

Academic Regulations-M.Tech. 2009-10



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
**Academic Regulations For The Award Of Full Time M.Tech. P.G. Degree**  
**(WITH EFFECT FROM THE ACADEMIC YEAR 2009-10)**

The Jawaharlal Nehru Technological University Anantapur shall confer M.Tech. Post Graduate degree to candidates who are admitted to the Master of Technology Programs and fulfill all the requirements for the award of the degree.

**1.0 ELIGIBILITY FOR ADMISSIONS:**

Admission to the above programme shall be made subject to the eligibility, qualifications and specialization prescribed by the University for each programme, from time to time.

Admissions shall be made either on the basis of merit rank obtained by the qualified candidates at an Entrance Test conducted by the University or on the basis of GATE / PGECET score, subject to reservations prescribed by the University or Government policies from time to time.

**2.0 COURSE WORK:**

- 2.1 A Candidate after securing admission must pursue the M.Tech. course of study for Four semesters duration.
- 2.2 Each semester shall be of 20 weeks duration including all examinations.
- 2.3 A candidate admitted to a programme should complete it within a period equal to twice the prescribed duration of the programme from the date of admission.

**3.0 ATTENDANCE:**

- 3.1 A candidate shall be deemed to have eligibility to write end semester examinations if he has put in at least 75% of attendance on cumulative basis of all subjects/courses in the semester.
- 3.2 Condonation of shortage of attendance up to 10% i.e., from 65% and above and less than 75% may be given by the college on the recommendation of the Principal.
- 3.3 Condonation of shortage of attendance shall be granted only on genuine and valid reasons on representation by the candidate with supporting evidence.
- 3.4 If the candidate does not satisfy the attendance requirement he is detained for want of attendance and shall reregister for that semester. He / she shall not be promoted to the next semester.

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#### **4.0. EVALUATION:**

The performance of the candidate in each semester shall be evaluated subject wise, with a maximum of 100 marks for Theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.

- 4.1 For the theory subjects 60% of the marks will be for the External End Examination. While 40% of the marks will be for Internal Evaluation, based on the better of the marks secured in the two Mid Term-Examinations held, one in the middle of the Semester (I-IV units) and another immediately after the completion of instruction (V-VIII) units with Three questions to be answered out of four in 2hours, evaluated\* for 40 marks.

\*Note: All the Questions shall be of equal weightage of 10 marks and the marks obtained for 3questions shall be extrapolated to 40 marks, any fraction rounded off to the next higher mark

- 4.2 For practical subjects, 60 marks shall be for the End Semester Examinations and 40 marks will be for internal evaluation based on the day to day performance.
- 4.3 For Seminar there will be an internal evaluation of 50 marks. A candidate has to secure a minimum of 50% to be declared successful. The assessment will be made by a board consisting of HOD and two internal experts at the end of IV semester instruction.
- 4.4 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.
- 4.5 In case the candidate does not secure the minimum academic requirement in any of the subjects (as specified in 4.4.) he has to reappear for the Semester Examination either supplementary or regular in that subject, or repeat the course when next offered or do any other specified subject as may be required.

#### **5.0 RE-REGISTRATION FOR IMPROVEMENT OF INTERNAL EVALUATION MARKS:**

Following are the conditions to avail the benefit of improvement of internal evaluation marks.

- 5.1 The candidate should have completed the course work and obtained examinations results for I & II semesters.
- 5.2 He should have passed all the subjects for which the Internal evaluation marks secured are more than 50%.
- 5.3 Out of the subjects the candidate has failed in the examination due to Internal evaluation marks secured being less than 50%, the candidate shall be given one chance for each Theory subject and for a maximum of **three** Theory subjects for Improvement of Internal evaluation marks.
- 5.4 The candidate has to re-register for the chosen subjects and fulfill the academic requirements.
- 5.5 For each subject, the candidate has to pay a fee equivalent to one third of the semester tuition fee and the amount is to be remitted in the form of D.D. in favour of the

Registrar, JNTUA payable at Anantapur along with the requisition through the Principal of the respective college.

- 5.6 In the event of availing the Improvement of Internal evaluation marks, the internal evaluation marks as well as the End Examinations marks secured in the previous attempt(s) for the reregistered subjects stand cancelled.

## 6.0 EVALUATION OF PROJECT WORK:

Every candidate shall be required to submit thesis or dissertation after taking up a topic approved by the college/ institute.

