.S. Rangasamy College of Technology – Autonomous R2018								
50PED E64- Theory of Plates and Shells								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100
Objective(s)	• To impart knowledge on the behavior of plates and shell elements • To learn classical theory and computation of principal stress and strain • To understand the formulation of governing equations for buckling of plates • To frame the governing equation for vibration of rectangular plates • To analyze thin elastic shells of revolution under axisymmetric loads shells							
Course Outcomes	**At the end of the course, the student will be able to** 1. Recognize the concept of energy principles and variation methods of elasticity. 2. Compute the principal stresses and strains by using classical theory. 3. Perform buckling analysis of rectangular plates under compressive forces using Navier and Levy's solution. 4. Describe the concepts of vibration in plates 5. Evaluate the elastic properties of shells and axisymmetric loads shells with double curvature.							

General Introduction

Review of equations of elasticity- kinematics, compatibility equations, stress measures – equations of motions- constitutive relations- transformation of stresses, strains and stiffness – energy principles and variational methods in elasticity- virtual work-external and internal virtual work variational operator –functionals- Euler Lagrange equations- energy principles- Hamilton's principle- principle of minimum total potential– applications. [9]

Classical Theory of Plates

Plates as structural elements- stress and moment resultants- assumptions made in the classical theory- displacement fields and strains- equations of equilibrium in Cartesian coordinates and in polar coordinates- boundary conditions – bending of rectangular plates with various boundary conditions and loading- symmetrical and asymmetrical bending of circular plates-limitations of classical theory- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination) [9]

Buckling Analysis of Rectangular Plates

Buckling of simply supported plates under compressive forces- governing equations- the Navier solution- biaxial compression of a plate- uniaxial compression of a plate- buckling of plates simply supported on two opposite edges- Levy's solution- buckling of plates with various boundary conditions- general formulation- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination). [9]

Vibration of Plates

Governing equations for natural flexural vibrations of rectangular plates - natural vibrations of plates simply supported on all edges - vibration of plates with two parallel sides simply supported - Levy's solution - vibration of plates with different boundary conditions – Rayleigh - Ritz method - Natural vibration of plates with general boundary conditions - transient analysis of rectangular plates - finite element analysis (elementary treatment only; discussion of various elements used and their capabilities- not for examination). [9]

Analysis of Thin Elastic Shells of Revolution

Classification of shell surfaces - geometric properties of shells of revolution - general strain displacement relations for shells of revolution - stress resultants - equations of motion of thin shells analytical solution for thin cylindrical shells - membrane theory - flexure under axisymmetric loads shells with double curvature- geometric considerations - equations of equilibrium - bending of spherical shells - vibration of cylindrical shells - finite element analysis (elementary treatment only; discussion of various elements used and their capabilities- not for examination). [9]

Total Hours: 45

Text book (s):

1. Baskar, K and Varadan, T. K., "Plates- Theories and Applications", Ane Books Pvt. Ltd., New Delhi, 2013.
2. Timoshenko, S., "Theory of Plates and Shells", McGraw Hill, 1990.

Reference(s):

1. Timoshenko, S and Krieger, S.W., "Theory of Plates and Shells", McGraw Hill Book Company, New York, 1990.
2. Reddy, J.N., "Theory and Analysis of Elastic Plates and Shells", C.R.C.Press, NY, USA, 2nd Edition, 2006.
3. Szilard, R., "Theories and Applications of Plate Analysis: Classical Numerical and Engineering Methods", Wiley, 2004.
4. Chandrashekhara, K., "Theory of Plates", University Press, Hyderabad, 2001.

