JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech in ENGINEERING DESIGN.
Effective from Academic Year 2017- 18 admitted batch

COURSE STRUCTURE AND SYLLABUS

I Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-1	Advanced Mechanics of Solids	25	75	4	0	0	4
PC-2	Advanced Mechanics of Machinery	25	75	4	0	0	4
PC-3	Vibration Analysis of Mechanical Systems	25	75	4	0	0	4
PE-1	1. Computer Simulation of Machines 2. Design Optimization 3. Theory of Elasticity	25	75	**3**	0	0	3
PE-2	1. Advanced Mechanics of Composite Materials 2. Mechanics of Metal Forming 3. Design for Manufacturing & Assembly	25	75	**3**	0	0	3
OE-1	***Open Elective - I**	25	75	3	0	0	3
Laboratory I	Kinematics & Dynamics Lab	25	75	0	0	3	2
Seminar I	Seminar - I	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

II Semester

Category	Course Title	Int. marks	Ext. marks	L	T	P	C
PC-4	Experimental Stress Analysis	25	75	4	0	1	4
PC-5	Advanced Finite Element Methods	25	75	4	0	1	4
PC-6	Mechanical Behavior of Engineering Materials	25	75	4	0	1	4
PE-3	1. Industrial Robotics 2. Engineering Design 3. Fuzzy logic & Neural Networks	25	75	**3**	0	0	3
PE4	1. Vehicle Dynamics 2. Design and Analysis of Experiments 3. Structural Health monitoring	25	75	**3**	0	0	3
OE-2	***Open Elective - II**	25	75	3	0	0	3
Laboratory II	Computer Aided Testing , Analysis & Modelling Lab	25	75	0	0	3	2
Seminar II	Seminar - II	100	0	0	0	3	2
Total		**275**	**525**	**21**	**0**	**6**	**25**

III Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Technical Paper Writing	100	0	0	3	0	2
Comprehensive Viva-Voce	0	100	0	0	0	4
Project work Review I	100	0	0	0	22	8
Total	**200**	**100**	0	**3**	22	**14**

IV Semester

Course Title	Int. marks	Ext. marks	L	T	P	C
Project work Review II	100	0	0	0	24	8
Project Evaluation (Viva-Voce)	0	200	0	0	0	16
Total	**100**	**200**	**0**	**0**	**24**	**24**

***Open Elective subjects must be chosen from the list of open electives offered by OTHER departments.**

 # For Project review I, please refer 7.10 in R17 Academic Regulations.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech I Year – II Sem.(Engineering Design)

EXPERIMENTAL STRESS ANALYSIS (PC - 4)

UNIT - I

Introduction**,** Theory of Elasticity, Plane stress and plane strain conditions, compatibility conditions, problem using plane stress and plane strain conditions, three-dimensional stress strain relations.
Strain measurement methods: various types of strain gauges, electrical resistance strain gauges, semiconductor strain gauge circuits.

UNIT- II

Recording Instruments: Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.

UNIT - III

Brittle Coatings: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.
Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometarical approach to moiré-fringe analysis, the displacement field approach to Moire-fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of moiré-fringes, experimental procedure and techniques.

UNIT - IV

Photo Elasticity: Photo elasticity, polariscope, plane and circularly polarized light, bright and dark filed setup, photo elasticity materials,, Isochromatic fringes – Isoclinics.

UNIT - V

Three Dimensional Photo Elasticity: introduction, locking in model deformation, materials for three dimensional photo elasticity, machining cementing and slicing three dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions, applications of the Frozen-stress method, the scattered-light method
Birefringent coating: Introduction, coating stress and stains, coating sensitivity, coating materials, application of coatings, effective of coating thickness, fringe-order determinations in coatings, stress separation methods.

