Academic Regulations

2017

MASTER OF TECHNOLOGY

Machine Design (MD)

(Applicable For Batches Admitted From 2017 – 2018)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY

(AUTONOMOUS)

DUVVADA - VISAKHAPATNAM – 530 049

(An Autonomous Institute, Accredited by NAAC, Affiliated to JNTUK, Kakinada, AP)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY

(AUTONOMOUS)

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ACADEMIC REGULATIONS

(VR 17)

VIGNAN'S INSTITUTE OF INFORMATION TECHNOLOGY (AUTONOMOUS)

VISAKHAPATNAM

ACADEMIC REGULATIONS for M. Tech. (Regular)

(Applicable for the batches admitted from 2017 onwards)

The selection for category A and B seats shall be as per Govt. of Andhra Pradesh rules.

1. Award of M. Tech. degree

A student will be declared eligible for the award of the M. Tech. Degree if he/she fulfills the following academic regulations.

Pursued a course of study for not less than two academic years and not more than four academic years.

Candidate has to register for 80 credits and shall secure 80 credits with all courses.

Students who fail to register for their two years course of study within four years or fail to acquire the 80 credits for the award of the degree within four academic years from the year of their admission shall forfeit their seat in M. Tech course and their admission shall stand cancelled.

2. Courses of Study

The following courses of study are offered at present for specialization in the M. Tech. Course.

Specialization Code	Specialization	Department
15	Machine Design (MD)	Mechanical Engineering (ME)
25	Software Engineering (SE)	Computer Science & Engineering (CSE)
38	Digital Electronics & Communication Systems (DECS)	Electronics & Communication Engineering (ECE)
40	Information Technology (IT)	Information Technology (IT)
42	Power & Industrial Drives (P & ID)	Electrical & Electronics Engineering (EEE)
58	Computer Science & Engineering (CSE)	Computer Science & Engineering (CSE)
70	Electronics & Communication Engineering (ECE)	Electronics & Communication Engineering (ECE)

And any other courses as approved by the authorities of the University from time to time

.

3. Registration

A student shall register for courses in each semester as per the courses offered by the concerned department.

4. Curricular Program

The Curriculum of the two year M. Tech Course has been designed to achieve a healthy balance between theory & lab hours, industry experience and to develop technical skills required for a career in the industry or a career in research.

5. Distribution and Weightage of Marks

5.1. Theory (100Marks)

5.1.1. For the theory courses, 60 marks shall be awarded based on the performance in the end Semester Examinations, 40 marks based on the Internal Evaluation. Internal Evaluation is made based on the average of the marks secured in two mid-term examinations.

5.1.2. First mid-term examination is conducted after 8 weeks from the commencement of the semester and the second mid-term examination, after 8 weeks from the Mid–I, at the end of the semester.

5.1.3. The duration for conducting each mid-term examination is two hours. Each theory question paper comprises 4 questions. First mid-term examinations shall be from first two and half units of the syllabus. The second mid-term examination is from next two and half units of the syllabus.

5.1.4. End examinations will be conducted for duration of three hours, out of 8 questions, 5 are to be answered.

5.2. Lab (100Marks)

5.2.1. For the evaluation of lab, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded based on the day to day performance and internal tests.

5.2.2. Out of the 40 marks, 30 marks are allocated for day to day performance of the student and 10 marks are allocated for internal test.

5.2.3. External Laboratory examinations for M. Tech courses must be conducted with two Examiners. Laboratory class teacher acts as internal examiner and external examiner shall be appointed by the Chief Superintendent of Examinations from the panel of experts recommended by the HOD.

5.3. Technical Seminar (50 Marks)

5.3.1. For Technical Seminar, a student shall collect the literature and critically review on a topic relevant to the program. The report is to be submitted in the department and oral presentation is to be made before the committee constituted by the Head of the department for 50 marks.There is no external evaluation.

5.4. Comprehensive Exam (100Marks)

5.4.1. Comprehensive exam consists of written objective examination for 60 marks and a viva-voce for 40 marks.

5.4.2. The Comprehensive exam aims to assess the student's understanding in various subjects which he / she studied during the M. Tech course of study.

5.4.3. It is totally internal evaluation done by the committee constituted by HOD.

5.5. Project Work/Dissertation

5.5.1. Registration of project work:

A candidate is permitted to register for the project work in the beginning of the second year first semester after successfully completing the first and second semester coursework and respective examinations and fulfill the Project Review Committee (PRC) requirements.

5.5.2. Project Evaluation

Every student has to carry out a project work assigned for 34 credits. Every candidate is allowed to submit thesis or dissertation after the student has passed first and second semester examinations and taken project topic approved by the Project Review Committee (PRC). PRC consists of Head of the Department, PG Coordinator, Project Guide and one senior faculty from the concerned department. PG Coordinator acts as chairperson for the PRC.

i. In case the project get an acceptable rating, viva-voce exam shall be conducted by a board comprising of the supervisor, head of the department and the external examiner who adjudicated the thesis. The board shall jointly evaluate the candidates work as one of the following:

- A -Excellent
- B –Good
- C-Satisfactory
- D – Not satisfactory

However, these grades will not be counted for the calculation of CGPA as the project work is approved/not approved type of course.

ii. If the project viva-voce performance is unsatisfactory, the candidate shall retake the viva- voce examination only after three months. If he fails to get a satisfactory report at the second viva-voce examination, the candidate has to re-register for the project and complete the project within the stipulated time as decided by the department.

