ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES :: TIRUPATI
(AUTONOMOUS)
DETAILED SYLLABI FOR THE COURSES OF REGULAR M.TECH (PE&ED)

M. Tech – I Semester

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
THEORY										
1	BS	22DBS9901	Advanced Mathematics for Engineers	3	0	0	3	40	60	100
2	PC	22DPC9001	Mechanical Vibrations	3	1	0	4	40	60	100
3	PC	22DPC9002	Advanced Material Science & Metallurgy	3	0	0	3	40	60	100
4	PE		**Professional Elective I**	3	0	0	3	40	60	100
		22DPE9001	Non-Destructive Evaluation							
		22DPE9002	Rapid Prototyping							
		22DPE9003	Advanced Mechanisms							
5	ML	22MBA0110	Research Methodology and IPR	2	0	0	2	40	60	100
6	MC		**Audit course I**	2	0	0	0	40	-	40
		22DMC2001	Disaster Management							
		22DMC9901	English for Research Paper Writing							
		22DMC9902	Sanskrit for Technical Knowledge							
		22DMC9903	Value Education							
PRACTICAL										
7	PC	22DPC9003	Mechanical Vibrations Lab	0	0	3	1.5	40	60	100
8	PC	22DPC9004	Mechanisms and Robotics (Virtual) Lab	0	0	3	1.5	40	60	100
						Total	18	320	420	740

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M. Tech – II Semester

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
THEORY										
1	PC	22DPC9005	Design for Manufacturing & Assembly	3	0	0	3	40	60	100
2	PC	22DPC9006	Advanced Finite Element Methods	3	1	0	4	40	60	100
3	PC	22DPC9007	Advanced Manufacturing Processes	3	0	0	3	40	60	100
4	PE		**Professional Elective III**	3	0	0	3	40	60	100
		22DPE9004	Simulation & Modeling of Manufacturing systems							
		22DPE9005	Advanced Mechanics of Solids							
		22DPE9006	Tribology in Design							
5	MC		**Audit course II**	2	0	0	0	40	-	40
		22DMC5801	Pedagogy Studies							
		22DMC9904	Constitution of India							
		22DMC9905	Stress Management by Yoga							
		22DMC9906	Personality Development through Life Enlightenment Skills							
PRACTICAL										
6	PC	22DPC9008	Design Simulation Lab	0	0	3	1.5	40	60	100
7	PC	22DPC9009	Manufacturing Simulation (Virtual) Lab	0	0	3	1.5	40	60	100
PROJECT										
8	PR	22DPR9001	Technical Seminar	0	0	4	2	100	-	100
						Total	**18**	**380**	**360**	**740**

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M. Tech –III Semester

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
THEORY										
1	PE		**Professional Elective IV**	3	0	0	3	40	60	100
		22DPE9007	Product Design and Development							
		22DPE9008	Engineering Fracture Mechanics							
2	OE		**Open Elective I**	3	0	0	3	40	60	100
		22DOE2001	1. Waste to Energy							
		22DOE2002	2. Project Management							
		22DOE5801	3. Business Analytics							
		22DOE9001	4. Industrial Safety							
		22DOE9002	5. Operations Research							
		22DOE9003	6. Composite Materials							
PROJECT										
3	PR	22DPR9002	Dissertation Phase – I	0	0	20	10	100	00	100
4	PR	22DPR9003	Co-curricular Activities	0	0	0	2	-	-	-
TOTAL							**18**	**180**	**120**	**300**

***Note**: Students are required to submit certificate for completion of the physical mode one week workshop/2 Credit NPTEL MOOCS course/ Publication of work in addition to project work related content in atleast a UGC-CARE level journal/ Presentation of a work in addition to project work related content in a National or International conference in their respective field of specialization.

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M. Tech – IV Semester

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
PROJECT										
1	PR	22DPR9004	Dissertation Phase – II	0	0	32	16	100	100	200
TOTAL							**16**	**100**	**100**	**200**

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M. Tech – I Semester

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
THEORY										
1	BS	22DBS9901	Advanced Mathematics for Engineers	3	0	0	3	40	60	100
2	PC	22DPC9001	Mechanical Vibrations	3	1	0	4	40	60	100
3	PC	22DPC9002	Advanced Material Science & Metallurgy	3	0	0	3	40	60	100
4	PE		**Professional Elective I**	3	0	0	3	40	60	100
		22DPE9001	Non-Destructive Evaluation							
		22DPE9002	Rapid Prototyping							
		22DPE9003	Advanced Mechanisms							
5	ML	22MBA0110	Research Methodology and IPR	2	0	0	2	40	60	100
6	MC		**Audit course I**	2	0	0	0	40	-	40
		22DMC2001	Disaster Management							
		22DMC9901	English for Research Paper Writing							
		22DMC9902	Sanskrit for Technical Knowledge							
		22DMC9903	Value Education							
PRACTICAL										
7	PC	22DPC9003	Mechanical Vibrations Lab	0	0	3	1.5	40	60	100
8	PC	22DPC9004	Mechanisms and Robotics (Virtual) Lab	0	0	3	1.5	40	60	100
						Total	18	320	420	740

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DBS9901	Advanced Mathematics for Engineers	3	0	0	3

Course Outcomes:

CO1 Analyse the concept of matrix in Numerical Methods.
CO2 Understand the wave equation and method of solutions.
CO3 Analyse the types of distributions and Sampling Theory.
CO4 Understand the concept of Estimation and Hypothesis.
CO5 Understand the concept of ANOVA and Curve fitting.

UNIT-I

Application of Numerical Methods: Examples, Solving set of equations – Matrix Notation – Determinants – Inverse – Eigen values and Eigen vectors. Iterative methods – Relaxation Methods – System of non-linear equations.

UNIT-II

Wave Equation: Displacements in a long string – A long string under its weight – A bar with prescribed force on one end – Free vibrations of a string.

UNIT-III

Probability & Statistics: Discrete and continuous random variables, Mathematical expectations-moments and moment generating functions. Fundamentals of Binomial, Poisson, Gamma, Normal, Uniform, and Weibull distributions.
Sampling: Sampling distribution – Law of large numbers – Central Limit Theorem.

UNIT-IV

Estimation: Point estimation, Interval estimation, and Confidence intervals (Maximum likely hood estimation), Bayesian estimation.
Statistical Hypothesis: Testing of Hypothesis – Large sample tests for testing of mean and proportions – Small sample tests for testing of mean and variance – Tests for independence of attributes and goodness of fit.

UNIT-V

Analysis of Variance: Introduction – one way and two way classifications.
Curve Fitting: Principle of least squares – Non linear curve fitting by method of least squares – Simple regression and correlation - regression analysis – partial and multiple linear regression – non linear regression.

Text books:

1. Numerical Methods for Scientific and Engineering Computations. M. K. Jain - S. R. K. Iyengar – R. K. Jain, Wiley Eastern Limited. New Age International (p) Ltd., Publishers.
2. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publishers, 42nd Edition.

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3. Numerical Methods for Engineers Stevan C.Chopra, Raymond P.Canal Mc. Graw Hill Book Company.
4. Numerical Methods for Engineering Problems by N. Krishna Raju and K.U. Muthu, M.C.
5. Millan Publishers, New Delhi.