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K.S. Rangasamy College of Technology – Autonomous R2018								
50 PED E65 - Bearing Design and Rotor Dynamics								
PED : M.E. Engineering Design								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	50	50	100

Objective(s)	• To know about different types of bearings available for machine design and their operating principles • To design hydrodynamic and hydrostatic bearing for given specifications and analyze the bearings for their performance • To know the selection and design of rolling bearings for specific application • To understand the bearing behavior under dynamic loading conditions • To learn the computation and measurements of vibration behavior bearing
Course Outcomes	**At the end of the course, the student will be able to** 1. Acquire knowledge on classification and selection of bearings. 2. Design and perform analysis of fluid film bearing and foil/air bearings. 3. Analyse the stresses induced in the rolling bearing and predict the fatigue life. 4. Describe the dynamics of hydrodynamic bearing with different loading. 5. Explain the rotor dynamics and vibration for different design configurations.

Classification and Selection of Bearings

Selection criteria-Dry and Boundary Lubrication Bearings-Hydrodynamic and Hydrostatic bearings-Electro Magnetic bearings-Dry bearings-Rolling Element bearings- Bearings for Precision Applications-Foil Bearings-Special bearings- Selection of plain Bearing materials –Metallic and Non-metallic bearings. [9]

Design of Fluid Film Bearings

Design and performance analysis of Thrust and Journal bearings – Full, partial, fixed and pivoted journal bearings design procedure-Minimum film thickness – lubricant flow and delivery – power loss, Heat and temperature distribution calculations- Design based on Charts & Tables and Experimental curves-Design of Foil bearings-Air Bearings- Design of Hydrostatic bearings-Thrust and Journal bearings- Stiffness consideration - flow regulators and pump design. [9]

Selection and Design of Rolling Bearings

Contact Stresses in Rolling bearings- Centrifugal stresses-Elasto hydrodynamic lubrication-Fatique life calculations- Bearing operating temperature- Lubrication- Selection of lubricants-Internal clearance – Shaft and housing fit- -Mounting arrangements-Materials for rolling bearings- Manufacturing methods- Ceramic bearings-Rolling bearing cages-bearing seals selection. [9]

Dynamics of Hydrodynamic Bearings

Hydrodynamic Lubrication equation for dynamic loadings-Squeeze film effects in journal bearings and thrust bearings -Rotating loads , alternating and impulse loads in journal bearings – Journal centre Trajectory- Analysis of short bearings under dynamic conditions- Finite difference solution for dynamic conditions. [9]

Rotor Dynamics

Rotor vibration and Rotor critical speeds- support stiffness on critical speeds- Stiffness and damping coefficients of journal bearings-computation and measurements of journal bearing coefficients -Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip-Design configurations of stable journal bearings. [9]

Total Hours: 45

Text book (s):

1. Neale, M.J., “Tribology Hand Book”, Butterworth Heinemann, United Kingdom 2001.
2. Cameron, A. “Basic Lubrication Theory”, Ellis Herward Ltd., UK, 1983.

Reference(s):

1. Halling, J., “Principles of Tribology”, Macmillian, 2010.
2. Williams J.A. “Engineering Tribology”, Oxford University Press, 2005.
3. Basu, S.K., Sengupta, S.N & Ahuja, B.B., “Fundamentals of Tribology”, Prentice –Hall of India Pvt Ltd, New Delhi, 2013.
4. Stachowiak, G. W., and Batchelor, A.W., “Engineering Tribology”, Butterworth-Heinemann, UK, 2014.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 AT 001 - English for Research Paper Writing								
Common to all Branches								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
I/II	2	0	0	30	-	100	-	100
Objectives	• To know how to improve your writing skills and level of readability • To learn about what to write in each section • To gain the skills needed when writing a Title • To improve research paper writing skills • To enhance the knowledge on plagiarism while writing papers							
Course Outcomes	**At the end of the course, the student will be able to** 1. Gain an introductory knowledge of the some of the issues explored in influential works of the English-language tradition, 2. Explain some of the stylistic strategies writers have used to explore those issues. 3. Read complex texts actively: recognize key passages; raise questions; 4. Describe complexity and ambiguity; comprehend the literal and figurative 5. Ability to uses of language.							