6. Attendance Requirements

i. It is desirable for a candidate to have 100% attendance in the class in all the courses. However, a candidate shall be permitted to appear for the end semester examination if he/she has a minimum of 75% aggregate attendance in the semester.

ii. Condonation of shortage of attendance may be considered on Medical grounds, if the

student provides the medical certificate to the HOD immediately after he / she recovers from the illness. Medical Certificate submitted afterwards shall not be permitted. Shortage of attendance equal to or above 65% and below 75% will be condoned on payment of fee as fixed by the competent authority and the student concerned will be permitted to take the end semester examination. This privilege is given to any student only once during the entire program of study.

iii. Shortage of attendance may be considered for the students who participate in prestigious sports, co and extra-curricular activities if their attendance is in the minimum prescribed limit.

iv. A student will be promoted to the next semester if satisfies attendance and credits requirement.

7. Academic Requirements

The following academic requirements have to be satisfied in addition to the attendance requirements.

For any course, student is considered to be passed upon securing minimum 40 % marks in the external examination alone and minimum 50% marks from both internal and external examination put together.

8. Supplementary Examinations

There are no supplementary examinations for PG programs separately.

9. Examinations and Evaluation

9.1. General guidelines

i. All the semester end examinations are conducted for duration of three hours under the supervision of the Chief Superintendent of Examinations.

ii. For laboratory examinations, the evaluation is done by internal examiner and one external examiner.

iii. Results shall be announced within 30 days after the completion of the last examination.

9.2. Revaluation

9.2.1. There is a provision for revaluation of theory courses if student fulfils the following norms

i.e., the request for revaluation must be made in the prescribed format duly recommended by the Chief Superintendent of Examinations through Additional Controller along with the prescribed revaluation fee.

9.2.2. The highest marks of the two evaluations will be awarded to the student.

9.3. Challenge Revaluation

If the student is very confident, there is a provision for challenge revaluation for the courses as per the following norms.

i. Applications for Challenge revaluation for semester end exam have to be submitted within one week from the date of notification of the results.
ii. The challenge revaluation will be carried out by a three member committee comprising of an external course expert nominated by Principal / Chief Superintendent of Examinations, the faculty member who taught the course chosen by student from the same institute and the third member is the Head of the respective department/faculty nominated by HOD.
iii. The candidate will forfeit the challenging revaluation fee if the difference in the marks awarded by the committee and the initial awarded marks is not more than 15%. If the difference in marks is more than 15%, the challenge fee will be returned to the candidate. The marks awarded in the Challenge revaluation will be the final.

10. Grading System

Absolute grading system shall be followed for the award of grades

Grade Point

It is a numerical weight allotted to each letter grade on a 10-point scale.

Grades and Grade Points

Marks Range for all courses (Max:100)	Letter Grade	Level	Grade Point
≥ 90	O	Outstanding	10
≥80 to <90	A	Excellent	9
≥70 to <80	B	Very Good	8
≥60 to <70	C	Good	7
≥50 to <60	D	Satisfactory	6
<50	F	Fail	0
		Absent	-1
		Withheld	-2
		Malpractice	-3

Computation of SGPA

The following procedure is to be adopted to compute the Semester Grade Point Average. (SGPA) and Cumulative Grade Point Average (CGPA):

The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

SGPA (Si) = Σ(Ci x Gi) / ΣCi

Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the I th course.

Computation of CGPA

- The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.
- CGPA = Σ(Ci x Si) / ΣCi
- Where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester.
- Equivalent Percentage = (CGPA – 0.75) X10

11. Award of Class

- After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree, he shall be placed in one of the following three classes:

Class Awarded	**CGPA to be secured**	**Based on CGPA secured from 46 Credits**
First Class with Distinction	≥ 7.75 with no subject failures	
First Class	≥ 6.75	
Second Class	≥ 5.75 to < 6.75	

12. General Instructions

Where the words ‘he’, ‘him’, ‘his’, occur they imply ‘she’, ‘her’, ‘hers’, also.

The academic regulations should be read as a whole for the purpose of any interpretation.

In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman, Academic Council is final.

The college may change or amend the academic regulations or syllabi from time to time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the college.

13. Transitory Regulations

The student has to continue the course work along with the regular students of the respective semester in which the student gets re-admission.

The student has to register for substitute / compulsory subjects offered in place of subjects studied earlier.

The mode of internal evaluation and end-semester examinations shall be on par with the regular students, i.e., the student has to follow the mode of internal evaluation and the then question paper model for the end-semester examinations along with the regular students of the respective semester in which the student gets re-admission. The marks secured in the internal and end-semester examinations will be in accordance with the regulations under which the student was first admitted.