- 6.1 Registration of Project work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses (theory and practical courses of I & II Sem)
- 6.2 An Internal Departmental Committee (I.D.C) consisting of HOD, Supervisor and one internal senior expert shall monitor the progress of the project work.
- 6.3 The work on the project shall be initiated in the penultimate semester and continued in the final semester. The duration of the project is for two semesters. The candidate can submit Project thesis with the approval of I.D.C. after 36 weeks from the date of registration at the earliest and one calendar year from the date of registration for the project work. Extension of time within the total permissible limit for completing the programme is to be obtained from the Head of the Institution.
- 6.4 The student must submit status report at least in three different phases during the project work period. These reports must be approved by the I.D.C before submission of the Project Report.
- 6.5 A candidate shall be allowed to submit the thesis / dissertation only after passing in all the prescribed subjects (both theory and practical) and then take viva voce examination of the project. The viva-voce examination may be conducted once in two months for all the candidates submitted during that period.
- 6.6 Three copies of the Thesis / Dissertation certified in the prescribed form by the supervisor & HOD shall be presented to the H.OD. One copy is to be forwarded to the University and one copy to be sent to the examiner.
- 6.7 The college shall submit a panel of three experts for a maximum of 5 students at a time. However, the thesis / dissertation will be adjudicated by one examiner nominated by the University.
- 6.8 If the report of the examiner is favorable viva-voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the thesis / dissertation. The board shall jointly report candidates work as:
 

1.	Very Good	Grade A
2.	Good	Grade B
3.	Satisfactory	Grade C
4.	Not satisfactory	Grade D

If the report of the viva-voce is not satisfactory (Grade D) the candidate will retake the viva-voce examination after three months. If he fails to get a satisfactory report at the second viva-voce examination he will not be eligible for the award of the degree unless the candidate is permitted to revise and resubmit the thesis.

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### **7.0 AWARD OF DEGREE AND CLASS:**

A candidate shall be eligible for the award of respective degree if he satisfies the minimum academic requirements in every subject and secures 'satisfactory' or higher grade report on his thesis/dissertation and viva-voce. Based on overall percentage of marks obtained, the following class is awarded.

First class with Distinction:	70% or more
First class	below 70% but not less than 60%
Second class	below 60% but not less than 50%

### **8.0 WITH – HOLDING OF RESULTS:**

If the candidate has not paid dues to the university or if any case of in-discipline is pending against him, the result of the candidate shall be withheld and he will not be allowed/ promoted into the next higher semester. The issue of degree is liable to be withheld in such cases.

### **9.0 TRANSITORY REGULATIONS:**

Candidates who have discontinued or have been detained for want of attendance or who have failed after having undergone the course in earlier regulations and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, subject to 4.5 and 2.3 sections. Whereas they continue to be in the academic regulations they were first admitted.

### **10.0 GENERAL:**

- i. The academic regulations should be read as a whole for purpose of any interpretation.
- ii. Disciplinary action for Malpractice / improper conduct in examinations is appended.
- iii. There shall be no places transfer within the constituent colleges and affiliated colleges of Jawaharlal Nehru Technological University Anantapur.
- iv. Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".
- v. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.
- vi. The University may change or amend the academic regulations or syllabi at any time and the changes or amendments shall be made applicable to all the students on rolls with effect from the dates notified by the University.

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### RULES FOR DISCIPLINARY ACTION FOR MALPRACTICE / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	Punishment
	<i>If the candidate</i>	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.

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4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
6.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.

7.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor is an outsider, he will be handed over to the police and a case is registered against him.
8.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

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9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.  Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
  - (i) A show cause notice shall be issued to the college.
  - (ii) Impose a suitable fine on the college.
  - (iii) Shifting the examination centre from the college to another college for a specific period of not less than one year.



**2009-10****JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**Course Structure and syllabus for  
M.Tech. Machine Design  
for affiliated Engineering Colleges 2009-10**

**I YEAR I SEMESTER**

S. No	Course code	Subject	Theory	Lab.	Credits
1.	9DBS101	Computational Methods	4		4
2.	9D15102	Advanced Mechanisms	4		4
3.	9D15103	Advanced Mechanics of Solids	4		4
4.	9D15104	Fracture, Fatigue & Creep deformation	4		4
5.	9D15105	Materials Technology	4		4
6.		<b>Elective – I</b>	4		4
	9D15106a	a Triobology			
	9D15106b	b Gear Engineering			
	9D15106c	c Non Destructive Evaluation			
7.	9D15107	Simulation Lab		3	2
		contact periods/week	24	3	26
			Total 27		

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**I YEAR I SEMESTER**

S. No	Course code	Subject	Theory	Lab.	Credits
1.	9D04201	Advanced Optimization Techniques	4		4
2.	9D04202	Robotics	4		4
3.	9D15203	Mechanical Vibrations	4		4
4.	9D15204	Experimental Stress Analysis	4		4
5.	9D15205	Theory of Plasticity	4		4
6.		<b>Elective – II</b>	4		4
	9D15206a	a. Design for Manufacturing			
	9D15206b	b. Pressure Vessel Design			
	9D15206c	c. Mechanics of Composite Materials			
7.	9D15207	Machine Dynamics Lab		3	2
		Contact periods/week	24	3	26
			Total 27		

**II YEAR (III & IV Semesters)**

S. No	Course code	Subject		credits
1	9D15401	Seminar		2
2	9D15402	Project work		16

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## (9DBS101) COMPUTATIONAL METHODS

**Unit – I**

**Introduction to numerical methods applied to engineering problems:** Examples, solving sets of equations – Matrix notation – Determinants and inversion – Iterative methods – Relaxation methods – System of non-linear equations – computer programs

**Unit – II**

**Numerical integration:** Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration

**Unit – III****Optimization:**

One dimensional unconstrained optimization, multidimensional unconstrained optimization – direct methods and gradient search methods, constrained optimization

**Unit – IV**

**Boundry value problems and charecteristic value problems:** Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayleigh – Ritz method – Characteristic value problems.