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness [5]

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction [5]

3Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. [5]

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, [5]

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions [5]

useful phrases, how to ensure paper is as good as it could possibly be the first- time submission [5]

Total Hours: 30

Text book(s):

1	Goldbort, R., “Writing for Science”, Yale University Press, 2006
2	Day, R., “How to Write and Publish a Scientific Paper”, Cambridge University Press, 2006.

Reference Book(s):

1	Highman N., “Handbook of Writing for the Mathematical Sciences”, SIAM. Highman’s book, 1999.
2	Adrian Wallwork, “English for Writing Research Papers”, Springer New York Dordrecht Heidelberg London, 2011
3	Singh Bhakar, “Hand Book for Writing Research Paper”, Bharati Publications, New Delhi, 2014.
4	Steven D. Krause, “The Process of Research Writing”, Steven D. Krause Publisher, 2004

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Tiruchengode - 637 215.

K.S. Rangasamy College of Technology – Autonomous R 2018								
50 AT 002 - Disaster Management								
Common to all Branches								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
I/II	2	0	0	30	-	100	-	-

Objectives	• Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response. • Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives. • To understand approaches of Disaster Management • Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations. • Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in
Course Outcomes	**At the end of the course the students will be able to:** 1. Understand the various hazards 2. Analyze the situation during hazards and take necessary steps for protection 3. Know the risks involved in natural disaster 4. Apply the knowledge of risk assessment and protect the public 5. Create awareness about disaster and its management techniques among public

Introduction

Disaster: Definition, Factors And Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude. [5]

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks of Disease And Epidemics, War And Conflicts. [5]

Disaster Prone Areas in India

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases and Epidemics[5]

Disaster Preparedness and Management

Preparedness: Monitoring of Phenomena Triggering A Disaster Or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness. [5]

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. [5]

Disaster Mitigation

Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs Of Disaster Mitigation in India. [5]

Total Hours: 30

Text book(s):

1	Nishith, R and Singh A K, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company.
2	Sahni, Pardeep, "Disaster Mitigation Experiences And Reflections", Prentice Hall of India, New Delhi.

Reference(s):

1	Damon Coppola, "Introduction to International Disaster Management" 3rd Edition, Butterworth-Heinemann, 2015.
2	Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.
3	Gupta A.K., Niar S.S and Chatterjee S. "Disaster management and Risk Reduction, Role of Environmental Knowledge", Narosa Publishing House, New Delhi, 2013.
4	Murthy D.B.N. "Disaster Management", Deep and Deep Publication PVT. Ltd. New Delhi, 2012.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 AT 003 - Sanskrit for Technical Knowledge								
Common to all Branches								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
I/II	2	0	0	30	-	100	-	100

Objective(s)	• To get a working knowledge in illustrious Sanskrit, the scientific language in the world. • To improve brain functioning • To develop the logic in mathematics, science & other subjects enhancing the memory power • To explore the huge knowledge from ancient literature • To inculcate technical knowledge on Sanskrit
Course Outcomes	**At the end of the course, the students will be able to** 1. Know the basic Sanskrit language. 2. Explain an ancient Sanskrit literature about science & technology. 3. Develop logical skill among the group. 4. Speak and write Sanskrit language 5. Describe the technical concepts of engineering

Basics of Sanskrit
Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences. [10]

Sanskrit Literature
Order, Introduction of roots, Technical information about Sanskrit Literature. [10]

Technical Concepts in Engineering
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics. [10]

Total Hours: 30

Text book (s) :

1	Dr.Vishwas, “Abhyaspustakam” – Samskrita-Bharti Publication, New Delhi. 2014
2	Prathama Deeksha-VempatiKutumbshastri, “Teach Yourself Sanskrit” Rashtriya Sanskrit Sansthanam, New Delhi, 2016

Reference(s) :

1	Suresh Soni, “India’s Glorious Scientific Tradition” Ocean books (P) Ltd., New Delhi, 2007
2	Venkitasubramonia Iyer, S., “Technical Literature in Sanskrit”, Volume 10, University of Kerala, 1997
3	Kaviraj Gopinath, “The Sandilya Sanhita Bhaktikhanda”, Nabu Press, 2016
4	Khmer Bible, “Sanskrit Textbook Rewrites the Script on Modern Science”, Cambodia Press, 2019.