Reference Books

1. Mathematical statistics by John E.Freund,5th edition, PHI
2. Elements of probability theory by Cramer.K
3. Perko, Differential equations and dynamical systems,springer-verlag,2001

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1		2	
CO2		2	
CO3		2	
CO4		2	
CO5		2	

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPC9001	Mechanical Vibrations	3	1	0	4

Course Outcomes:

CO1 Determine the natural frequency of transverse vibrations of the shaft and torsional vibrations of rotor systems.

CO2 Analyze the mathematical modeling of the two degrees of freedom systems and explain about the working principle of vibration absorber

CO3 Compute the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system

CO4 Select the numerical methods to determine natural frequencies of the beam and rotor systems

CO5 Describe the vibration measurement by using transducers and vibration exciters

UNIT I

Transverse vibrations, single concentrated load, uniformly distributed load, several loads, Dunkerley's method, energy method, whirling of shafts. Torsional vibrations – single rotor, two-rotor, three-rotor systems, torsionally equivalent shaft, geared system.

UNIT II

Two degree of freedom systems – Principal modes of vibration – two masses fixed on tightly stretched string – double pendulum – torsional system with damping – forced vibration with harmonic excitation – undamped dynamic vibration absorber – untuned viscous damper
Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

UNIT III

Multi degree of freedom systems – exact analysis - free vibrations – equations of motion – influence coefficients - generalized co-ordinates –Co-ordinate coupling – natural frequencies and mode shapes – eigen values and eigenvectors - orthogonal properties of normal modes – modal analysis

UNIT IV

Multi degree of freedom systems – Numerical methods – Rayleigh`s method – Dunkerley`s method – Stodola's method – Rayleigh Ritz method – Method of matrix iteration – Holzer's method for natural frequencies of multi rotor systems.

UNIT V

Continuous systems – vibration of strings – longitudinal vibrations of bars – torsional vibrations of circular shafts - lateral vibration of beams Critical speeds of shafts – Critical speed of a light shaft having a single disc – without damping and with damping. Critical speed of a shaft having multiple discs – secondary critical speed.

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Text books:

1. Leonard Meirovitch, "Fundamentals of vibrations", McGraw Hill International Edition
2. Mechanical Vibrations by G. K. Groover.

References:

1. William T Thomson & Marie Dillon Dahleh, "Theory of Vibrations with application", 5e, Pearson Education Publication, 2007
2. Mechanical Vibrations – Schaum series.
3. Vibration problems in Engineering by S. P. Timoshenko.
4. V. P. Singh, "Mechanical vibrations", 3e, Dhanpat Rai& Co., 2006
5. Mechanical Vibrations – V. Ram Murthy.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2	2	
CO2	3	3	2
CO3			2
CO4	2		
CO5	2	1	

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPC9002	Advanced Material Science & Metallurgy	3	0	0	3

Course Outcomes:

CO1 Determine the natural frequency of transverse vibrations of the shaft and torsional vibrations of rotor systems.

CO2 Analyze the mathematical modeling of the two degrees of freedom systems and explain about the working principle of vibration absorber

CO3 Compute the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system

CO4 Select the numerical methods to determine natural frequencies of the beam and rotor systems

CO5 Describe the vibration measurement by using transducers and vibration exciters

UNIT I

Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening. Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non-crystalline material

UNIT II

Griffith's Theory, stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and 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 mechanism and paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non-metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis.

UNIT III

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.

UNIT IV

Powder Metallurgy: Powder manufacturing and conditioning – characteristics and testing of metal powders – powder compaction.

UNIT V

Modern Metallic Materials: Dual Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Managing Steel, Inter metallic, Ni and Ti Aluminides, Smart Materials, Shape Memory alloys, Metallic Glass Quasi Crystal and Nano Crystalline Materials.

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Text Books:

1. Mechanical Behavior of Materials/Thomas H. Courtney/ McGraw Hill/2 nd Edition/2000
2. Mechanical Metallurgy/George E. Dieter/McGraw Hill, 1998.

References:

1. Selection and use of Engineering Materials 3e/Charles J.A / Butterworth Heiremann.
2. Engineering Materials Technology/James A Jacob Thomas F Kilduff / Pearson
3. Material Science and Engineering/William D Callister/John Wiley and Sons
4. Introduction to Physical Metallurgy by SH Avner, Tata Mc Graw Hill.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		2
CO2	3	1	3
CO3			2
CO4	2		
CO5	2	1	

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPE9001	Non-Destructive Evaluation	3	0	0	3

Course Outcomes:

CO1 Analysis of ultra-sonic hardness testing methods and principles of eddy current testing
CO2 Study of X-ray radiography and image scattering and quality.
CO3 Study of methods of X-ray radiography process and techniques used.
CO4 Study and analysis of holography and practices and techniques.
CO5 Applications of NDT in castings, welding and different case studies.

UNIT I

Ultra Sonic Hardness Testing: Flaw Detection Using Dye Penetrants. Magnetic Particle Inspection introduction to electrical impedance, Principles of Eddy Current testing, Flaw detection using eddy currents.

UNIT II

Introduction to X-Ray Radiography: The Radiographic process, X-Ray and Gamma-ray sources, Geometric Principles, Factors Governing Exposure, Radio graphic screens, Scattered radiation, Arithmetic of exposure, Radiographic image quality and detail visibility, Industrial X-Ray films,

UNIT III

X-Ray Radiography processes: Fundamentals of processing techniques, Process control, The processing Room, Special Processing techniques, Paper Radiography, Sensitometric characteristics of x-ray films, Film graininess signal to noise ratio in radiographs, The photographic latent image, Radiation Protection,

UNIT IV

Holography: Principles and practices of Optical holography, acoustical, microwave, x-ray and electron beam holography techniques.

UNIT V

Applications-I: NDT in flaw analysis of Pressure vessels, piping, Castings, Welded constructions, etc., Case studies

Text books:

1. Ultrasonic testing by Krautkramer and Krautkramer
2. Ultrasonic inspection 2 Training for NDT : E. A. Gingel, Prometheus Press,
3. ASTM Standards, Vol 3.01, Metals and alloys

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Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		2
CO2	3		3
CO3			2
CO4	2		
CO5	2		

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPE9002	Rapid Prototyping	3	0	0	3

Course Outcomes:

CO1 Identify the need for reduction of product development time.
CO2 Model any complex part for rapid manufacture
CO3 Illustrate the working principles of rapid manufacturing technologies.
CO4 Able to learn the different tools and errors in RPT
CO5 Identify and minimize errors that occur during conversion of CAD models.

UNIT I

Introduction: Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

UNIT II

Photo polymerization RP Processes: Stereolithography (SL), SL resin curing process, SL scan patterns, Micro stereolithography, Applications of Photo polymerization Processes. **Powder Bed Fusion RP Processes:** Selective laser Sintering (SLS), Powder fusion mechanism and powder handling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Applications of Powder Bed Fusion Processes.

UNIT III

Extrusion-Based RP Systems: Fused Deposition Modelling (FDM), Principles, Plotting and path control, Applications of Extrusion-Based Processes.

Printing RP Processes: 3D printing (3DP), Research achievements in printing deposition, Technical challenges in printing, Printing process modelling, Applications of Printing Processes.

UNIT IV

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc.