**Unit – V**

**Numerical solutions of partial differential equations:** Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non – rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method.

**Unit – VI**

**Parabolic partial differential equations:** Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

**Unit – VII**

**Hyperbolic partial differential equations:** Solving wave equation by finite differences-stability of numerical method –method of characteristics-wave equation in two space dimensions-computer programs.

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## Unit – VIII

**Curve fitting and approximation of functions:** Least square approximation fitting of non-linear curves by least squares –regression analysis- multiple linear regression, non linear regression - computer programs.

## TEXT BOOKS:

1. Steven C.Chapra, Raymond P.Canale “Numerical Methods for Engineers” Tata Mc-Graw hill
2. Curtis F.Gerald, partick.O.Wheatly,”Applied numerical analysis”Addison-wesley,1989
3. Douglas J..Faires,Riched Burden”Numerical methods”Brooks/cole publishing company,1998.Second edition.

## REFERENCES:

1. 1.Ward cheney &David Kincaid “Numerical mathematics and computing”Brooks/cole publishing company1999,fourth edition.
2. 2.Riley K.F.M.P.Hobson&Bence S.J,”mathematical methods for physics and engineering”Cambridge university press,1999.

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### (9D15102) ADVANCED MECHANISMS

## 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  $d_i$  ; Bobillier’s Construction ;Collineation 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; Hall’s Equation; Polode curvature in the four bar mechanism; coupler motion; relative motion of the output and input links; etermination 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 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 Rotocenter 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.

## Unit – VI

**Introduction to Synthesis - Analytical Methods:** Function Generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation; Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition; Method of components; Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link; Method of components.

## Unit – VII

**Manipulator kinematics – I:** D-H notation, D-H convention of assignment of co-ordinate frames and link parameters table;D-H transformation matrix ; Direct and Inverse kinematic analysis of Serial manipulators: Articulated ,spherical & industrial robot manipulators- PUMA, SCARA,STANFORD ARM, MICROBOT.

## Unit – VIII

**Manipulator kinematics – II:** Differential kinematics Formulation of Jacobian for planar serial manipulators and spherical manipulator; Singularity analysis.

## 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. E.W.P.Publishers.

## REFERENCES:

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.
3. Mohsen Shahinpoor, A Robot Engineering Text book,Harper & Row Publishers, New York,1987.
4. Joseph Duffy, Analysis of mechanisms and Robot manipulators, Edward Arnold,1980

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**M.Tech. I SEMESTER (M/c.Des.)**

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**(9D15103) ADVANCED MECHANICS OF SOLIDS**

**Unit I-Shear center:** Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections

**Unit II-Unsymmetrical bending:** Bending stresses in Beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending.

**Unit III-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.

**Unit IV-Torsion :** Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section ;Hollow thin wall torsion members ,Multiply connected Cross Section.

**Unit V-Contact stresses:** Introduction; problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact, Normal and Tangent to contact area.

**Unit VI-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.

**Unit VII-Two Dimensional Elasticity Problems:** in polar co-ordinators, general equations in polar coordinates, stress distribution symmetrical about an axis, pure bending of curved bars, displacements for symmetrical stress distributions, rotating discs.

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

**TEXTBOOKS:**

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

**REFERENCES:**

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

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## (9D15104) FRACTURE, FATIGUE &amp; CREEP DEFORMATION

## 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 unnotched components. Fracture at elevated temperature.

## UNIT-II

**Griffiths analysis:** Concept of energy release rate,  $G$ , and fracture energy,  $R$ . Modification for ductile materials, loading conditions. Concept of  $R$  curves.

## UNIT-III

**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-IV

**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.

## UNIT-V

**Elastic-Plastic Fracture Mechanics; (EPFM).** The definition of alternative failure prediction parameters, Crack Tip Opening Displacement, and the  $J$  integral. Measurement of parameters and examples of use.

## UNIT-VI

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

## UNIT-VII

**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 Miner's rule. Micromechanisms 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.

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## UNIT-VIII

**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, (1995)
2. B. Lawn, Fracture of Brittle Solids, Cambridge Solid State Science Series 2nd ed 1993.
3. J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths (1973)
4. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials.
5. H.L. Ewald and R.J.H. Wanhill Fracture Mechanics, Edward Arnold, (1984).
6. S. Suresh, Fatigue of Materials, Cambridge University Press, (1998)
7. L.B. Freund and S. Suresh, Thin Film Materials Cambridge University Press, (2003).
8. G. E. Dieter, Mechanical Metallurgy, McGraw Hill, (1988)
9. D.C. Stouffer and L.T. Dame, Inelastic Deformation of Metals, Wiley (1996)
10. F.R.N. Nabarro, H.L. de Villiers, The Physics of Creep, Taylor and Francis, (1995)

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

**M.Tech. I SEMESTER (M/c.Des.)**

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### (9D15105) MATERIALS TECHNOLOGY

**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.

**Unit – II**-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 – III**-Motivation of selection, cost basis and service requirements, selection for mechanical properties, strength, toughness, fatigue and creep.