REFERENCES:

1. Theory of elasticity / Timoshenko and Goodier Jr.
2. Experimental Stress analysis/ Dally and Riley, Mc Graw-Hill
3. A treatise on Mathematical theory of elasticity / LOVE A.H./ Dover Publications
4. Photo Elasticity / Frocht/ Wiley / 3rd Edition
5. Experimental Stress Analysis / Sadhu singh / Khanna Publications.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech I Year – II Sem. (Engineering Design)

ADVANCED FINITE ELEMENT METHODS (PC - 5)

UNIT- I:
Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variational approach, Glerkin's Methods. Co-ordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain- displacement relations.

UNIT- II:
1-D Structural Problems: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.
Analysis of Trusses : Plane Trusses and Space Truss elements and problems
Analysis of Beams : Hermite shape functions – stiffness matrix – Load vector – Problems.

UNIT- III:
2-D Problems: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration.
Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.
3-D Problems: Tetrahedran element – Jacobian matrix – Stiffness matrix.

UNIT- IV:
Scalar Field Problems: 1-D Heat conduction-Slabs – fins - 2-D heat conduction problems – Introduction to Torsional problems.

UNIT- V:
Dynamic considerations, Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.

REFERENCES:

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.
2. Finite Element Methods: Basic Concepts and applications, Alavala, PHI
3. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall
4. Finite Element Method – Zienkiewicz / Mc Graw Hill
5. Introduction to Fininte element analysis- S.Md. Jalaludeen, Anuradha Publications, print-2012
6. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition
7. Finite Element Method – Krishna Murthy / TMH
8. Finite Element Analysis – Bathe / PHI

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech I Year – II Sem. (Engineering Design)

MECHANICAL BEHAVIOUR OF ENGINEERING MATERIALS (PC - 6)

UNIT- I

Introduction: Fracture behavior of metals and alloys. The ductile/brittle transition temperatures for notched and un-notched components, Ductile rupture as a failure mechanism Fracture at elevated temperature.

Definitions of types of fracture and failure, Introduction to stress intensity factor and strain energy release rate, Equivalence of energy approach and stress intensity approach.

Stress Intensity Factor and its use in Fracture Mechanics: Early concepts of stress concentrators and flaws, Ingles solution to stress round an elliptical hole-implications of results. Stress intensity factor for a crack. Westergaard's solution for crack tip stresses. Stresses and displacement in Cartesian and polar coordinates,

UNIT- II

Linear Elastic Fracture Mechanics (LEFM): Three loading modes and the state of stress ahead of the crack tip, stress concentration factor, strain energy release rate, fracture energy, R. Modification for ductile materials, loading conditions. Stress intensity factor and the material parameter, the critical stress intensity factor.

UNIT- III

Elastic/Plastic Fracture Mechanics: The crack opening displacement and J-integral approaches, R-curve analysis Testing procedures, Measurement of these parameters, RAD, Fail sage and safe life design approaches, Practical applications. Advanced topics in EOFM.

UNIT- IV

Fatigue: definition of terms used to describe fatigue cycles, High Cycle Fatigue, Low Cycle Fatigue, Fatigue of Welded structures: Factors effecting the fatigue lives of welded joints. 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, Creep integrals, Examples.

REFERENCE:

1. Mechanical Metallurgy / Dieter / McGraw Hill
2. Fracture Mechanics: Fundamental and Applications /Anderson T.L & Boca Raton/ CRC Press, Florida, 1998.
3. Deformation and Fracture mechanics of Engineering Materials / Richard W Hertz /Wiley
4. Plasticity for structural Engineers / W.F. Chen and D.J, Ha,
5. Engineering Fracture Mechanics/ D.R.J. Owen and A.J. Fawkes /Pincridge press, Swansea, U.K.
6. Fracture and fatigue control in structures/ S.T. Rolfe and J. M. Barsom/ Prentice Hall, Eglewood cliffs, N.J..
7. Fracture of brittle solids/ B. R. Lawn and T. R. Wilshaw/ Cambridge university press.