For the courses studied under earlier regulations but failed, the student has to appear, pass and acquire credits from the supplementary examinations as and when conducted. The question paper model shall remain same as the one in which the student took examination during previous regulations.

The promotion criteria based on attendance as well as credits shall be in accordance with the regulations under which the student was first admitted.

All other academic requirements shall be in accordance with the regulations under which the student was first admitted.

Any other clarification the decision of the Principal is final and binding.

Transcripts

After successful completion of the entire program of study, a transcript containing performance of all academic years will be issued as a final record. Partial transcript will also be issued up to any point of study to a student on request, after payment of requisite fee.

The Academic Calendar consisting of instruction period of the program is released for every academic year before the commencement of the class work.

There shall be no program transfers after the completion of the admission process. There shall be no transfer from one college/stream to another within the Constituent Colleges and Units of Jawaharlal Nehru Technological University Kakinada.

14.Disciplinary Action Guidelines for Malpractices

14.1. For Malpractices identified by squad or special invigilators

Punishments to the candidates will be given as per the above guidelines.

MALPRACTICES RULES		
DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN		
EXAMINATIONS		
	Nature of Malpractices/ Improper conduct	**Punishment**
	If the candidate:	
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.
3.	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 classwork and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
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 examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	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.
6.	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	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.

	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.	
7.	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 examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	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.
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.	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.
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.

15. UGC recommended punishment for Ragging

i. Suspension from attending classes and academic privileges
ii. Withholding/withdrawing scholarships/fellowship and other benefits.
iii. Debarring from appearing in any test/examination or other evaluation process
iv. With holding results
v. Debarring from representing the institution in any regional, national or international meet, tournament, youth festival etc.
vi. Suspension/expulsion from the hostel
vii. Cancellation of admission
viii. Rustication from the institution for period ranging from 1 to 4semesters.
ix. Expulsion from the institution and consequent debarring from admission to any other institution for a specified period.
x. Fine may extend up to Rs. 2.5lakh.

Program Structure for Machine Design
Department of Mechanical Engineering
(VR 17)

I Year I Semester

S. No	CODE	Name of the Subject	Theory	Practical	credits
1	2015171101	Computational Methods In Engineering	3+1	0	3
2	2015171102	Advanced Mechanics Of Solids	3+1	0	3
3	2015171103	Advanced Mechanisms	3+1	0	3
4	2015171104	Mechanical Vibrations	3+1	0	3
5	2015171105	Design with Advanced Materials	3+1	0	3
ELECTIVE – I					
6	2015171106	Design of Automobile Systems	3+1	0	3
7	2015171107	Product Design			
8	2015171108	Geometric Modeling			
9	2015171109	Design Synthesis			
10	2015171121	Machine Dynamics Lab	0	3	2
11	2015171132	Technical Seminar -1	0	0	2
Total Credits					22

I Year II Semester

S. No	CODE	Name of the Subject	Theory	Practical	credits
1	2015171201	Optimization and Reliability	3+1	0	3
2	2015171202	Experimental Stress Analysis	3+1	0	3
3	2015171203	Finite Element Method	3+1	0	3
ELECTIVE – II					
4	2015171204	Signal Analysis and Condition Monitoring	3+1	0	3
5	2015171205	Acoustics and Noise Control	3+1	0	3
6	2015171206	Non Destructive Evaluation	3+1	0	3
7	2015171207	Tribology	3+1	0	3
ELECTIVE – III					

8	2015171208	Fracture Mechanics	3+1	0	3
9	2015171209	Theory of Plasticity			
10	2015171210	Continuum Mechanics			
11	2015171211	Mechanics of Composite Materials			
ELECTIVE – IV					
12	2015171212	Pressure Vessel Design	3+1	0	3
13	2015171213	Gear Engineering			
14	2015171214	Mechatronics			
15	2015171215	Design for Manufacturing & Assembly			
16	2015171221	Design Practice Lab	0	3	2
17	2015171232	Technical Seminar -2	0	0	2
18	2015171235	Comprehensive Exam	0	0	2
Total Credits					24

II Year I Semester

S. No	CODE	Name of the Subject	Theory	Lab.	Credits
1	2015172138	Project Work(Stage- I)	0	0	16
Total Credits					16

II Year II Semester

S. No	CODE	Name of the Subject	Theory	Lab.	Credits
1	2015172238	Project Work(Stage- II)	0	0	18
Total Credits					18

I Year – I Semester	L	P	C
Subject Code: 2015171101	3+1	0	3

Computational Methods In Engineering

Unit – I

Introduction to numerical methods applied to engineering problems: Examples, solving setsof equations – Matrix notation – Determinants and inversion – Iterative methods – Relaxation methods – System of non-linear equations. Least square approximation fitting of non-linear curves by least squares –regression analysis- multiple linear regression, non linear regression - computer programs.

Unit – II

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

Unit – III

Transformation Techniques: Continuous fourier series, frequency and time domains, laplace transform, fourier integral and transform, discrete fourier transform (DFT), Fast fourier transform (FFT).