**Unit – IV**-Modern metallic Materials: Dual phase steels, micro alloyed, high strength low alloy (HSLA) Steel, transformation induced plasticity (TRIP) Steel, maraging steel, intermetallics, Ni and Ti aluminides

**Unit – V**-Smart materials, shape memory alloys, metallic glass, quasi crystal and nano crystalline materials.



**Unit – VI-Non metallic materials:** Polymeric materials and their molecular structures, production techniques for fibers, foams, adhesives and coatings, structure, properties and applications of engineering polymers.

**Unit – VII-Advanced structural ceramics** WC, TiC, TaC, Al<sub>2</sub>O<sub>3</sub>, SiC, Si<sub>3</sub>N<sub>4</sub>, CBN and diamond-properties, processing and applications.

**Unit – VIII-Advance structural composites;** Introduction, reinforcement, types of composite materials, - properties, processing and application, and mechanics of composite materials.

#### TEXT BOOKS:

1. Mechanical behavior of materials/Thomas H.Courtney/2<sup>nd</sup> Edition, McGraw-Hill, 2000
2. Mechanical Metallurgy/George E.Dieter/McGraw Hill, 1998

#### REFERENCES:

1. Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann.

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#### **Elective-I** **(9D15106a) TRIBOLOGY**

#### **Unit – I**

**Introduction:** Nature of surfaces and contact-Surface topography-friction and wear mechanisms and effect of lubricants- methods of fluid film formation.

#### **Unit – II**

**Selection of rolling element bearings:** Nominal life, static and dynamic capacity-Equivalent load, probabilities of survival- cubic mean load- bearing mounting details, pre loading of bearings, conditioning monitoring using shock pulse method.

#### **Unit – III**

**Hydrodynamic bearings:** Fundamentals of fluid formation – Reynold's equation; Hydrodynamic journal bearings – Sommerfield number- performance parameters – optimum bearing with maximum load capacity – Friction – Heat generated and Heat dissipated. Hydrodynamic thrust bearings; Raimondi and Boyd solution for hydrodynamic thrust bearings- fixed tilting pads, single and multiple pad bearings-optimum condition with largest minimum film thickness.

#### **Unit – IV**

**Hydrostatic Bearings:** Thrust bearings – pad coefficients- restriction- optimum film thickness- journal bearings – design procedure –Aerostatic bearings; Thrust bearings and Journal bearings – design procedure.

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### **Unit – V**

**Dry rubbing Bearings:** porous metal bearings and oscillatory journal bearings – qualitative approach only.

### **Unit – VI**

**Lubrication:** Choice of lubricants, types of oil, Grease and solid lubricants- additives- lubrication systems and their selection – selection of pump, filters, piping design- oil changing and oil conservation.

### **Unit – VII**

**Seals:** different type-mechanical seals, lip seals, packed glands, soft piston seals, Mechanical piston rod packing, labyrinth seals and throttling bushes, oil flinger rings and drain grooves – selection of mechanical seals.

### **Unit – VIII**

**Failure of Tribological components:** Failure analysis of plain bearings, rolling bearings, gears and seals, wear analysis using soap and Ferrography.

### **Text Books:**

1. Rowe WW& O' Dionoghue,"Hydrostatic and Hybrid bearing design " Butterworths & Co.Publishers Ltd,1983.
2. Collacott R.A," Mechanical Fault diagnosis and condition monitoring", Chapman and Hall, London 1977.
3. Bernard J.Hamrock, " Fundamentals of fluid film lubricant", Mc Graw-Hill Co.,1994.

### **References:**

1. 1.Neale MJ, (Editor) " Tribology hand Book"Neumann Butterworths, 1975.
2. 2.Connor and Boyd JJO (Editors) " Standard hand book of lubrication engineers " ASLE,Mc Graw Hill Book & Co.,1968
3. Shigley J, E Charles," Mechanical Engineering Design", McGraw Hill Co., 1989

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**Elective-I**  
**(9D15106b) GEAR ENGINEERING**  
**(PSG Design data Book to be used and allowed in Examinations)**

**Unit – I**

Introduction: Principles of gear tooth action, Generation of Cycloid and Involute gears, Involutometry, gear manufacturing processes and inspection, gear tooth failure modes, stresses, selection of right kind of gears.

**Unit – II**

Spur Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of spur gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

**Unit – III**

Helical Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of helical gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

**Unit – IV**

Bevel Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of bevel gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Design of gear shaft and bearings.

**Unit – V**

Worm Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of worm gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load, Heat dissipation considerations. Design of gear shaft and bearings.