UNIT V

RP Software: Need for RP software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, SolidView, 3DView, etc., software, Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

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Text Books:

1. Chua Chee Kai., Leong Kah Fai., Chu Sing Lim, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific, 2010.
2. Ian Gibson., David W Rosen., Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
3. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		2
CO2	3	2	2
CO3			2
CO4	2		
CO5	2		

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPE9003	Advanced Mechanisms	3	0	0	3

Course Outcomes:

CO1 Study of elements of mechanisms in different geometry.
CO2 Study and construction of kinematics of plane motions
CO3 Design and determination of different mechanisms in advanced kinematics of plane motion.
CO4 Study and analysis of synthesis graphical method
CO5 Design of different functions and methods of graphical method and theorems.

UNIT I

Introduction: Elements of Mechanisms; Mobility Criterion for Planar mechanisms and manipulators; Mobility Criterion for spatial mechanisms and manipulators. Spherical mechanisms-spherical trigonometry.

UNIT II

Advanced Kinematics of plane motion-I: The Inflection circle ; Euler – Savary Equation; Analytical and graphical determination of di; Bobillier's Construction; Collineastion axis ; Hartmann's Construction ;Inflection circle for the relative motion of two moving planes; Application of the Inflection circle to kinematic analysis.

UNIT III

Advanced Kinematics of plane motion - II: Polode curvature; Halls Equation; Polode curvature in the four bar mechanism; coupler motion; relative motion of the output and input links; Determination of the output angular acceleration and its Rate of change; Freudenstein's collineation –axis theorem; Carter –Hall circle; The circling – point curve for the Coupler of a four bar mechanism.

UNIT IV

Introduction to Synthesis-Graphical Methods - I: The Four bar linkage ;Guiding a body through Two distinct positions; Guiding a body through Three distinct positions; The Roto center triangle ; Guiding a body through Four distinct positions; Burmester's curve.

UNIT V

Introduction to Synthesis-Graphical Methods - II: Function generation- General discussion; Function generation: Relative –rotocenter method, Overlay's method, Function generation- Velocity – pole method; Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

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Text Books:

1. Jeremy Hirschhorn, Kinematics and Dynamics of plane mechanisms, McGraw-Hill, 1962.
2. L. Sciavicco and B. Siciliano, Modelling and control of Robot manipulators, Second edition ,Springer - Verlag, London, 2000.
3. Amitabh Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines. East West Publishers.

Reference Books:

1. Allen S. Hall Jr., Kinematics and Linkage Design, PHI, 1964.
2. J. E Shigley and J. J . Uicker Jr., Theory of Machines and Mechanisms , McGraw-Hill, 1995.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		2
CO2	2	3	
CO3			
CO4	2		3
CO5	2		

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22MBA0110	Research Methodology and IPR	2	0	0	2

Course Outcomes:

CO1 Get acquainted with basics of research problem formulation
CO2 Familiar with research related information and ethics.
CO3 Aware about research report writing and presentation.
CO4 Understand and get knowledge of basic rights for protection of innovative.
CO5 Understand different types of IPRs

Unit 1: Introduction to Research – Types of Research, Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches to investigation of solutions for research Problem.
Unit 2: Review of Literature and Data Collection - Effective literature studies approaches, analysis, Plagiarism and Research ethics.
Data collection, analysis, interpretation, Necessary instrumentations.
Unit 3: Report Writing - Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.
Unit 4: Intellectual Property Rights: Nature, Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.
Unit 5: Patent Rights - Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

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Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		
CO2	1		
CO3		3	
CO4			2
CO5	2		

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DMC2001	Disaster Management	2	0	0	0

Course Outcomes:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries.
5. Create technological innovations in disaster risk reduction, advantages and problems.

UNIT I

Introduction: Disaster - Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II

Repercussions of Disasters and Hazards: Economic Damage, Loss OfHuman 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.

UNIT III

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.

UNIT IV

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.

UNIT V

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.

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DETAILED SYLLABI FOR THE COURSES OF REGULAR M.TECH (PE&ED)

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.

Text Books:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company".
2. Sahni, Pardeep et al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	1		
CO2	1		
CO3	1		
CO4	1		
CO5	1		

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DMC9901	English for Research Paper Writing	2	0	0	0

Course Outcomes:

CO1 Improve writing skills and level of readability
CO2 Learn what to write in each section, avoiding plagiarism
CO3 Understand the review of research literature
CO4 Apply skills in writing a Title, abstract and literature
CO5 Learn the skills of drafting Summations

UNIT I

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

UNIT II

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

UNIT III

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. 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

UNIT IV

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

UNIT V

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Text Books:

1. Goldbort R, Writing for Science, Yale University Press (available on Google Books)
2. Day R, How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM.
4. Adrian Wall work, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1			
CO2			
CO3			
CO4			
CO5			

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DMC9902	Sanskrit for Technical Knowledge	2	0	0	0

Course Outcomes:

CO1 To get a working knowledge in illustrious Sanskrit, the scientific language in the world
CO2 Learning of Sanskrit to improve brain functioning
CO3 Understanding basic Sanskrit language
CO4 Ancient Sanskrit literature about science & technology can be understood
CO5 Being a logical language will help to develop logic in students

UNIT I

a. Alphabets in Sanskrit,
b. Past/Present/Future Tense,
c. Simple Sentences

UNIT II

1) Order
2) Introduction of roots
3) Technical information about Sanskrit Literature

UNIT III

1. Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

Text Books :

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita - Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1			
CO2			
CO3			
CO4			
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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DMC9903	Value Education	2	0	0	0

Course Outcomes:

CO1 Understand value of education and self- development
CO2 Imbibe good values in students
CO3 Let the should know about the importance of character
CO4 Learn the importance of Human values
CO5 Developing the overall personality

UNIT I

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

UNIT II

- 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

UNIT III

- 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

UNIT IV

- Character and Competence –Holy books vs Blind faith.
- Self-management and Good health.

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- Science of reincarnation.
- Equality, Nonviolence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively

Suggested reading

Chakroborty, S. K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1			
CO2			
CO3			
CO4			
CO5			

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPC9003	Mechanical Vibrations Lab	0	0	3	1.5

Course Outcomes:

CO1 Determine the radius of gyrations in suspension types.
CO2 Study the pressure profile at different conditions of loads
CO3 Determine different frequency of undamped torsional vibrations.
CO4 Determine frequency of damped force vibration
CO5 Determine undamped free vibration of spring mass system.

List of Experiments:

1. To study the forced vibration of the beam for different damping.
2. To determine the radius of gyration 'k' of a given compound pendulum.
3. To determine the radius of gyration of trifilar suspension.
4. To determine the radius of gyration of given bar using bi-filler suspension.
5. To verify the dunker lay's rule viz.
6. To study the pressure profile of lubricating conditions of load and speed.
7. To determine the natural frequency of undamped torsional vibration of a single rotor shaft system.
8. To determine the natural frequency of undamped torsional vibration of two rotor shaft system.
9. To determine the frequency of undamped free vibration of an equivalent spring mass system.
10. To determine the frequency of damped force vibration of a spring mass system

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2	2	
CO2	2	3	
CO3		2	
CO4			2
CO5			3

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Year: I **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPC9004	Mechanisms and Robotics (Virtual) Lab	0	0	3	1.5

Course Outcomes:

CO1 Identify the geometric relationship between input and output motion parameters of robotic arms

CO2 Formulate the transformation matrix through which a relationship is established between different links of the manipulator.