8. Plastic deformation of Metals/ R. W. K. Honeycombe/ 2nd edition, Edward Arnold
9. Elements of Fracture Mechanics/Prasanth Kumar/TMH
10. F. R. N. Nabarro, H.L. deVilliers, The Physics of Creep, Taylor and Francis, (1995)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech I Year – II Sem. (Engineering Design)

INDUSTRIAL ROBOTICS (PE - 3)

UNIT - I:
Introduction: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.
Control System and Components: basic concept and modals controllers control system analysis, robot actuators and feedback components (sensors): Internal & External Sensors, Positions sensors, velocity sensors - Desirable features, tactile, proximity and range sensors, uses sensors in robotics , Power Transmission Systems.

UNIT - II:
Motion Analysis and Control: Manipulator kinematics, position representation Homogeneous transformation, D-H Notation, D-H Transformation Matrix, Forward & Inverse transformations, problems on planar & spatial manipulators, Differential Kinematics, Jacobian Formulation, problems, manipulator path control: Slew, Joint Interpolated & Straight line motions, trajectory planning: Joint space scheme, Cartesian space scheme, Cubic Polynomial fit without and with via point, blending.

UNIT - III:
Robot Dynamics: Lagrange – Euler & Newton Euler formulations, problems on two link planar manipulators, configuration of robot controller.
End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.
Machine Vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, Image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT - IV:
Robot Programming: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINGNAL AND DELAY commands, Branching capabilities and Limitations.
Robot Languages: Textual robot languages, Generation, Robot language structures, Elements and functions.

UNIT - V:
Robot Cell Design and Control: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work cell design, Work cell control, Inter locks, Error detection, Work cell controller.
Robot Applications: Material transfer, Machine loading/unloading. Processing operations, Assembly and Inspection, Future Applications.

REFERENCE BOOKS:

1. Introduction to Robotics Mechanics & Control/ John J.Craig/Pearson
2. Industrial robotics / Mikell P. Groover / McGraw Hill.
3. Modelling & Ctrl of Robot Manipulators/L. Sciavicco & B. Siciliano/Springer
4. Robot Technology Fundamentals, James G. Keramas, CENGAGE
5. Robotics / K.S. Fu / McGraw Hill.
6. Robot Analysis/Lung Wen Tsai/John Wiley & Sons
7. Robotics & control/R K Mittal & I J Nagrath/ Tata McGraw Hill
8. Fundamentals of Robotics/Robert J. schilling/PHI
9. Robotics by saha/TMG
10. Robotic Engineering/ Richard D. Klafter, Thomas A. Chmielewski/PHI

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech I Year – II Sem.(Engineering Design)

ENGINEERING DESIGN (PE - 3)

UNIT - I

DESIGN PHILOSOPHY: Design process, Problem formation, Introduction to product design, Various design models-Shigley model, Asimov model and Norton model, Need analysis, Strength considerations -standardization. Creativity, Creative techniques, Material selections, Notches and stress concentration, design for safety and Reliability

UNIT – II

Embodiment & **Modelling**: introduction, size and strength, scheme drawing, form design, provisional materials and process determination, design for assembly and manufacture, industrial design, principles. Mathematical modelling, optimization, scale models, simulation, principles.

UNIT - III

Economic Factors Influencing Design: Economic analysis, Break-even analysis, Human engineering considerations, Ergonomics, Design of controls, Design of displays. Value engineering, Material and process selection in value engineering, Modern approaches in design.

UNIT - IV

Failure Theories: Static failure theories, Distortion energy theory, Maximum shear stress theory, Coulomb-Mohr's theory, Modified Mohr's theory, Fracture mechanics theory., Fatigue mechanisms, Fatigue failure models, Design for fatigue strength and life, creep: Types of stress variation, design for fluctuating stresses, design for limited cycles, multiple stress cycles, Fatigue failure theories ,cumulative fatigue damage, thermal fatigue and shock, harmful and beneficial residual stresses, Yielding and transformation

UNIT - V

Surface Failures: Surface geometry, mating surfaces, oil film and their effects, design values and procedures, adhesive wear, abrasive wear, corrosion wear, surface fatigue, different contacts, dynamic contact stresses, surface fatigue failures, surface fatigue strength, Problem formulation for design optimization

Detail design: introduction**,** factor of safety, selection procedure for bought out components, Robust design, principles