Unit – IV

Numerical solutions of partial differential equations: Laplace's equations – Representationsas 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 – V

Partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria. Solving wave equation by finite differences-stability of numerical method –method of characteristics-wave equation in two space dimensions-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.Ward Cheney and David Kincaid "Numerical mathematics and computing" Brooks/Cole publishing company1999, Fourth edition.

2.Riley K.F,.M.P. Hobson and Bence S.J, "Mathematical methods for physics and engineering", Cambridge University press,1999.

3. Kreysis, Advanced Mathematics

I Year – I Semester	L	P	C
Subject Code: 2015171102	3+1	0	3

Advanced Mechanics of Solids

Unit I

Theories of stress and strain, Definition of stress at a point, stress notation, principal stresses, other properties, differential equations of motion of a deformable body, deformation of a deformable body, strain theory, principal strains, strain of a volume element, small displacement theory.

Stress –strain temperature relations: Elastic and non-elastic response of a solid, first law of thermodynamics, Hooke's Law, Anisotropic elasticity, Hooke's Law, Isotropic elasticity, initiation of Yield, Yield criteria.

Unit II

Failure criteria: Modes of failure, Failure criteria, Excessive deflections, Yield initiation, fracture, Progressive fracture, (High Cycle fatigue for number of cycles $N > 10^6$, buckling. Application of energy methods: Elastic deflections and statically indeterminate members and structures: Principle of stationary potential energy, Castiglione's theorem on deflections, Castiglione's theorem on deflections for linear load deflection relations, deflections of statically determinate structures.

Unit III

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

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 whicha 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.

Textbooks:

1.Advanced Mechanics of materials by Boresi& Sidebottom-Wiely International.

2. Advanced Mechanics of Solids, L.S Srinath

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

I Year – I Semester	L	P	C
Subject Code: 2015171103	3+1	0	3

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; Collineastion axis; Hartmann's Construction ;Inflection circle for the relative motion of two moving planes; Application of the Inflection circle to kinematic analysis.

Advanced Kinematics of plane motion - II: Polode curvature; Hall's Equation; Polodecurvature 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 – III

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.

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 – IV

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 – V

Manipulator kinematics: D-H transformation matrix;Direct and Inverse kinematic analysis of Serial manipulators: Articulated, spherical & industrial robot manipulators- PUMA, SCARA,STANFORD ARM, MICROBOT.

Text Books:

1. Jeremy Hirschhorn, Kinematics and Dynamics of plane mechanisms,McGraw-Hill,1962.

2. L.Sciaviccoand 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.

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.

3. Joseph Duffy, Analysis of mechanisms and Robot manipulators, Edward Arnold, 1980

I Year – I Semester	L	P	C
Subject Code: 2015171104	3+1	0	3

Mechanical Vibrations

Unit I

Single degree of Freedom systems: Undamped and damped free vibrations: forced vibrations;coulomb damping; Response to harmonic excitation; rotating unbalance and support excitation, Vibration isolation and transmissibility, Vibrometers, velocity meters & accelerometers.

Unit 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

Multi degree freedom systems: Principal modes – undamped and damped free and forced vibrations; undamped vibration absorbers, 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 IV

Numerical Methods: Rayliegh's, stodola's, Matrix iteration, Rayleigh-Ritz Method andHolzer's methods

Unit V

Application of concepts: Free vibration of strings – longitudinal oscillations of bars-transverse vibrations of beams- Torsional vibrations 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 Viabrations – V.Ram Murthy.

I Year – I Semester	L	P	C
Subject Code: 2015171105	3+1	0	3

Design with Advanced Materials

Unit – I

Fundamentals of material science: Elasticity in metals, mechanism of plastic deformation, slip twinning, 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. Yield criteria: Von mises and Tresca criteria.

Unit – II

Motivation of selection, cost basis and service requirements, selection for mechanical properties, strength, toughness, fatigue, impact and creep, use of material property charts for material selection.

Unit – III

Modern metallic Materials: Dual phase steels, micro alloyed steels, high strength low alloy (HSLA) Steel, maraging steel, intermetalics, Ni and Ti aluminides, super alloys.

Unit – IV

Nonmetallic materials: Polymeric materials and their molecular structures, production techniques for fibers, foams, adhesives and coatings, structure, properties and applications of engineering polymers. composites; Introduction, reinforcement, types of composite materials, - properties, processing and application of composite materials.

Unit – V

Properties, structure and applications of Smart materials, shape memory alloys, metallic glass, quasi crystal and nano crystalline materials, ceramic materials, ceremets, high temperature materials, refractory materials.

TEXT BOOKS:

1. Mechanical behavior of materials/Thomas H.Courtney/2nd Edition, McGraw-Hill, 2000
2. Mechanical Metallurgy/George E.Dieter/McGraw Hill, 1998
3. Material selection in mechanical design by M.F Ashby. Bott

REFERENCES:

1. Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann.
Material science and metallurgy by V.D. Kodgire, Everest publishing house

I Year – I Semester	L	P	C
Subject Code: 2015171106	3+1	0	3

DESIGN OF AUTOMOBILE SYSTEMS

(ELECTIVE-I)

UNIT I

Conceptual design of automobiles: body shape definition based on aerodynamic structure safety, sub - systems integration considerations, road load analysis, transmission of road loadsto structure.