CO3 Create the workspace through a 3D graph plot of manipulator position for various inputs.

CO4 Assess the robot motion for various inputs of the joint angular value.

CO5 Interpret the simulation of mechanisms for different input parameters.

List of Experiments:

1. Move master
2. Forward Kinematics of PUMA 560
3. Inverse Kinematics of PUMA 560
4. KGP 50
5. Oldham Coupling Mechanism
6. A quick return mechanism
7. CAM follower mechanism

WEB REFERENCE: http://vlabs.iitkgp.ernet.in/mr/

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		2
CO2		3	
CO3	2		3
CO4	2		2
CO5	2		

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M. Tech – II Semester

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
THEORY										
1	PC	22DPC9005	Design for Manufacturing & Assembly	3	0	0	3	40	60	100
2	PC	22DPC9006	Advanced Finite Element Methods	3	1	0	4	40	60	100
3	PC	22DPC9007	Advanced Manufacturing Processes	3	0	0	3	40	60	100
4	PE		**Professional Elective III**	3	0	0	3	40	60	100
		22DPE9004	Simulation & Modeling of Manufacturing systems							
		22DPE9005	Advanced Mechanics of Solids							
		22DPE9006	Tribology in Design							
5	MC		**Audit course II**	2	0	0	0	40	-	40
		22DMC5801	Pedagogy Studies							
		22DMC9904	Constitution of India							
		22DMC9905	Stress Management by Yoga							
		22DMC9906	Personality Development through Life Enlightenment Skills							
PRACTICAL										
6	PC	22DPC9008	Design Simulation Lab	0	0	3	1.5	40	60	100
7	PC	22DPC9009	Manufacturing Simulation (Virtual) Lab	0	0	3	1.5	40	60	100
PROJECT										
8	PR	22DPR9001	Technical Seminar	0	0	4	2	100	-	100
						Total	**18**	**380**	**360**	**740**

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPC9005	Design for Manufacturing & Assembly	3	0	0	3

Course Outcomes:

CO1 Outline the appropriate design for economical production and select the materials.
CO2 Select between various machining and metal joining processes.
CO3 Apply a systematic understanding of knowledge in the field of metal casting and forging.
CO4 Integrate the knowledge of compliance analysis and interference analysis for assembly.
CO5 Integrate the knowledge of compliance analysis and interference analysis for automatic assembly.

UNIT I

Introduction: Design philosophy steps in Design process - General Design rules for manufacturability - basic principles of designing for economical production - creativity in design. Materials: Selection of Materials for design Developments in Material technology - criteria for material selection - Material selection interrelationship with process selection, process selection charts.

Machining processes: Overview of various machining processes-general design rules for machiningdimensionaltoleranceandsurfaceroughness-Designformachining–ease–redesigningofcomponentsformachiningeasewithsuitableexamples.Generaldesignrecommendationsformachinedparts.

UNIT II

Metal casting: Appraisal of various casting processes, selection of casting process, - general design considerations for casting - casting tolerances - use of solidification simulation in casting design - product design rules for sand casting.

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

UNIT III

Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

Extrusion & Sheet Metal Work: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, Deep Drawing - Keeler Goodman Forming Line Diagram - Component Design for Blanking.

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UNIT IV

Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, Weight on Handling Time, Effects of Combinations of Factors, Application of the DFA Methodology.

UNIT V

Design for Assembly Automation: Fundamentals of automated assembly systems, System configurations, parts delivery system at workstations, various escapement and placement devices used in automated assembly systems, Quantitative analysis of Assembly systems, Multi station assembly systems, and single station assembly lines.

TEXT BOOKS:

1. Design for Manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,
3. Design for Manufacture, James Bralla

REFERENCES:

1. ASM Hand book Vol.20
2. Assembly Automation and Product Design/ Geoffrey Boothroyd/ Marcel Dekker Inc., NY,1992.
3. Engineering Design - Material & Processing Approach/ George E. Deiter/McGraw Hill Intl.2nd Ed. 2000.
4. Hand Book of Product Design/ Geoffrey Boothroyd/ Marcel and Dekken, N.Y. 1990.
5. Computer Aided Assembly London/ A Delbainbre/.
6. Product Design for Manufacturing and Assembly/ Geoffrey Boothroyd, Peter Dewhurst &Winston Ansthony Knight/CRC Press/2010
7. Design and Manufacturing / Surender Kumar & Goutham Sutradhar / Oxford & IBH

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2	2	3
CO2	2	2	3
CO3	2		3
CO4	2		2
CO5	2		3

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPC9006	Advanced Finite Element Methods	3	1	0	4

Course Outcomes:

CO1 Demonstrate understanding of FE formulation for linear problems in solid mechanics

CO2 Understand behaviour of elastic-plastic materials and visco-plasticity, Use of Newton-Raphson method for solving nonlinear equations of equilibrium

CO3 Understand flow rules and strain hardening, loading and unloading conditions, Drucker' suitability postulates, J2 flow of theory of plasticity

CO4 Demonstrate use of FE formulation to solve the problems of large deformation of structures under loads

CO5 Able to solve contact problems by using the techniques of non-linear FEM

UNIT I

Formulation Techniques: Methodology, Engineering problems and governing differential equations, finite elements., Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations, Essential and natural boundary conditions.

UNIT II

Review of linear FEA: FE formulation of 1D bar, 3D linear elastic continuum, 2D plane strain, plane stress.

Two dimensional problems: CST, LST, four noded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions, axi-symmetric elements; Iso-parametric mapping; numerical integration.

UNIT III

Finite elements in Structural Dynamics: Dynamic equations, Eigen value problems, and their solution methods, simple problems.

Convergence: Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, Pascal's triangle.

UNIT IV

Continuum theories of plasticity: Review of tensor algebra; Yield condition, flow rule and hardening rules; loading and unloading conditions; Drucker's stability postulates; Convexity and normality; J2 flow theory of plasticity and visco-plasticity, Gurson model.

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UNIT V

FE formulation for 1D plasticity: Elastic-perfectly plastic material; Isotropic and kinematic hardening; Integration algorithms for 1D plasticity; FE formulation; Newton-Raphson method for solving nonlinear equilibrium equations; 1D visco-plasticity and integration algorithm.

Text Books:

1. K. J. Bathe, Finite Element Procedures, Prentice-Hall of India Private Limited, New Delhi, 1996.
2. J. C. Simo and T. J. R. Hughes, Computational Inelasticity, Springer-Verlag New York, Inc., New York, 1998.
3. O. C. Zienkiewicz and R. L. Taylor, Finite Element Method: Volume 2 Solid Mechanics, Fifth Edition, Butterworth-Heinemann, Oxford
4. T. Belytschko and W. K. Liu and B. Moran, Nonlinear Finite Elements for Continua and Structures, John Wiley & Sons Ltd., England.