**Unit – VI**

Gear failures

Analysis of gear tooth failures, Nomenclature of gear tooth wear and failure, tooth breakage, pitting, scoring, wear, overloading, gear-casing problems, lubrication failures

**Unit – VII**

Gear trains: Simple, compound and epicyclic gear trains, Ray diagrams, Design of a gear box of an automobile, Design of gear trains from the propeller shafts of airplanes for auxiliary systems.

**Unit – VIII**

**Optimal Gear design:** Optimization of gear design parameters, Weight minimization, Constraints in gear train design-space, interference, strength, dynamic considerations, rigidity etc. Compact design of gear trains, multi objective optimization of gear trains. Application of Traditional and non-traditional optimization techniques

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**Text Books:**

1. Maleev and Hartman, Machine Design, C.B.S. Publishers, India.
2. Henry E.Meritt, Gear engineering, Wheeler publishing, Allahabad, 1992.
3. Practical Gear design by Darle W. Dudley, McGraw-Hill book company

**REFERENCES:**

1. Earle Buckingham, Analytical mechanics of gears, Dover publications, New York, 1949.
2. G.M.Maitha, Hand book of gear design, TaTa Mc.Graw Hill publishing company Ltd., New Delhi, 1994.

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**Elective-I**

**(9D15106c) NON - DESTRUCTIVE EVALUATION**

**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-Introduction to Ultrasonic Testing:** Generation of ultrasonic waves, Horizontal and shear waves, Near field and far field acoustic wave description, Ultrasonic probes- straight beam, direct contact type, Angle beam, Transmission/reflection type, and delay line transducers, acoustic coupling and media,

**Unit – V-Ultrasonic tests:** Transmission and pulse echo methods, A-scan, B-scan, C-scan, F-scan and P-scan modes, Flaw sizing in ultrasonic inspection: AVG, Amplitude, Transmission, TOFD, Satellite pulse, Multi-modal transducer, Zonal method using focused beam. Flow location methods, Signal processing in Ultrasonic NDT; Mimics, spurious echos and noise. Ultrasonic flaw evaluation.

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

**Unit – VII-Applications - I:** NDT in flaw analysis of Pressure vessels, piping

**Unit – VIII-Applications - II:** NDT in 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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**(9D15107) SIMULATION LABORATORY**

**I. Modeling**

- 1.Surface modeling
- 2.Solid modeling
- 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

**III. Thermal Analysis using any FEA Package** for different structures that can be discretised with 1-D,2-D & 3-D elements

1. Steady state thermal analysis
2. Transient thermal analysis

**IV. Transient analysis using any FEA Package** for different structures that can be discretised with 1-D,2-D & 3-D elements

1. Linear
2. Non-Linear (Geometrical Non-linearity)

**REFERENCES:**

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

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**(9D04201) ADVANCED OPTIMIZATION TECHNIQUES**

**UNIT - I**

**Linear programming:** Two-phase simplex method, Big-M method, duality, interpretation, applications.

**UNIT - II**

**Assignment problem:** Hungarian's algorithm, Degeneracy, applications, unbalanced problems, traveling salesman problem.

**UNIT - III**

**Classical optimization techniques:** Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints – method of Lagrange multipliers, Kuhn-Tucker conditions.

**UNIT - IV**

**Numerical methods for optimization:** Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, types of penalty methods for handling constraints.

**UNIT - V**

**Genetic algorithm (GA) :** Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

**UNIT - VI**

**Genetic Programming (GP):** Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

**UNIT – VII**

**Multi-Objective GA:** Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems .

**UNIT VIII**

**Applications of Optimization in Design and Manufacturing systems:** Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

**TEXT BOOKS:**

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
3. Engineering Optimization – S.S.Rao, New Age Publishers

**REFERENCES:**

1. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Genetic Programming- Koza
3. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

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**(9D04202) ROBOTICS**

**Unit – I-Fundamentals of Robots:** Introduction, definition of robot, classification of robots, History of robotics, robot components, degree of freedom, robot joints, robot coordinates, reference frames, programming modes, robot characteristics, robot work space, robot languages, advantages, disadvantages and applications of robots.

**Unit – II-Matrix transformations:** Introduction, robots as a mechanisms, matrix representation- representation of a point in a space, representation of a vector in space, representation of a frame at the origin of a reference frame, representation of a frame in a reference frame, representation of a rigid body.

Homogeneous transformation matrices, representation of a pure translation, pure rotation about an axis, representation of combined transformations, transformations relative to the rotating, inverse of transformation matrices.

**Unit – III-Robot kinematics:** Forward and inverse kinematics of robots-forward and inverse kinematic equations for position, forward and inverse kinematic equations for orientation, forward and inverse kinematic equations for position and orientation, Denavit-Hartenberg (D-H) representation of forward kinematic equations of robots, The inverse kinematic solution and programming of robots, Degeneracy and Dexterity, simple problems with D-H representation.