UNTI II

Detail design of structural elements, load analysis for different vehicles, safety consideration, design for bending, torsion conditions, criteria for toppling, based on cornering loads.

UNIT III

Suspension system integration with vehicle for ride comfort, methods of mounting suspension and power train systems.

UNIT IV

Driver cabin/seat design, design of control systems based on ergonomics, anthropometry, human factors engineering considerations.

UNIT V

Safety aspects of automobiles, devices, energy absorbing systems, crash worthiness, legislation relating to safety, vehicle performance requirements, sub systems packaging and verification of vehicle performance through testing(lab, field testing).

TEXT BOOKS

1 DonaldE.Males, Fundamentals of automobile body structure design(R-394), SAE2011

2 W.F.Milliker, D.L.Milliker, Maurice Olly, Chassis design: Principlesand Analysis(R-206)SAE2002

3. J.H Smith, Modern Vehicle System Design

I Year – I Semester	L	P	C
Subject Code: 2015171107	3+1	0	3

PRODUCT DESIGN

(ELECTIVE - I)

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 SELECTION: Task – Structured approaches – Clarification

– Search – Externally and internally – explore systematically – reflect on the solutions and process – concept selection – methodology – benefits.

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

UNIT - III

PRODUCT DEVELOPMENT MANAGEMENT: Establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

INDUSTRIAL DESIGN: Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – simulating product performance and manufacturing processing electronically – Need for industrial design – impact – design process.

UNIT - IV

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 - V

DESIGN FOR MANUFACTURING AND PRODUCTY DEVELOPMENT: Definition – Estimation of manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity. Prototype basics – Principles of prototyping – planning for prototypes – Economics analysis – Understanding and representing tasks – baseline project planning – accelerating the project execution.

TEXT BOOKS:

1. Product Design and Development / Kari T. Ulrich and Steven D. Eppinger / McGraw Hill International Edns. 1999.
2. Concurrent Engg/integrated Product development / Kemnneth Crow / DRM Associates, 26/3, Via Olivera, Palos Verdes, CA 90274(310)377-569, Workshop Book.

REFERENCES:

1 Effective Product Design and Development / Stephen Rosenthal / Business One Orwin, Homewood, 1992, ISBN, 1-55623-603-4.

2 Tool Design–Integrated Methods for Successful Product Engineering / Staurt Pugh / Addsion Wesley Publishing, Neyourk, NY, 1991, ISBN 0-202-41369-5.

3 Production and Operations Management/Chase/TMH

I Year – I Semester	L	P	C
Subject Code: 2015171108	3+1	0	3

GEOMETRIC MODELING

(ELECTIVE - I)

Unit - I

Cubic spline –I Definition, Explicit and implicit equations, parametric equations, Algebraic andgeometric form of cubic spline, Hermite cubic spline, tangent vectors, parametric space of a curve, blending functions.

Unit - II

Cubic Splines-II:

Four-point form, reparametrization, truncating and subdividing of curves. Graphic construction and interpretation, composite pc curves.

Bezier Curves: Bernstein basis, equations of Bezier curves, properties, derivatives.

Unit - III

B-Spline Curves: B-Spline basis, equations, knot vectors, properties, and derivatives.

Unit – IV

Surfaces: Bicubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, surfaces ofrevolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, Gaussian curvature.

Unit – V

Solids: Tricubic solid, Algebraic and geometric form.

Solid modeling concepts: Wire frames, Boundary representation, Half space modeling, spatialcell, cell decomposition, classification problem.

TEXT BOOKS:

1. Elements of Computer Graphics by Roger & Adams Tata McGraw Hill.
2. Geometric Modeling by Micheal E. Mortenson, McGraw Hill Publishers
3.

REFERENCES:

1. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.Mallikarjuna Rao, MMM Sarcar, PHI Publishers.

I Year – I Semester	**L**	**P**	**C**
Subject Code: 2015171109	**3+1**	**0**	**3**

DESIGN SYNTHESIS

(ELECTIVE - I)

UNIT – I

Design process and methodologies of systematic design conceptual design variants and evaluation; Standardization and its exploitation in design.

UNIT – II

Tolerance from process and function; interchangeability and selective assembly; selection of fits for different design situations, surface finish. Load transmission, load equalization light weight and rigid constructions.

UNIT – III

Design of cast forged sheet metal parts and welded constructions Machining considerations.

UNIT – IV

Design for assembly and dismantling; Modular constructions erection, operation inspection and maintenance considerations; Ergonomics Design of accuracy; Location pins and registers, Machining in assembly, adjustment, Backlash and Clearance adjustment.

UNIT – V

Problems formulation for design optimization Example illustration the various principles available design variants for some of the common basic functional requirements.