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50 AT 004 - Value Education								
Common to all Branches								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
I/II	2	0	0	30	-	100	-	100

Objectives	• To know value of education and self- development • To Imbibe good values in students • To let the should know about the importance of character • To gain knowledge on moral values • To inculcate the habit of ethics and behaviour
Course Outcomes	**At the end of the course, the students will be able to** 1. Explain about knowledge of self-development 2. Describe lthe importance of Human values 3. Develop the overall personality 4. Ability to work with ethics in work place 5. Demonstrate moral values and behaviour in practice

- Values and self-development –Social values and individual attitudes. Work ethics, Indian
- vision of humanism.
- Moral and non- moral valuation. Standards and principles.
- Value judgements [5]

- Importance of cultivation of values.
- Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.
- Honesty, Humanity. Power of faith, National Unity.
- Patriotism. Love for nature, Discipline [5]

- Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking.
- Integrity and discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of labour.
- Universal brotherhood and religious tolerance.
- True friendship.
- Happiness Vs suffering, love for truth.
- Aware of self-destructive habits.
- Association and Cooperation.
- Doing best for saving nature [10]

- 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 [10]

Total Hours: 30

Text book(s):

1	Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi 2016
2	Ghose, D N., “A Textbook of Value Education”, Dominant Publishers, 2005

Reference Books:

1	Venkataiah, N., “Value Education”, APH Publishing, 1998
2	Venkataiah, N., “Research in Value Education”, APH Publishing, 1996
3	Shukla, R P, “Value Education and Human Rights”, Sarup & Sons, 2004
4.	Satya Pal Ruhela, “The Emerging Concept of Education in Human Values”, Daya Books, 1996

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 AT 005 - Pedagogy Studies								
Common to all Branches								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I/II	2	0	0	30	-	100	-	100

Objectives	• To understand the language background of students. • To learnt about the nature of classroom discourse. • To describe the nature and need of informational reading. • To analyse content areas and to write. • To understand the importance and role of language for content areas.
Course Outcomes	**At the end of the course the students will be able to** 1. Develop and document their own personal learning network 2. Create a concept map to identify layers of understanding 3. Develop a project-based lesson plan that emphasizes student exploration, interaction, creation, and feedback cycles 4. Compare strengths and weaknesses of online tools and methods 5. Articulate a personal philosophy for teaching and learning

Module 1

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching. [6]

Module 2

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. [4]

Module 3

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies. [8]

Module4

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. [6]

Module 5

Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education Curriculum and assessment Dissemination and research impact. [6]

Total Hours: 30

Text book(s):

1	Anderson, T., & Elloumi, F. "Theory and Practice of Online Learning" 2nd Edition, Athabasca, AB, Canada: Athabasca University, 2008.
2	Fink, L. D. "Creating Significant Learning Experiences: An Integrated Approach to Designing College Courses". San Francisco, CA: Jossey-Bass, 2013.

Reference Books:

1	Akyeampong K, "Teacher Training in Ghana - does it count? " Multi-site teacher education research project (MUSTER) country report 1. London: DFID, 2003.
2	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, 2013
3	Alexander R J, "Culture and Pedagogy: International Comparisons in Primary Education". Oxford and Boston: Blackwell, 2001.
4	Chavan M, "Read India: A Mass Scale, Rapid, learning to read" campaign.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 AT 006 - Stress Management by Yoga								
Common to all Branches								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
I/II	2	0	0	30	-	100	-	100

Objective(s)	• To gain knowledge on overall health of body and mind. • To know how to overcome stress. • To inculcate the habit of yoga practice • To perform yoga excerises • To manage stress at work place
Course Outcomes	**At the end of the course, the students will be able to** 1. Develop healthy mind in a healthy body 2. Improve social health 3. Ability to prove their efficiency 4. Handle stress at work places 5. Practice yoga exercise