**Unit – IV-Differential motions and Velocities:** Introduction, differential relationship, Jacobian, differential motions of a frame-translations, rotation, rotating about a general axis, differential transformations of a frame. Differential changes between frames, differential motions of a robot and its hand frame, calculation of Jacobian, relation between Jacobian and the differential operator, Inverse Jacobian.

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**Unit – V-Dynamic analysis and forces:** Introduction, Lagrangian mechanics, Effective moments of inertia, dynamic equations for multi-degree of freedom robots-kinetic energy, potential energy, the Lagrangian, robot's equations of motion, static force analysis of robots.

**Unit – VI-Trajectory planning:** Introduction, path Vs trajectory, basics of trajectory planning, joint space trajectory planning-third order polynomial trajectory planning, fifth order polynomial trajectory planning, Cartesian-space trajectories.

**Unit – VII-Robot Actuators:** Introduction, characteristics of Actuating systems-weight, power to weight ratio, operating pressure, stiffness Vs compliance, comparison of actuating systems, hydraulic devices, pneumatic devices, Electric motors-DC motor, car motors, Brushless DC motors, direct Drive electric motors, servomotors, stepped motors.

**Unit – VIII-Robot sensors:** Introduction, sensor characteristics, Position sensors-potentiometers, encoders, LVDT, Resolvers, time of travel displacement sensor, Velocity sensors-Encoders, Tachometers, differentiation of position signal, Accelerating sensors, force and pressure sensors-piezoelectric, force sensing resistor, strain gauges, Torque sensors, light and infrared sensors, touch and tactile sensors, proximity sensors-magnetic proximity sensors, optical proximity sensors, Ultrasonic proximity sensors, inductive proximity sensors, capacitive proximity sensors, eddy current proximity sensors, sniff sensors.

### Text Books:

1. Introduction to Robotics – Analysis, System, Applications by Saeed B. Niku, PHI
2. Industrial Robotics – Mikell P. Groover & Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey – Mc Graw Hill, 1986

### REFERENCES:

1. Robot Modeling and Kinematics – Rachid Manseur, Firewall Media Publishers (An imprint of Laxmi Publications Pvt. Ltd., New Delhi)
2. Robot Analysis and Control - H. Asada and J.J.E. Slotine John Wiley & Sons.
3. Fundamentals of Robotics: Analysis and control, Robert J. Schilling, Prentice Hall, 1990.
4. A robot Engineering text book – Mohsen shahinpoor, Harper & Row Publishers, 1987
5. Introduction to Robotics: Mechanics and Control, John.J. Craig, Addison- Wesley, 1999
6. Robotics: Control, sensing, vision, and intelligence – K.S. FU, R.C. Gonzalez and C.S.G Lee. Mc Graw Hill, 1987.
7. Modeling and control of Robot manipulators, L. sciavicco and b. Siciliano, Springer (second edition) 2000.
8. ROBOTICS ( Fundamental concepts and analysis) ASHITAVA GHOSAL. Oxford university press, Y.M.C.A. Library building, jai singh Road. NEW DELHI-110001



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## (9D15203) MECHANICAL VIBRATIONS

**Unit I**

**Single degree of Freedom systems I:** Undamped and damped free vibrations: forced vibrations ; coulomb damping; Response to harmonic excitation; rotating unbalance and support excitation ; Vibration isolation and transmissibility .

**Unit II**

**Single degree of Freedom systems II:** Response to Non Periodic Excitations: unit Impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

**Unit III**

**Vibration measuring instruments :** Vibrometers, velocity meters & accelerometers

**Unit IV**

**Two degree freedom systems:** Principal modes – undamped and damped free and forced vibrations ; undamped vibration absorbers ;

**Unit V**

**Multi degree freedom systems:** Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi – rotor systems and geared systems; Discrete-Time systems.

**Unit VI**

**Numerical Methods:** Rayleigh's, Stodola's, Matrix iteration, Rayleigh-Ritz Method and Holzer's methods.

**Unit VII**

**Continuous systems:** Free vibration of strings – longitudinal oscillations of bars-traverse vibrations of beams- Torsional vibrations of shafts.

**Unit VIII**

**Critical speeds of shafts:** Critical speeds without and with damping, secondary critical speed.

**Text books:**

1. Elements of Vibration Analysis by Meirovitch.
2. Mechanical Vibrations by G.K. Groover.

**REFERENCES:**

1. Vibrations by W.T. Thomson
2. Mechanical Vibrations – Schaum series.
3. Vibration problems in Engineering by S.P. Timoshenko.
4. Mechanical Vibrations – V.Ram Murthy.

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**(9D15204) EXPERIMENTAL STRESS ANALYSIS**

**Unit – I**

**Introduction:** Theory of Elasticity, Plane stress and plane strain conditions, Compatibility conditions. Problems using plane stress and plane strain conditions, Three-dimensional stress strain relations.