REFERENCES:

1. Engineering Design / George E Dieter / McGraw Hill /2008
2. Engineering design principles/ Ken hurst/ Elsevier
3. Machine Design An Integrated Approach / Robert L. Norton / Prentice-Hall New Jersey, USA.
4. Engineering design process/ Yusef Haik, Tamer M.Shahin/ cengage learning.
5. Engineering by design/ Gerard Voland / pearson
6. Engineering design/ G.Pahl, W. Beitz,J, Feldhusen, K.H. grote/ springer international edition
7. Mechanical design/ Manjula B Waldron, Kenneth J. Waldron/ springer international edition
8. Product Design and Manufacturing /A.K. Chitale and R.C. Gupta / Prentice Hall

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech I Year – II Sem. (Engineering Design)

FUZZY LOGIC & NEURAL NETWORKS (PE - 3)

UNIT- I

Fuzzy Set Theory and Fuzzy Logic Control:

Basic concepts of fuzzy sets- Operations on fuzzy sets- Fuzzy relation equations- Fuzzy logic control- Fuzzification –Defuzzificatiuon- Knowledge base- Decision making logic- Membership functions – Rule base.

UNIT- II

Adaptive Fuzzy Systems:

Performance index- Modification of rule base0- Modification of membership functions- Simultaneous modification of rule base and membership functions- Genetic algorithms-Adaptive fuzzy system- Neuro fuzzy systems.

UNIT- III

Artificial Neural Networks:

Introduction- History of neural networks- multilayer perceptions- Back propagation algorithm and its Variants- Different types of learning, examples.

UNIT- IV

Mapping and Recurrent Net works:

Counter propagation –Self organization Map- Congnitron and Neocognitron- Hopfield Net- Kohonnen Nets- Grossberg Nets- Art-I, Art-II reinforcement learning

UNIT- V

Case Studies:

Application of fuzzy logic and neural networks to Measurement- Control- Adaptive Neural Controllers – Signal Processing and Image Processing

TEXT BOOK:

1. Vallum B. R And Hayagriva V.R C++, Neural networks and Fuzzy logic, BPB Publications, New Delhi, 1996

REFERENCE BOOKS:

1. Fuzzy logic &Neural Networks/ Chennakesava R. Alavala/ New Age International, 2008
2. Neural Networks for control, Millon W. T, Sutton R.S and Werbos P.J, MIT Press 1992
3. Fuzzy sets Fuzzy logic, Klir, G.J anfd Yuan B.B Prentice Hall of India Pvt. Ltd.,, New Delhi
4. Neural Networks and Fuzzy systems, Kosko.. Prentice hall of India Pvt. Ltd.,, New Delhi 1994
5. Introduction to Fuzzy control, Dirankov D. Hellendoorn H, Reinfrank M., Narosa Publications House, New Delhi 1996
6. Introduction to Artificial Neural systems, Zurada J. M Jaico Publishing House, New Delhi 1994

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech I Year – II Sem.(Engineering Design)

VEHICLE DYNAMICS (PE - 4)

UNIT - I:

Introduction: Fundamental Principles, Vehicle tires performance, cornering characteristics, Mechanics of Vehicle Terrain interaction. Vehicle Kinematics, Fundamental principles of velocity, acceleration. Two dimensional mechanisms, Forward Vehicle Dynamics.

UNIT - II:

Three dimensional Mechanisms, Multi-Body Systems Design, Introduction to 3D vehicle design.

UNIT III:

Suspension Design: Computer models using Bond Graph Technology, Drive train dynamics, vehicle performance

UNIT - IV:

Steering Mechanisms: Two and three dimensional analysis, Mechanics of Vehicle Terrain interaction. Vehicle Collations, Fundamental laws of motion, energy and momentum, Forces and Moments 2D and 3D. The Dynamics of vehicle rollovers.