References:

1. Finite Element of Nonlinear continua, J. N. Oden, McGraw-Hill, New York, 1971
2. Finite Element Method, Zienckiwicz O. C. & R. L. Taylor, McGraw-Hill, 1983.
3. J. C. Simo and T. J. R. Hughes, Computational Inelasticity, Springer-Verlag New York, Inc., New York, 1998
4. O. C. Zienkiewicz and R. L. Taylor, Finite Element Method: Volume 2 Solid Mechanics, Fifth Edition, Butterworth-Heinemann, Oxford
5. T. Belytschko and W. K. Liu and B. Moran, Nonlinear Finite Elements for Continua and Structures, John Wiley & Sons Ltd., England.
6. D. R. J. Owen and E. Hinton, Finite Elements in Plasticity: Theory and Practice, Pineridge Press Ltd.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		2
CO2		3	
CO3	2		3
CO4	2		2
CO5	2		3

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPC9007	Advanced Manufacturing Processes	3	0	0	3

Course outcomes:

CO1 To produce useful research output in machining of various materials
CO2 Use this knowledge to develop hybrid machining techniques
CO3 Application of this knowledge to manage shop floor problems
CO4 Apply the reverse engineering process for product development
CO5 Develop a prototype with modern prototyping techniques

UNIT I

Unconventional Machining: Introduction-Bulk processes - surface processes- Plasma Arc Machining- Laser Beam Machining- Electron Beam Machining-Electrical Discharge Machining – Electro chemical Machining-Ultrasonic Machining- Water Jet Machining-Electro Gel Machining-Anisotropic machining - Isotropic machining-Elastic Emission machining – Ion Beam Machining.

UNIT II

Precision Machining: Ultra Precision turning and grinding: Chemical Mechanical Polishing (CMP) - ELID process – Partial ductile mode grinding-Ultra precision grinding- Binderless wheel – Free form optics. A spherical surface generation Grinding wheel - Design and selection of grinding wheel-High-speed grinding-High-speed milling- Diamond turning.

UNIT III

Micro Machining and Nano Fabrication: Theory of micromachining-Chip formation-size effect in micromachining - microturning, micromilling, microdrilling- Micromachining tool design-Micro EDM - Microwire EDM-Nano fabrication: LIGA, Ion beam etching, Molecular manufacturing techniques –Atomic machining- Nano machining techniques – Top/Bottom up Nano fabrication techniques - Sub micron lithographic technique, conventional film growth technique, Chemical etching, Quantum dot fabrication techniques – MOCVD – Epitaxy techniques.

UNIT IV

Advances in Metal Forming: Orbital forging, Isothermal forging, Warm forging, Overview of Powder Metal techniques –Hot and Cold isostatic pressing - high speed extrusion, rubber pad forming, Hydroforming, Superplastic forming, Peen forming-micro blanking –Powder rolling – Tooling and process parameters.

UNIT V

Rapid Prototyping and Surface Modification Techniques: Introduction – Classification – Principle advantages limitations and applications- Stereo lithography – Selective laser sintering –FDM, SGC, LOM, 3D Printing-Surface modification Techniques: Sputtering-CVD-PVD-Diamond like carbon coating-Plasma Spraying Technique.-Diffusion coatings-Pulsed layer deposition.

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Text Books:

1. Serope Kalpakjian., "Manufacturing Engineering and Technology" Pearson Education, 2001
2. Madou, M.J., Fundamentals of Micro fabrication: The Science of Miniaturization, Second Edition, CRC Press (ISBN: 0849308267), 2006.

References:

1. McGeough,J.A., "Advanced methods of Machining", Springer, 2011.
2. Narayanaswamy, R., Theory of Metal Forming Plasticity, Narosa Publishers,1989.
3. Pandey, P.S. and Shah.N., "Modern Manufacturing Processes", Tata McGraw Hill, 1980.
4. Benedict, G.F.,"Non Traditional manufacturing Processes", CRC press,2011

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		2
CO2		3	
CO3	2		3
CO4	2		2
CO5	2		3

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPE9004	Simulation & Modeling of Manufacturing systems	3	0	0	3

Course outcomes:

CO1 Students gain knowledge on various types of simulation and simulation languages steps in simulation and applications of simulation

CO2 Students gain knowledge on parameter estimation and hypothesis

CO3 Students can build simulation model and also can validation and verify model

CO4 Can Generation of random variants and variables

CO5 Applications of simulation and systems

UNIT I

System – ways to analyze the system – Model – types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages & Disadvantages. Parameter estimation – estimator – properties – estimate – point estimate – confidence interval estimates – independent – dependent – hypothesis – types of hypothesis- steps – types 1& 2 errors – Framing – strong law of large numbers.

UNIT II

Building of Simulation model – validation – verification – credibility – their timing – principles of valid simulation Modeling – Techniques for verification – statistical procedures for developing credible model. Modeling of stochastic input elements – importance – various procedures – theoretical distribution – continuous – discrete – their suitability in modeling.

UNIT III

Generation of random variates – factors for selection – methods – inverse transform – composition – convolution – acceptance – rejection – generation of random variables – exponential – uniform – weibull – normal Bernoullie – Binomial – uniform – poisson. Simulation languages – comparison of simulation languages with general purpose languages – Simulation languages vs Simulators – software features – statistical capabilities – G P S S – SIMAN- SIMSCRIPT –Simulation of M/M/1 queue – comparison of simulation languages.

UNIT IV

Output data analysis – Types of Simulation w.r.t output data analysis – warm up period- Welch algorithm – Approaches for Steady – State Analysis – replication – Batch means methods – comparisons

UNIT V

Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – News paper boy problem.

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References:

1. Simulation Modelling and Analysis / Law, A.M. & Kelton / McGraw Hill, 2nd Edition, New York, 1991.
2. Discrete Event System Simulation / Banks J. & Carson J.S., PH / Englewood Cliffs,NJ, 1984.
3. Simulation of Manufacturing Systems / Carrie A. / Wiley, NY, 1990.
4. A Course in Simulation / Ross, S.M., McMillan, NY, 1990. Simulation Modelling and SIMNET / Taha H.A / PH, Englewood Cliffs, NJ, 1987

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		2
CO2		3	
CO3	2		3
CO4	2		2
CO5	2		3

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPE9005	Advanced Mechanics of Solids	3	0	0	3

Course outcomes:

CO1 Analyze and determine beams under unsymmetrical loading
CO2 Apply shear center of thin wall beams, torsion & axi-symmetric problems
CO3 Analyze and determine the contact stresses
CO4 Understand and analyze stresses and strains at a point in 2D
CO5 Understand and analyze stresses and strains at a point in 3D

UNIT I

Curved beam theory: Winkler Bach formula for circumferential stress – Limitations Correction factors –Radial stress in curved beams – closed ring subjected to concentrated and uniform loads-stresses in chain links.

Unsymmetrical bending: Bending stresses in Beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending

UNIT II

Shear center: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections.

Torsion: Torsion of cylindrical bar of circular cross-section Saint-Venant's semi-inverse method - Linear elastic solution - The Prandtl elastic - Membrane (soap-film) analogy - Narrow rectangular cross-section - Hollow thin-wall torsion members: Multiply connected cross-section - Thin-wall torsion members with restrained ends.

UNIT III

Contact stresses: Introduction - The problem of determining contact stresses - Assumptions on which a solution for contact stresses is based - Notation and meaning of terms - Expressions for principal stresses - Method of computing contact stresses - Deflection of bodies in point contact - Stress for two bodies in contact over narrow rectangular area (line contact). Loads normal to area - Stresses for two bodies in line contact. Loads normal and tangent to contact area.

UNIT IV

Two-Dimensional Elasticity Problems: Plane stress & Plain Strain-Problems in Rectangular Co-ordinates, bending of cantilever loaded at the end, bending of a beam by uniform load. General equations in polar coordinates, stress distribution symmetrical about an axis, pure bending of curved bars, displacements for symmetrical stress distributions, rotating discs.