TEXT BOOK:

1. Engineering Design a material and processing approach/ George Dieter/ McGraw Hi8 ll international book company 1983

REFERENCES:

1. Engineering Design a systematic approach/ G. Phal W. Beitz/ Springer /3rd Edition

2. Mechanical Design Theory Methodology/ Manjula B. Waldron and Kenneth J. Waldron/ Springer Verlag New York 1996.

I Year – I Semester	**L**	**P**	**C**
Subject Code: 2015171121	**0**	**3**	**2**

MACHINE DYNAMICS LAB

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 & Determination of the magnitude and orientation of the balancing mass in dynamic balancing

4. Field balancing of the thin rotors using vibration pickups.

5. Determination of the magnitude of gyroscopic couple, angular velocity of precession, and representation of vectors.

6. Determination of natural frequency of given structure using FFT analyzer

7. Diagnosis of a machine using FFT analyzer.

8. .Direct kinematic analysis of a robot

9. Inverse kinematic analysis of a robot

10 An experiment on friction, wear, pin-on-disc

1. An experiment on stress intensity factors / fatigue, fracture
2. Modal analysis of beams and plates

I Year – II Semester	L	P	C
Subject Code: 2015171201	3+1	0	3

OPTIMIZATION AND RELIABILITY

UNIT - I

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, merits and demerits of classical optimization techniques.

UNIT - II

NUMERICAL METHODS FOR OPTIMIZATION: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, Pattern search methods, conjugate method, types of penalty methods for handling constraints, advantages of numerical methods.

UNIT - III

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,

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

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

UNIT – IV

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.

UNIT V

RELIABILITY: Concepts of Engineering Statistics, risk and reliability, probabilistic approach to design, reliability theory, design for reliability, numerical problems, hazard analysis.

TEXT BOOKS:

1. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
2. Engineering Optimization – S.S.Rao, New Age Publishers
3. Reliability Engineering by L.S.Srinath
4. Multi objective genetic algorithm by Kalyanmoy Deb, PHI Publishers.

REFERENCES:

1. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers

2. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers

3. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers

4. An Introduction to Reliability and Maintainability Engineering by CE Ebeling, Waveland Printers Inc., 2009

5. Reliability Theory and Practice by I Bazovsky, Dover Publications, 2013

I Year – II Semester	L	P	C
Subject Code: 2015171202	3+1	0	3

EXPERIMENTAL STRESS ANALYSIS

UNIT – I

Introduction: Stress, strain, Plane stress and plane strain conditions, Compatibility conditions. Problems using plane stress and plane strain conditions, stress functions, Mohrs circle for stress strain, Three-dimensional stress strain relations.

UNIT – II

Strain Measurement and Recordings: Various types of strain gauges, Electrical Resistance strain gauges, semiconductor strain gauges, strain gauge circuits. 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

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

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 – 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.

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 – V

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

3. Experimental stress analysis, Video course by K.Ramesh / NPTEL

I Year – II Semester	L	P	C
Subject Code: 2015171203	3+1	0	3

FINITE ELEMENT METHOD

UNIT – I

Formulation Techniques: Methodology, Engineering Problems and governing differential equation, 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

One-dimensional elements: Bar, trusses, beams and frames, displacements, stresses and temperature effects.

UNIT – III

Two dimensional problems: CST, LST, four noded and eight nodded rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary conditions. Heat Transfer problems: Conduction and convection, examples: - two-dimensional fin.

UNIT – IV

Isoperimetric formulation: Concepts, sub parametric, super parametric elements, numerical integration, Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions, pascal's triangle, Patch test.

UNIT – V

Finite elements in Structural Analysis: Static and dynamic analysis, eigen value problems, and their solution methods, case studies using commercial finite element packages.

TEXT BOOK :

1. Finite element methods by Chandrubatla & Belagondu.

REFERENCES:

1. J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press, 1994

2. Zienckiwicz O.C. & R. L. Taylor, Finite Element Method, McGraw-Hill,1983.

3. K. J. Bathe, Finite element procedures, Prentice-Hall, 1996

I Year – II Semester	**L**	**P**	**C**
Subject Code: 2015171204	**3+1**	**0**	**3**

SIGNAL ANALYSIS AND CONDITION MONITORING

(ELECTIVE- II)

UNIT-I

Introduction, Basic concepts. Fourier analysis. Bandwidth. Signal types. Convolution.

Signal analysis: Filter response time. Detectors. Recorders. Analog analyzer types.

UNIT-II

PRACTICAL ANALYSIS OF STATIONARY SIGNALS: Stepped filter analysis. Swept filter analysis. High speed analysis. Real-time analysis.

UNIT-III

PRACTICAL ANALYSIS OF CONTINUOUS NON-STATIONARY SIGNALS: Choice of window type. Choice of window length. Choice of incremental step. Practical details. Scaling of the results.

UNIT-IV

PRACTICAL ANALYSIS OF TRANSIENTS: Analysis as a periodic signal. Analysis by repeated playback (constant bandwidth). Analysis by repeated playback (variable bandwidth).