UNIT - V:

Wheeled Vehicle Handling – Handling control loop, vehicle transfer function, Kinematic behavior of vehicles with rigid wheels and with complaint tyres: Neutral steer point, static margin, over and under-steer. Solution with two degree of freedom in the steady state: Stability factor, characteristic and critical speeds. Tracked Vehicle Handling – Analysis of sprocket torques and speeds, required to skid steer a tracked vehicle. Extension of theory to include three degrees of freedom.

REFERENCES:

1. Vehicle Dynamics: Theory and Application/Reza Jazar/Springer 2008
2. Theory of Ground Vehicles/ J.Y.Wong/ John Wiley.
3. Vehicle stability/ Dean Karnopp/ Dekker Mechanical Engineering
4. Modeling & Simulation of Mechatronics Systems/ Karnoop Margolis, Rosenberg, /Wiley/ 2007.
5. Suspension and Tyres / Giles J.G. Steering/ Illiffe Books Ltd., London.
6. Fundamental of Vehicle Dynamics/ Gillespie/ T.D, SAE USA.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech I Year – II Sem. (Engineering Design)

DESIGN AND ANALYSIS OF EXPERIMENTS (PE - 4)

UNIT - I:
Fundamentals of Experimentation: Role of experimentation in rapid scientific progress, historical perspective of experimental approaches , Steps in experimentation, principles of experimentation

UNIT - II:
Simple comparative experiments: Basic concepts of probability & statistics, comparison of two means and two variances, comparison of multiple (more than two) means and ANOVA

UNIT- III:
Experimental designs: Factorial designs, fractional factorial designs, orthogonal arrays, standard orthogonal arrays and interaction tables, modifying orthogonal arrays, selection of suitable orthogonal array design, analysis of experimental data

UNIT- IV:
Response surface methodology: Concept, linear model, steepest ascent, second order model, regression.

UNIT - V:
Taguchi's Parameter Design: Concept of robustness, noise factor, objective function & S/N ratios, inner array& outer array design, data analysis

REFERENCE BOOKS:

1. Montgomery DC, Design and Analysis of Experiments, 7th Edition, John Wiley & Sons, NY, 2008.
2. Ross P J , Taguchi techniques for Quality Engineering, McGraw-Hill Book Company, NY, 2008

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M. Tech I Year – II Sem.(Engineering Design)

STRUCTURAL HEALTH MONITORING (PE - 4)

UNIT-I:
Introduction: Definition, Principles, significance of SHM, potential applications in civil, naval, aerospace & manufacturing Engineering

UNIT- II:
Operational Evaluation: Sensor technology, piezoelectric wafer active sensors, data acquisition and cleaning procedures, elastic waves in solid structures, guided waves

UNIT-III:
Feature Extraction methods: Identifying damage sensitive properties , signal processing, Fourier and short term Fourier transform, wavelet analysis

UNIT-IV:
Pattern Recognition: State-of-Art damage identification and pattern reorganization methods, neural networks, Feature extraction algorithms

UNIT-V:
Case studies: SHM based flaw detection in mechanical structures- Integrity and damage recognition in plates and pipes, defect identification in weld joints, Wear monitoring in cutting tools

REFERENCE BOOKS:

1. Daniel Balageas, Claus-Peter Fritzen and Alfredo Guemes, Structural Health Monitoring, John Wiley & Sons, 2006.
2. Victor Giurgiutiu, Structural Health Monitoring with Piezoelectric wafer Active Sensors, Academic Press, 2008.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech I Year – II Sem. (Engineering Design)

COMPUTER AIDED TESTING, ANALYSIS AND MODELLING LAB

TESTING

1. Preparation and study of the Micro Structure of ferrous metals and alloys.
2. Preparation and study of the Microstructure of nonferrous metals and alloys.
3. Effect of tempering time on the hardness of quenched carbon steels.
4. Effect of tempering temperature on the hardness of a hardened carbon steels.
5. Preparation of metallic specimens by electro polishing.
6. Study of work hardening characteristics of a pure metal.
7. Determination of carbon percentage in the given ferrous specimen.

MODELING

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

ANALYSIS OF STRUCTURES USING FEA PACKAGES

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