UNIT V

Introduction to Three Dimensional Problems: Uniform stress stretching of a prismatic bar by its own weight, twist of circular shafts of constant cross section, pure bending of plates.

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Text Books:

1. Advanced Mechanics of materials by Boresi & Sidebottom-Wiely International.
2. Theory of elasticity by Timoshenko S.P. and Goodier J.N. McGraw-Hill Publishers 3rd Edition

Reference Books:

1. Advanced strength of materials by Den Hortog J.P.
2. Theory of plates – Timoshenko.
3. Strength of materials & Theory of structures (Vol I & II) by B. C Punmia
4. Strength of materials by Sadhu singh

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		2
CO2		3	3
CO3	2	3	3
CO4	2	3	2
CO5	2		3

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPE9006	Tribology in Design	3	0	0	3

Course outcomes:

CO1 Ability to select material / surface properties based on the tribological requirements

CO2 Methodology for deciding lubricants and lubrication regimes for different operating conditions

CO3 Analysis ability of different types of bearings for given load / speed conditions

CO4 Familiar with common anti-friction and anti-wear components.

CO5 Methodology for deciding the lubricants used therein

UNIT I

Surface interaction and friction: Topography of Surfaces – Surface Features-Properties and measurement – Surface interaction –Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions – Thermal considerations in sliding contact

UNIT II

Wear and surface treatment: Types of wear – Mechanism of various types of wear – Laws of wear –Theoretical wear models- Wear of Metals and Non metals – Surface treatments – Surface modifications – surface coatings methods- Surface Topography measurements – Laser methods – instrumentation – International standards in friction and wear measurements

UNIT III

Lubricants and lubrication regimes: Lubricants and their physical properties- Viscosity and other properties of oils –Additives-and selection of Lubricants- Lubricants standards ISO, SAE, AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary Lubrication- Hydrodynamic lubrication — Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication.

UNIT IV

Theory of hydrodynamic and hydrostatic lubrication: Reynolds Equation, -Assumptions and limitations-One and two-dimensional Reynolds Equation- Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings-Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing- Pressure, flow, load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings

UNIT V

High pressure contacts and elasto hydrodynamic lubrication: Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory- Soft and hard EHL-

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Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives

Text Books:

1. Cameron, A. "Basic Lubrication Theory", Ellis Herward Ltd., UK, 1981
2. G. W. Stachowiak & A. W. Batchelor , Engineering Tribology, Butterworth - Heinemann, UK, 2005

References Books:

1. Halling, J. (Editor) – "Principles of Tribology", Macmillian – 1984

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		2
CO2		3	
CO3	2		3
CO4	2		2
CO5	2		3

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DMC5801	Pedagogy Studies	2	0	0	0

Course Outcomes:

CO1 Understand the concept, nature, characteristics of growth and development
CO2 Appreciate the contribution of the school and society on various aspects of development.
CO3 Update their knowledge about the personality development.
CO4 Understand the concept and process of teaching-learning.
CO5 Understand the concept and importance of individual differences

UNIT – I

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.

UNIT II

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

UNIT III

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.

UNIT IV

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

UNIT V

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

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References:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272– 282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**					
CO2	**1**					
CO3	**1**					
CO4	**1**					
CO5	**1**					

(Levels of Correlation, viz., 1.Low, 2.Moderate, 3.High

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DMC9904	Constitution of India	2	0	0	0

Course Outcomes:

CO1 Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2 Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3 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.

CO4 Discuss the passage of the Hindu Code Bill of 1956

CO5 Discuss about Local Administration and Election Commission

UNIT I

History of making of the Indian Constitution: History, Drafting Committee, (Composition & Working)

UNIT II

Philosophy of the Indian Constitution: Preamble, Salient Features

UNIT III

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.

UNIT IV

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

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UNIT V

Local Administration:

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

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.

Text Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D. D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1			
CO2			
CO3			
CO4			
CO5			

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DMC9905	Stress Management by Yoga	2	0	0	0

Course Outcomes:

CO1 Develop healthy mind in a healthy body thus improving social health
CO2 Improve efficiency
CO3 Understanding the role of yoga in mental hygiene
CO4 Develop strong mental health
CO5 Understand the role of yoga in stress management

UNIT I

Definitions of Eight parts of yoga. (Ashtanga)

UNIT II

Yam and Niyam - Do`s and Don't's in life - Ahinsa, Satya, Astheya, Bramhacharya and Aparigraha - Shaucha, Santosh, Tapa, Swadhyay, Ishwarpranidhan

UNIT III

Asan and Pranayam - Various yoga poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam.

UNIT IV

Mental Hygiene and Yoga - Mental health: A Yogic Perspective - Mental hygiene and role of Yoga in mental hygiene - Yogic principles for the management of stress (Prayer and meditation for mental health).

UNIT V

Yogic Management of Stress: Specific practices for stress management: Yogasana, Breath awareness, Shvasana, Yoganidra, Pranayama and Meditation

Text Books:

1. 'Yogic Asanas for Group Tarining - Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1			
CO2			
CO3			
CO4			
CO5			

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DMC9906	Personality Development through Life Enlightenment Skills	2	0	0	0

Course Outcomes:

CO1 Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and b achieve the highest goal in life
CO2 The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO3 Study of Neetishatakam will help in developing versatile personality of students.
CO4 To become a person with stable mind, pleasing personality and determination
CO5 To awaken wisdom in students

UNIT I

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)

UNIT II

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta : 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.

UNIT III

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

Suggested reading

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

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Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	1		
CO2	1		
CO3	1		
CO4	1		
CO5	1		

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPC9008	Design Simulation Lab	0	0	3	1.5

Course Outcomes:

CO1 Designing of different modeling of components
CO2 Drafting of individual components and analysis
CO3 Analyzing of different components using structure analysis
CO4 Designing of Modal, Buckling and static analysis
CO5 Analysis of composites and fracture mechanics.

I Modeling

1. Surface modelling
2. Solid modelling
3. Drafting
4. Assembling

II Structural Analysis using any FEA Package for different structures that can be discretised with 1-D,2-D & 3-D elements

1. Static Analysis
2. Modal Analysis
3. Harmonic Analysis
4. Spectrum Analysis
5. Buckling Analysis
6. Analysis of Composites
7. Fracture mechanics

References:

User manuals of ANSYS package Version 10.0
PRO/E, I-DEAS Package / UNIGRAPHICS, CATIA

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	3	3	3
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3
CO5		3	3

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Year: I **Semester: II** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPC9009	Manufacturing Simulation (Virtual) Lab	0	0	3	1.5

Course Outcomes:

CO1 Understanding the different queuing models
CO2 Analyzing the simulation of production shop
CO3 Analyzing of simulation of algorithms in scheduling and dispatching
CO4 Designing of Layout models for product and process
CO5 Applying the simulation methods for forecasting techniques.