**Unit – II**

**Strain Measurement Methods:** Various types of strain gauges, Electrical Resistance strain gauges, semiconductor strain gauges, strain gauge circuits

**Unit – III**

**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 – IV**

**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.

**Unit – V**

**Moire Methods:** Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, the displacement field approach to Moire-Fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire-Fringes, experimental procedure and techniques.

**Unit – VI**

**Photo elasticity:** Photo elasticity – Polariscope – Plane and circularly polarized light, Bright and dark field setups, Photo elastic materials – Isochromatic fringes – Isoclinics

**Unit – VII**

**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.

**Unit – VIII****Birefringent Coatings**

Introduction, Coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, Fringe-order determinations in coatings, stress separation methods.

**TEXT BOOKS :**

1. Theory of Elasticity by Timoshenke and Goodier Jr
2. Experimental stress analysis by Dally and Riley, Mc Graw-Hill

**REFERENCES:**

1. A treatise on Mathematical theory of Elasticity by Love .A.H
2. Photo Elasticity by Frocht

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**(9D15205) THEORY OF PLASTICITY**

**Unit – I-Introduction:** Modeling Uniaxial behavior in plasticity. Index notation, Cartesian tensors. Yield and failure criteria Stress, stress deviator tensors. Invariants, principal, mean stresses. Elastic strain energy. Mohr's representation of stress in 2 & 3 dimensions. Haigh-Westergaard stress space. Equilibrium equations of a body. Yield criteria: Tresca's, von Mises rules, Drucker-Prager criterion, anisotropic yield criteria.

**Unit – II -Strain at point:** Cauchy's formulae for strains, principal strains, principal shear strains, derivative strain tensor. Strain-displacement relationships. Linear elastic stress strain relations, Generalized Hooke's law, nonlinear elastic stress strain relations

**Unit – III -Principle of virtual work and its rate forms:** Drucker's stability postulate, normality, convexity and uniqueness for an elastic solid. Incremental stress strain relations.

**Unit – IV -Criteria for loading and unloading:** Elastic and plastic strain increment tensors, Plastic potential and flow rule associated with different Yield criteria, Convexity, normality and uniqueness considerations for elastic-plastic materials. Expansion of a thick walled cylinder.

**Unit – V -Incremental stress strain relationships:** Prandtl-Reuss material model.  $J_2$  deformation theory, Drucker-Prager material, General Isotropic materials.

**Unit – VI -Deformation theory of plasticity:** Loading surface, Hardening rules. Flow rule and Drucker's stability postulate. Concept of effective stress and effective strain, mixed hardening material. Problems.

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**Unit – VII-Finite element formulation for an elastic plastic matrix:** Numerical algorithms for solving non linear equations, Convergence criteria, Numerical implementations of the elastic plastic incremental constitutive relations.

**Unit – VIII -Bounding surface theory:** Uniaxial and multiaxial loading anisotropic material behaviour Theorems of limit analysis : Statically admissible stress field and kinematically admissible velocity field. Upper and lower bound theorems, examples and problems.

### Text books/References:

1. Plasticity for structural engineering W.F.Chen and D.J.Han, Springer verlag-1987.
2. Mechanics of Materials –II, Victor E. Saouma

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### Elective-II

### (9D15206a) DESIGN FOR MANUFACTURING

**UNIT – I-Introduction:** Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production-creativity in design.

**UNIT – II-Materials:** Selection of materials for design-developments in material technology-criteria for material selection-material selection interrelationship with process selection-process selection charts.

**UNIT – III-Machining processes:** Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease – redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

**UNIT – IV-Metal casting:** Appraisal of various casting processes, selection of casting process,- general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

**UNIT – V-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 – VI-Forging:** Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

**UNIT – VII-Extrusion & Sheet metal work:** Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

**UNIT VII-Plastics:** Visco elastic and creep behavior in plastics-design guidelines for plastic components-design considerations for injection moulding – design guidelines for machining and joining of plastics.

**Text Books:**

1. Design for manufacture, John cobert, Adisson Wesley. 1995
2. Design for Manufacture by Boothroyd,

**REFERENCES:**

1. ASM Hand book Vol.20

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**Elective-II**  
**(9D15206b) PRESSURE VESSEL DESIGN**

**Unit – I**

**Introduction:** Materials-shapes of Vessels-stresses in cylindrical, spherical and arbitrary, shaped shells. Cylindrical Vessels subjected to internal pressure, wind load, bending and torque-ilation of pressure vessels-conical and tetrahedral vessels.

**Unit – II**

**Theory of thick cylinders:** Shrink fit stresses in built up cylinders-auto frettage of thick cylinders. Thermal stresses in Pressure Vessels.

**Unit – III**

**Theory of rectangular plates:** Pure bending-different edge conditions.

**Unit – IV**

**Theory circular plates:** Simple supported and clamped ends subjected to concentrated and uniformly distributed loads-stresses from local loads. Design of dome bends, shell connections, flat heads and cone openings.

**Unit – V**

**Discontinuity stresses in pressure vessels:** Introduction, beam on an elastic foundation, infinitely long beam, semi infinite beam, cylindrical vessel under axially symmetrical loading, extent and significance of load deformations on pressure vessels, discontinuity stresses in vessels, stresses in a bimetallic joints, deformation and stresses in flanges.