UNIT-V

CONDITION MONITORING IN REAL SYSTEMS: Diagnostic tools. Condition monitoringof two stage compressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Air separator. Preheater fan. Field balancing of rotors. ISO standards on vibrations, active, passive hybrid methods of condition monitoring

TEST BOOK:

1. Condition Monitoring of Mechanical Systems / Kolacat.

REFERENCES:

1. Frequency Analysis /R.B.Randall.

2. Mechanical Vibrations Practice with Basic Theory / V. Ramamurti/ Narosa Publishing House.
3. Theory of Machines and Mechanisms/ Amitabh Ghosh & AK Malik/ EWP

I Year – II Semester	L	P	C
Subject Code: 2015171205	3+1	0	3

Acoustics and Noise Control
(ELECTIVE- II)

Unit-I
Basic Acoustic Principles – Acoustic terminology and definitions, plane and spherical wave propagation – Theories of monopole, dipole and quadrapole sound sources. Sound transmission and absorption – Mass law transmission, sound transmission through double walls and multiple layers – sound transmission through ducts, sound absorbing materials.

Unit-II
Structure borne sound: Sound radiation and structural response, acoustic fatigue.

Unit-III
Machine Noise-Noise generation by bearing, gears motors, fans propellers, generator sets, cooling, pump sets, pipe, etc.

Unit-IV
Noise Control: Noise ratings and standards, human tolerance levels, equivalent sound level and loudness contours – Engine and muffler designs.

Unit-V
Noise control through barriers and enclosures and absorbent linings –Vehicular noise and control – Environmental noise control.

Text/Reference Books
1. M. L. Munjal, 2014, Noise and Vibration Control, World Scientific Press: Singapore
2. E. G. Williams, 1999, Fourier Acoustics: Sound Radiation and Near Field Acoustic Holography, Academic Press: New York

I Year – II Semester	**L**	**P**	**C**
Subject Code: 2015171206	**3+1**	**0**	**3**

NON - DESTRUCTIVE EVALUATION

(ELECTIVE - II)

UNIT – I

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

UNIT – II

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, 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 – III

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, 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 – IV

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

UNIT – V

Applications: NDT in flaw analysis of Pressure vessels, piping, 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

I Year – II Semester	L	P	C
Subject Code: 2015171207	3+1	0	3

TRIBOLOGY

(ELECTIVE - II)

UNIT – I

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

Lubrication: Choice of lubricants, types of oil, Grease and solid lubricants- additives-lubrication systems and their selection.

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

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

UNIT – IV

Hydrodynamic bearings: Fundamentals of fluid formation – Reynold's equation; Hydrodynamic journal bearings – Sommer field 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 – V

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.

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

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

TEXT BOOKS:

1.Rowe WW& O' Dionoghue, "Hydrostatic and Hybrid bearing design "Butter worths &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.Neale MJ, (Editor) "Tribology hand Book" Neumann Butterworths, 1975.

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

I Year – II Semester	L	P	C
Subject Code: 2015171208	3+1	0	3

FRACTURE MECHANICS

(ELECTIVE - III)

UNIT-I

Introduction: Prediction of mechanical failure. Macroscopic failure modes; brittle and ductile behavior. 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

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, crack tip plasticity, effect of thickness on fracture toughness.

UNIT-III

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-IV

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. Goodmans 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, (1995)

2. B. Lawn, Fracture of Brittle Solids, Cambridge Solid State Science Series 2nd ed1993.

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. deVilliers, The Physics of Creep, Taylor and Francis, (1995)

I Year – II Semester	**L**	**P**	**C**
Subject Code: 2015171209	**3+1**	**0**	**3**

THEORY OF PLASTICITY

(ELECTIVE – III)

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.

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 – II

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

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 – III

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

Deformation theory of plasticity: Loading surface, Hardening rules. Flow rule and Druckers stability postulate. Concept of effective stress and effective strain, mixed hardening material. Problems.

UNIT – IV

Finite element formulation for an elastic plastic matrix: Numerical algorithms for solving nonlinear equations, Convergence criteria, Numerical implementations of the elastic plastic incremental constitutive relations

UNIT – V

Bounding surface theory: Uniaxial and multiaxial loading anisotropic material behavior, Theroms of limit analysis: Statically admissible stress field and kinematically admissible velocity field. Upper and lower bound theorms, examples and problems.

TEXT BOOK:

1. Plasticity for structural engineering W.F.Chen s and D.J.Han, Springer verlag-1987.

REFERENCES:

1. Mechanics of Materials –II, Victor E. Saouma.

2. Theory of plasticity, Sadhu Singh

I Year – II Semester	L	P	C
Subject Code: 2015171210	3+1	0	3

CONTINUUM MECHANICS

(ELECTIVE – III)

UNIT – I

Tensor calculus: Tensor calculus, Multi linear forms, Definition of Tensor over including vector spaces, Alternating tensors, determinants, orientation, tensor products, kinematics of deformations and motion, strain analysis, rotation of tensors, calculations of tensors, internal calculations of tensors and integral identities.

UNIT – II

Eulerian and Lagrangian description of a continuous, discrete systems, continua, physical quantities and their derivatives. Rigid body motion, Relation between continuum models and real materials.

UNIT – III

Conservation laws in a continuum: Mass conservation in Lagrangen and Eulerian frames, Conservation of momentum in Lagrangen and Eulerian frames.