1. Definitions of Eight parts of yoga. (Ashtanga) [10]

2. Yam and Niyam.

Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan [10]

3. Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii) Regularization of breathing techniques and its effects-Types of pranayama [10]

Total Hours: 30

Text Book(s):

1	Janardan Swami Yogabhyasi Mandal, "Yogic Asanas for Group Training-Part-I", Nagpur.2016
2	Swami Vivekananda, "Rajayoga or Conquering the Internal Nature" Advaita Ashrama (Publication Department), Kolkata. 2018

Reference Books:

1	Acharya Yatendra, "Yoga & Stress Management", The Picnic Basket, 2019
2	Swami Shivapremananda, "Yoga for Stress Relief: A Simple and Unique Three-Month Program for De-Stressing and Stress Prevention", Random House; 1st edition , January 20, 1998.
3	Udupa, K N., "Stress and its Management by Yoga", Motilal Banarsidass Publ., 1985
4	Udupa, K N., "Disorders of Stress and Their Management by Yoga: A Study of Neurohumoral Response", Banaras Hindu University, 1978.

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50 AT 007 - Personality Development Through Life Enlightenment Skills								
Common to all Branches								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
I/II	2	0	0	30	-	100	-	100

Objective(s)	• To learn to achieve the highest goal happily. • To become a person with stable mind, pleasing personality and determination. • To awaken wisdom in students. • To inculcate the habit of personality development • To gain knowledge on life skills
Course Outcomes	**At the end of the course, the students will be able to** 1. Develop versatile personality. 2. Achieve the highest goal in life by developing personality. 3. Lead the nation and mankind to peace and prosperity. 4. Ability to improve life skills 5. Explain about work culture in work place

Neetisatakam -Holistic development of personality

Verses- 19,20,21,22 (wisdom)
Verses- 29,31,32 (pride & heroism)
Verses- 26,28,63,65 (virtue)
Verses- 52,53,59 (dont's)
Verses- 71,73,75,78 (do's) [10]

Approach to day to day work and duties.
ShrimadBhagwadGeeta : Chapter 2-Verses 41, 47,48,
Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
Chapter 18-Verses 45, 46, 48. [10]

Statements of basic knowledge.
ShrimadBhagwadGeeta: Chapter2-Verses 56, 62, 68
Chapter 12 -Verses 13, 14, 15, 16,17, 18
Personality of Role model. ShrimadBhagwadGeeta:
Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
Chapter 4-Verses 18, 38,39
Chapter18 – Verses 37,38,63 [10]

Total Hours: 30

Text Book(s):

1	Swami Swarupananda "Srimad Bhagavad Gita", Advaita Ashram Publication Department), Kolkata, 2016
2	Gopinath,P., Rashtriya, "Bhartrihari's Three Satakam (Niti-sringar-vairagya)", Sanskrit Sansthanam, New Delhi. 2015

Reference Books:

1	Sagir Ahmed, "Enlightenment: Personality Development & Management", Mind & Body Philosophy eBooks, 2015
2	Chakroborty, S K., "Values and Ethics for Organizations Theory and Practice", Oxford University Press, New Delhi, 2018
3	Prashant Kumar Nayak, "Personality Development Through Life Enlightenment Skills", Springer, 2010
4	Saroj Hiremath, "Life Skills and Personality Development", Sage Publisher, 2016

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 AT 008 - Constitution of India								
Common to all Branches								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
I/II	2	0	0	30	-	100	-	100

Objective(s)	• To know the premises informing the twin themes of liberty and freedom from a civil rights perspective. • To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism. • To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution. • To gain knowledge on bill passing • To acquire knowledge on function of election commission
Course Outcomes	**At the end of the course the students will be able to** 1. Discuss the growth of the demand for civil rights in India for the bulk of fns before the arrival of Gandhi in Indian politics. 2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India. 3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution. 4. Discuss the passage of the Hindu Code Bill of 1956. 5. Explain the functions of Election Commission