1) Queuing Experiments
   a) Simple Queuing
   b) Capacitated Queuing
   c) General Queuing
   d) Model Comparisons (Practice Problems)

2) Production Shop Experiments
   a) Simulation of Single Machine
   b) Simulation of Parallel Machines
   c) Simulation of Flow Shop
   d) Simulation of Job Shop
   e) Simulation of Job with Breakdown

3) Scheduling Experiments
   a) Priority Dispatching Rules
   b) Branch and Bound Algorithm

4) Layout Experiments
   a) Industrial Dryer Production Facility

5) Forecasting Experiments
   a) M-Period Moving Average
   b) Simple Exponential Smoothing
   c) Holt's Method
   d) Holt Winter's Method

References:

Weblink: http://gssl.iitk.ac.in/pssl/

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	3	3	3
CO2	3	2	2
CO3	3	3	3
CO4	3	3	3
CO5		3	

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M. Tech –III Semester

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
THEORY										
1	PE		**Professional Elective IV**	3	0	0	3	40	60	100
		22DPE9007	Product Design and Development							
		22DPE9008	Engineering Fracture Mechanics							
2	OE		**Open Elective I**	3	0	0	3	40	60	100
		22DOE2001	1. Waste to Energy							
		22DOE2002	2. Project Management							
		22DOE5801	3. Business Analytics							
		22DOE9001	4. Industrial Safety							
		22DOE9002	5. Operations Research							
		22DOE9003	6. Composite Materials							
PROJECT										
3	PR	22DPR9002	Dissertation Phase – I	0	0	20	10	100	00	100
4	PR	22DPR9003	Co-curricular Activities	0	0	0	2	-	-	-
TOTAL							**18**	**180**	**120**	**300**

***Note**: Students are required to submit certificate for completion of the physical mode one week workshop/2 Credit NPTEL MOOCS course/ Publication of work in addition to project work related content in atleast a UGC-CARE level journal/ Presentation of a work in addition to project work related content in a National or International conference in their respective field of specialization.

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Year: II **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPE9007	Product Design and Development	3	0	0	3

Course Outcomes:

CO1 Understand a product design brief

CO2 Know how to communicate product design ideas and concepts

CO3 Be able to develop product design proposals

CO4 Be able to realize outcomes to a design brief

CO5 Understand the principles of Prototype and economics

UNIT- I:

Introduction: Need for IPPD – strategic importance of product development – integration of customer, designer, material supplier and process planner, Competitor and costumer – behavior analysis. Understanding customer – promoting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specification.

UNIT II

Concept generation and concept selection: Activity of concept generation – Structured approaches – Five step Method: clarify – Search-Externally and internally – explore systematically – reflect on the solutions and processes – Concept selection – Integral part of PDD process-methodology – benefits. ROBUST DESIGN-introduction, various steps in robust design.

UNIT III

Industrial design: Assessing the need for industrial design, impact – design process Integrate design process – assessing the quality of industrial design. Investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT IV

Product architecture: Implications – Product change – variety – component standardization – product performance – manufacturability.

Design for manufacturing: Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs –cost of supporting production. Minimizing System complexity.

UNIT V

Prototyping: Prototype basics – Principles of prototyping – planning for prototypes – Economic analysis. Understanding and representing tasks – baseline project planning – accelerating the project execution.

Competitive Aspects of Product Design: Product Quality, Reliability, Concurrent engineering aspects, Substitution of materials, SQC and SPC

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Text Books:

1. Product Design and Development, Kari T. Ulrich and Steven D. Eppinger, McGraw Hill International Edns. 1999.
2. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4.

Reference Books:

1. Concurrent Engineering, integrated Product development, Kemnneth Crow , DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274(310)377-569, Workshop Book.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	3	3	3
CO2	3		
CO3	3	3	3
CO4	3	3	3
CO5	3	2	2

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Year: II **Semester: I** **Branch of Study: PEED**

Subject Code	Subject Name	L	T	P	Credits
22DPE9008	Engineering Fracture Mechanics	3	0	0	3

Course Outcomes:

CO1 Identify and explain the types of fractures of engineered materials and their characteristic features
CO2 Understand the differences in the classification of fracture mechanics (LEFM and EPFM) and how their corresponding parameters can be utilized
CO3 To determine conditions under which engineering materials will be liable to fail catastrophically in service
CO4 Understand and explain the mechanisms of fracture; and learn how to carry out engineering failure analysis
CO5 Appreciate the theoretical basis of the experimental techniques utilized for fracture and failure analysis

UNIT I

Introduction: Prediction of mechanical failure. Macroscopic failure modes; brittle and ductile behaviour. Fracture in brittle and ductile materials – characteristics of fracture surfaces; inter- granular and intra-granular failure, cleavage and micro-ductility, growth of fatigue cracks, the ductile/brittle fracture transition temperature for notched and un notched components. Fracture at elevated temperature.

UNIT II

Griffith's analysis: Concept of energy release rate, G, and fracture energy, R. Modification for ductile materials, loading conditions. Concept of R curves.

Linear Elastic Fracture Mechanics (LEFM): Three loading modes and the state of stress ahead of the crack tip, stress concentration factor, stress intensity factor and the material parameter the critical stress intensity factor.

UNIT III

The effect of Constraint, definition of plane stress and plane strain and the effect of component thickness. The plasticity at the crack tip and the principles behind the approximate derivation of plastic zone shape and size. Limits on the applicability of LEFM.

Elastic-Plastic Fracture Mechanics: The definition of alternative failure prediction parameters, Crack Tip Opening Displacement, and the J integral. Measurement of parameters and examples of use

UNIT IV

The effect of Microstructure on fracture mechanism and path, cleavage and ductile failure, factors improving toughness.

Fatigue: Definition of terms used to describe fatigue cycles, High Cycle Fatigue, Low Cycle Fatigue, mean stress R ratio, strain and load control. S-N curves. Goodman's rule and Miners rule. Micro mechanisms of fatigue damage, fatigue limits and initiation and propagation

control, leading to a consideration of factors enhancing fatigue resistance. Total life and damage tolerant approaches to life prediction.

UNIT V

Creep deformation: the evolution of creep damage, primary, secondary and tertiary creep. Micro- mechanisms of creep in materials and the role of diffusion. Ashby creep deformation maps. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller parameters. Creep-fatigue interactions. Examples.

Text Books:

1. T. L. Anderson, Fracture Mechanics Fundamentals and Applications, 2nd Ed. CRC press.
2. B. Lawn, Fracture of Brittle Solids, Cambridge Solid State Science Series 2nd ed1993.

References:

1. S. Suresh, Fatigue of Materials, Cambridge University Press.
2. L. B. Freund and S. Suresh, Thin Film Materials Cambridge University Press.
3. G. E. Dieter, Mechanical Metallurgy, McGraw Hill.
4. D.C. Stouffer and L.T. Dame, Inelastic Deformation of Metals, Wiley
5. F. R. N. Nabarro, H.L. deVilliers, The Physics of Creep, Taylor and Francis.
6. J. F. Knott, Fundamentals of Fracture Mechanics, Butter worths.
7. J. F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials.
8. H. L. Ewald and R.J.H. Wanhill Fracture Mechanics, Edward Arnold.