**Unit – VI**

**Pressure vessel materials and their environment:** Introduction, ductile material tensile tests, structure and strength of steel, Leuder's lines, determination of stress patterns from plastic flow observations, behaviour of steel beyond the yield point, effect of cold work or strain hardening on the physical properties of pressure vessel steels, fracture types in tension, toughness of materials, effect of neutron irradiation of steels, fatigue of metals, fatigue crack growth, fatigue life

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prediction, cumulative fatigue damage, stress theory of failure of vessels subject to steady state and fatigue conditions.

### Unit – VII

**Stress concentrations:** Influence of surface effects on fatigue, effect of the environment and other factors on fatigue life, thermal stress fatigue, creep and rupture of metals at elevated temperatures, hydrogen embrittlement of pressure vessel steels, brittle fracture, effect of environment on fracture toughness, fracture toughness relationships, criteria for design with defects, significance of fracture mechanics evaluations, effect of warm prestressing on the ambient temperature toughness of pressure vessel steels.

### Unit – VIII

**Design features:** Localized stresses and their significance, stress concentration at a variable thickness transition section in a cylindrical vessel, stress concentration about a circular hole in a plate subjected to tension, elliptical openings, stress concentration, stress concentration factors for superposition, dynamic and thermal transient conditions, theory of reinforced openings, nozzle reinforcement, placement and shape, fatigue and stress concentration.

### Text Books:

1. Theory and design of modern Pressure Vessels by John F. Harvey, Van Nostrand Reinhold company, New York.
2. Pressure Vessel Design and Analysis by Bickell, M.B. Ruiz.

### REFERENCES:

1. Process Equipment design- Beowll & Yound Ett.
2. Indian standard code for unfired Pressure vessels IS:2825.
3. Pressure Vessel Design Hand Book, Henry H. Bednar, P.E., C.B.S. Publishers, New Delhi.
4. Theory of plates and shells- Timoshenko & Noinosky.

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

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**Elective-II****(9D15206c) MECHANICS OF COMPOSITE MATERIALS****UNIT-I**

**Introduction to Composite Materials:** Introduction ,Classification: Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications .

**UNIT-II**

**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-III**

**Manufacturing methods:** Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

**UNIT-IV**

**Macromechanical Analysis of a Lamina :**Introduction ,Definitions: Stress, Strain ,Elastic Moduli,Strain Energy. Hooke's Law for Different Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Reduction of Hooke's Law in Three Dimensions to Two Dimensions, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina,

**UNIT-V**

Hooke's Law for a Two-Dimensional Angle Lamina, Engineering Constants of an Angle Lamina, Invariant Form of Stiffness and Compliance Matrices for an Angle Lamina Strength Failure Theories of an Angle Lamina : Maximum Stress Failure Theory Strength Ratio,Failure Envelopes,Maximum Strain Failure Theory ,Tsai–Hill Failure Theory, Tsai–Wu Failure Theory, Comparison of Experimental Results with Failure Theories. Hygrothermal Stresses and Strains in a Lamina: Hygrothermal Stress–Strain Relationships for a Unidirectional Lamina, Hygrothermal Stress–Strain Relationships for an Angle Lamina

**UNIT-VI**

**Micromechanical Analysis of a Lamina :**Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi-Empirical Models ,Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion.

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## **UNIT-VII**

**Macromechanical Analysis of Laminates:** Introduction , Laminate Code , Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus of a Laminate , Hygrothermal Effects in a Laminate, Warpage of Laminates

## **UNIT-VIII**

**Failure, Analysis, and Design of Laminates :** Introduction , Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues

### **Text Books:**

1. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
2. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley- Interscience, New York, 1980.
3. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), By Autar K. Kaw ,Publisher: CRC

### **REFERENCES:**

1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

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### **(9D15207) MACHINE DYNAMICS LABORATORY**

#### **Experiments:**

1. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils
2. Determination of steady state amplitude of a forced vibratory system
3. Static balancing using steel balls
4. Determination of the magnitude and orientation of the balancing mass in dynamic balancing
5. Field balancing of the thin rotors using vibration pickups.
6. Determination of the magnitude of gyroscopic couple, angular velocity of precession, and representation of vectors.
7. Determination of natural frequency of given structure using FFT analyzer
8. Diagnosis of a machine using FFT analyzer.
9. Direct kinematic analysis of a robot
10. Inverse kinematic analysis of a robot
11. Trajectory planning of a robot in joint space scheme.
12. Palletizing operation using Robot programming.



**2009-10**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**M.Tech. IV SEMESTER (M/c.Des.)**

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**(9D15401) SEMINAR**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**

**M.Tech. IV SEMESTER (M/c.Des.)**

**C  
16**

**(9D15402) PROJECT WORK**

The Project Work should be on a contemporary topic relevant to the core subjects of the course. It should be original work of the candidate.

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