UNIT – IV

Conservation in angular momentum in lagrengian form. Conservation of energy in in Lagrangen and Eulerian frames.Strain and decomposition. Finite deformation, infinitesimal displacements

UNIT - V

Material frame indifference, Elastic Materials, Viscous fluids, linear visco-elasticity, case studies for metals and polymers.

TEXT BOOK

1. Continuous mechanics, George Backus, Samizdat Press, 1997

REFERENCES:

1.Mechanics of Continua, A.C. Eringan, 1962
2.Continuous Physics, Vol. 1, A.C. Eringan, 1967, Academic press
3.Introduction to Continuous Mechanics, B.L.N. Kennett
4.Quick introduction to Tensor analysis, R.Sharipov, 2004, Samizdat Press.
5.Non-linear continuum mech-win, SEACAS theory manuals part II,T.A.Laursen, S.W.Attaway And R.I.Zadoks

I Year – II Semester	**L**	**P**	**C**
Subject Code: 2015171211	**3+1**	**0**	**3**

MECHANICS OF COMPOSITE MATERIALS

(ELECTIVE – III)

UNIT-I

Introduction to Composites: Introduction, Classification, matrix materials, reinforced matrix of composites

UNIT-II

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-III

Macro mechanical 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-IV

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

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, hybrid laminates

UNIT-V

Design of Laminates: Introduction, thin plate theory, specially orthotropic plate, cross andangle ply laminated plates, problems using thin plate theory, Failure Criterion for a Laminate, Design of a Laminated Composites.

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.

1. 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.

I Year – II Semester	L	P	C
Subject Code: 2015171212	3+1	0	3

PRESSURE VESSEL DESIGN
(ELECTIVE - IV)

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 for computation 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.

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 – IV

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 joint, deformation and stresses in flanges.

UNIT – V

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

TEXT BOOKS:

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

REFERENCES:

1. Process Equipment design- Beowll & YoundEtt.

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.

I Year – II Semester	**L**	**P**	**C**
Subject Code: 2015171213	**3+1**	**0**	**3**

GEAR ENGINEERING
(PSG Design data Book is allowed)

(ELECTIVE - IV)

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, Helical gears, Bevel gears and worm 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

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 – IV

Gear failures

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

UNIT – V

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

TEXT BOOKS:

1. Maleev and Hartman, Machine Design, C.B.S. Publishers, India.
2. Henry E.Merrit,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.

I Year – II Semester	L	P	C
Subject Code: 2015171214	3+1	0	3

MECHATRONICS

(ELECTIVE - IV)

UNIT – I

Introduction: Definition of Mechatronics products, design considerations and tradeoffs. Overview of Mechatronic products. Intelligent machine Vs Automatic machine economic and social justification.

Actuators and drive systems: Mechanical, Electrical, hydraulic drive systems, Characteristics of mechanical, Electrical, Hydraulic and pneumatic actuators and their limitations.

UNIT – II

Motion Control: Control parameters and system objectives, Mechanical Configurations, Popular control system configurations. S-curve, motor/load inertia matching, design with linear slides.

Motion Control algorithms: Significance of feed forward control loops, shortfalls, fundamentals concepts of adaptive and fuzzy – control. Fuzzy logic compensatory control of transformation and deformation non- linearity's.

UNIT – III

Sensor interfacing: Analog and digital sensors for motion measurement, digital transducers, Human-Machine and machine- Machine inter facing devices and strategy.

Architecture of intelligent machines: Introduction to Microprocessor and programmable logic controls and identification of systems. System design classification, motion control aspects in design.

UNIT – IV

Machine vision: Feature and pattern recognition methods, concepts of perception and cognition in decision-making, basics of image processing, binary and grey scale images, sharpening and smoothening of images.

UNIT – V

Micro mechatronic Systems: Micro sensors, micro actuators, smart instrumentation, micro-fabrication methods – lithography, etching, micro-joining.

TEXT BOOKS:

1.“Designing intelligent machines”, open university, London.MichelB. Histand and David G. Alciatore.

2.Introduction to Mechatronics and Measurement systems, Tata Mc Graw Hill.

3.C.W. Desilva, “Control Sensors and Actuators”, Prentice Hall

I Year – II Semester	**L**	**P**	**C**
Subject Code: 2015171215	**3+1**	**0**	**3**

DESIGN FOR MANUFACTURING AND ASSEMBLY (ELECTIVE - IV)

UNIT - I

Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design?, Typical DFMA Case Studies, Overall Impact of DFMA on Industry.

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 - II

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 - III

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.

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 - IV

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

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, 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

REFERENCE:

ASM Hand book Vol.20

I Year – II Semester	**L**	**P**	**C**
Subject Code: 2015171221	**0**	**3**	**2**

DESIGN PRACTICE LABORATORY

I. Modeling

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

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

Static Analysis
Modal Analysis
Harmonic Analysis
Spectrum Analysis
Buckling Analysis
Analysis of Composites
Fracture mechanics

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

V. Prudent Design – a case study

REFERENCES:

User manuals of ANSYS package Version 9.0

I-DEAS Package Version 9.0