History of Making of the Indian Constitution
History - Drafting Committee, (Composition & Working) [5]

Philosophy of the Indian Constitution
Preamble - Salient Features [5]

Contours of Constitutional Rights & Duties
Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation -Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties. [5]

Organs of Governance
Parliament - Composition - Qualifications and Disqualifications - Powers and Functions Executive - President - Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions. [5]

Local Administration
District's Administration head: Role and Importance, - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation - Pachayati raj: Introduction, PRI: Zila Pachayat - Elected officials and their roles, CEO Zila Pachayat: Position and role- Block level: Organizational Hierarchy (Different departments) -Village level: Role of Elected and Appointed officials - Importance of grass root democracy. [5]

Election Commission
Election Commission: Role and Functioning- Chief Election Commissioner and Election Commissioners- State Election Commission: Role and Functioning- Institute and Bodies for the welfare of SC/ST/OBC and Women. [5]

Total Hours: 30

Text Book(s):

1	"The Constitution of India", 1950 (Bare Act), Government Publication
2	Busi, S N., Ambedkar, B.R.,"Framing of Indian Constitution", 1st Edition, 2015.

Reference(s):

1	Basu, D D., "Introduction to the Constitution of India", Lexis Nexis, 2015.
2	Jain, M P., "Indian Constitution Law", 7th Edition, Lexis Nexis, 2014.
3	Bhansali, S R., "Textbook on The Constitution of India, Universal Publishers, 2015.
4	Jain, M P., "Outlines of Indian Legal and Constitutional History", Lexisnexis, 2014.

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K.S.Rangasamy College of Technology – Autonomous R2018								
50 AT 009 - Research Ethics								
Common to all Branches								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
III	1	0	0	15	0	100	-	100
Objective(s)	• Analyze the ethical practices in research • Familiarize about research and documentation • Enlighten about collaborative research • Aware about publication ethics							
Course Outcomes	**At the end of the course, the student will be able to** CO1: Comprehend the importance of ethical practices in research. CO2: Distinguish ethical practices from unethical practices in Research Design. CO3: Understand ethical practices in conducting research and its dissemination.							

Introduction to Ethical Practice in Research

Values Underlying Research Integrity; Framework for Good Academic Research Practices [2]

Ethics in Research Design & Conducting Research

Planning; Research Questions and Documentation ; Literature Review; Data Precision, Accuracy & errors, Research Execution, Documentation & Manuscript writing; Checks for Plagiarism, Falsification, Fabrication, and Misrepresentation. [5]

Collaborative Research & IPR

Collaboration and Authorship; Sharing of Credits; Intellectual Property [5]

Dissemination

Selection of the Right Medium for Publication; Choosing the Right Journal for Publication; Translation of Research [3]

Total Hours: 15

Text Book(s):

1	Guidance Document: Good Academic Research Practices. New Delhi: University Grants Commission, Sep 2020 (https://www.ugc.ac.in/e-book/grap_29092020/mobile/index.html)
2	UGC Regulation: Promotion of Academic Integrity and Prevention of Plagiarism in HEI's, Regulation 2018 (https://www.ugc.ac.in/pdfnews/7771545_academic-integrity-Regulation2018.pdf)

Reference(s):

1	Muralidhar, K., Ghosh, A., &Singhvi, A. K. (2019). Ethics in Science Education, Research and Governance. ISBN: 978-81-939482-1-7 (https://www.insaindia.res.in/pdf/Ethics_Book.pdf)
2	Griffiths, P. A., McCormick Adams, R., Albertis, B. M., Blout, E. R., Browder, F. E., Challoner, M. D., & Stine, D. D. (1995). On being a scientist: responsible conduct in research. Washington (DC): National Academy
3	Steven D. Krause (2007) Process of Research writing (Open Textbook Library, University of Michigan)
4	Chery Lowry (2016) Choosing & Using sources: A guide to academic research (Open Textbook Library, University of Michigan)

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