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	3	3	3
CO2	3		
CO3	3	3	3
CO4	3	3	3
CO5	3	2	2

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Year: II **Semester: I** **Branch of Study: Common to all**

Subject Code	Subject Name	L	T	P	Credits
22DOE2001	Waste to Energy	3	0	0	3

Course Outcomes:

CO1 Able to classify types of wastes

CO2 Understand the method of pyrolysis

CO3 Understand the use and application of Biomass gasifiers

CO4 Design biomass combustors

CO5 Analyze the properties of Biogas

UNIT I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors

UNIT V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion – Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

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Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	1		
CO2	1		
CO3	1		
CO4	2		
CO5	1		

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Year: II **Semester: I** **Branch of Study: Common to all**

Subject Code	Subject Name	L	T	P	Credits
22DOE2002	Project Management	3	0	0	3

Course Outcomes:

CO1 To understand the importance of project management and organization

CO2 To apply theoretical and practical aspects of project management planning techniques to achieve project goals

CO3 To understand the resources, cost and accounts managements

CO4 To know about the project implementation, and contract management and procurement management

CO5 Understand to apply knowledge and skills of quality and safety managements in construction

UNIT I

Introduction to Project management: Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization

UNIT II

Project Planning: Planning techniques- Bar Chart, Gantt Charts- Networks: basic terminology, preparation of CPM-computation of float values, critical paths-PERT-Determination of three time estimates- Comparison between CPM and PERT.

UNIT III

Resources Management: Flow chart of Resources Management, Labour's requirement, Factors behind the selection of equipment, Material Management- flow chart and functions.

Cost and Accounts Management: Cost–volume relationship- Basic Cost Control System-Principle of accounting, Account process, Balance sheet.

UNIT IV

Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management

UNIT V

Quality management

Inspection, quality control and quality assurance in projects- Cost of quality, cost versus quality levels- ISO standards- benefits-ISO 9001-2000 family of standards- Audit- types, ISO 9001-2000 for internal audit.

Safety management

Cause for accident in construction site- -Principle of safety- Role of safety personnel's -General safety conditions.

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Textbooks:

1. Kumar Neeraj Jha, Construction Project Management Theory & Practice, Pearson Education Ltd., 2014.
2. Chitkara.K.K., Construction Project Management Planning Scheduling and Controlling, TataMcGraw-Hill, 2014
3. Project Planning And Control With PERT And CPM By Dr.B.C.Punmia, K.K.Khandelwal, Lakshmi Publications New Delhi
4. Total Project Management, The Indian Context- By : P.K.JOY- Mac Millan Publishers India Limited

Additional Readings:

1. John M Nicholas, Project Management for Business and Technology: Principles and Practice, Prentice Hall, India, 2002.
2. N. J. Smith (Ed), Project Management, Blackwell Publishing, 2002.
3. Robert K. Wysocki, Robert Back Jr. and David B. Crane, Effective Project Management, John Wiley, 2002.
4. Jack R Meredith and Samuel J Mantel, Project Management: A Managerial Approach, John Wiley, 2000

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	2		
CO2	2	2	
CO3	1		
CO4	2	2	
CO5	2		

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Year: II **Semester: I** **Branch of Study: Common to all**

Subject Code	Subject Name	L	T	P	Credits
22DOE5801	Business Analytics	3	0	0	3

Course Outcomes:

CO1 Ability to work with different data types.

CO2 Ability to solve various problems related to businesses.

CO3 Ability to effectively utilize the time and involve in collaborative tasks.

CO4 Able to evaluate strategic objectives that enhance organizational effectiveness and operational performance.

CO5 Able to demonstrate collaboration for effective leadership and decision making

Unit I

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst. Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

Unit II

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles. Forming Requirements: Overview of requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.

Unit III

Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State- Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling

Unit IV

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools

Unit V

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.

Text Book:

1. Business Analysis by James Cadle et al. Project Management:
2. The Managerial Process by Erik Larson and, Clifford Gray
3. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
4. Business Analytics by James Evans, persons Education.

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Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2			
CO2	2	2	2			
CO3	2	2	2			
CO4	2	2	2			
CO5	2	2	2			

(Levels of Correlation, viz., 1.Low, 2.Moderate, 3.High Year: II

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Semester: I Branch of Study: Common to all

Subject Code	Subject Name	L	T	P	Credits
22DOE9001	Industrial Safety	3	0	0	3

Course Outcomes:

CO1 Analyze the basics of industrial safety.
CO2 Understand the Fundamentals of maintenance engineering
CO3 Apply the methods of prevention of corrosion and wear.
CO4 Understand the Fault tracing and their applications.
CO5 Understand the methods of preventive measures and maintenance

UNIT I

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

UNIT II

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, (i). Screw down grease cup, (ii). Pressure grease gun, (iii). Splash lubrication, (iv). Gravity lubrication, (v). Wick feed lubrication (vi). Side feed lubrication, (vii). Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, (i). Any one machine tool, (ii). Pump (iii). Air compressor, (iv). Internal combustion engine, (v). Boiler, (vi). Electrical motors, Types of faults in machine tools and their general causes.

UNIT V

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of

electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: (i). Machine tools, (ii). Pumps, (iii). Air compressors, (iv). Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winter korn, Hans, Chapman & Hall London

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	3		
CO2	3		
CO3		2	
CO4	3		
CO5		2	

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Year: II **Semester: I** **Branch of Study: Common to all**

Subject Code	Subject Name	L	T	P	Credits
22DOE9002	Operations Research	3	0	0	3

Course Outcomes:

CO1 Understand the characteristics and phases, types of models, allocation in linear programming

CO2 Apply the concept of optimal solution, unbalanced problem, degeneracy and Transportation problem & sequencing.

CO3 Understand the concept of replacement of items and related problems, theory of games related problems

CO4 Apply the concept of the knowledge of queuing models, inventory management models.

CO5 Apply the knowledge of dynamic programming, the concept of the simulation and simulation languages.

UNIT I

Optimization Techniques, Model Formulation, models, General LP Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

UNIT II

Formulation of a LPP - Graphical solution revised simplex method - duality theory – dual simplex method - sensitivity analysis - parametric programming.

UNIT III

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

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	PO1	PO2	PO3
CO1	2		
CO2		3	
CO3	2		
CO4		2	
CO5		2	

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Year: II **Semester: I** **Branch of Study: Other than PEED**

Subject Code	Subject Name	L	T	P	Credits
22DOE9003	Composite Materials	3	0	0	3

Course Outcomes:

CO1 Understanding of basic concepts and characteristics of geometric and physical applications of composites.

CO2 Explain different reinforcements and their properties.

CO3 Study of micromechanics and properties of composite material.

CO4 Study of coordinate transformations of stress and strain laws.

CO5 Study of elastic behaviour of unidirectional composites; Joining Methods and Failure Theories

UNIT I

Introduction: Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials,

Reinforcements: Fibres- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT II

Manufacturing methods : Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical.

Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester, etc.

UNIT III

Micromechanics: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.

Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

UNIT IV

Coordinate transformations: Hook's law for different types of materials, Hook's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off - axis, stiffness modulus, off - axis compliance.

UNIT V

Elastic behavior of unidirectional composites: Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations

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Joining Methods and Failure Theories: Joining –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures.

Text Books:

1. Chawla, Krishan K, Composite Materials Science and Engineering, Springer, 3rd Edition 2012.
2. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.

References:

1. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.
3. Engineering Mechanics of Composite Materials by Isaac and M.Daniel, Oxford University Press, 1994

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3
CO1	3		
CO2	2		
CO3		2	
CO4	3		
CO5	3		

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M. Tech – IV Semester

S.No	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
PROJECT										
1	PR	22DPR9004	Dissertation Phase – II	0	0	32	16	100	100	200
TOTAL							**16**	**100**	**100**	**200**