DEPARTMENT OF MECHANICAL ENGINEERING

DR24 M.Tech Regulations

For

MACHINE DESIGN PROGRAMME

(Applicable for batches admitted from 2024-2025)

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
BALUSUMUDI, BHIMAVARAM, W.G. Dist., A.P., PIN-534 202
(Autonomous)
(Approved by AICTE, New Delhi & Affiliated to JNTUK, Kakinada)
(Accredited with A++ Grade by NAAC & Accredited by NBA)
Ph: 08816-221238, Email: dnrcet@gmail.com,Website: https://dnrcet.org

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
BALUSUMUDI, BHIMAVARAM, W.G. Dist., A.P., PIN-534 202
(Autonomous)

ACADEMIC REGULATIONS DR24 FOR M. Tech (REGULAR) DEGREE COURSE
(Applicable for the batches admitted from 2024-25)

Applicable for the students of M. Tech (Regular) Course from the Academic Year 2024-25 onwards. The M. Tech Degree of D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY, Bhimavaram affiliated to Jawaharlal Nehru Technological University Kakinada shall be conferred on candidates who are admitted to the program and who fulfil all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

Admission to the above program shall be made subject to eligibility, qualification and specialization as prescribed by the JNTUK, University and Andhra Pradesh State Council of Higher Education (APSCHE) from time to time.

2.0 AWARD OF M. Tech DEGREE

2.1 A student shall be declared eligible for the award of the M. Tech Degree, if he pursues a course of study in not less than two and not more than four academic years.

2.2 **The student shall register for all 68 credits and secure all the 68 credits.**

2.3 The minimum instruction days in each semester are 90.

3.0 A. PROGRAMME OF STUDY

The following specializations are offered at present for the M. Tech Programme of study.

M.Tech

1. M.Tech- Structural Engineering
2. M.Tech- Machine Design
3. M.Tech- Digital Electronics and Communication Systems
4. M.Tech- Computer Science & Engineering

and any other course as approved by AICTE/ University from time to time.

3.0 B. Departments offering M. Tech Programmes with specializations are noted below:

CE	M.Tech. - Structural Engineering (87)
ME	M.Tech- Machine Design (15)
ECE	M.Tech- Digital Electronics and Communication Systems (38)
CSE	M.Tech- Computer Science & Engineering (58)

4.0 ATTENDANCE

3.1 A student shall be eligible to write University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects/courses, and with minimum 50% in each and every course including practicals.

3.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic

Committee.

3.3 Shortage of Attendance **below** 65% in aggregate shall not be condoned and not eligible to write their end semester examination of that class.

3.4 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.

3.5 A prescribed fee shall be payable towards the condonation of shortage of attendance.

3.6 A student shall not be promoted to the next semester unless, he satisfies the attendance requirement of the present semester, as applicable. They may seek re-admission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for re-admission into the same class.

5.0 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 practical, on the basis of Internal Evaluation and End Semester Examination.

5.1 For the theory subjects 75 marks shall be awarded based on the performance in the End Semester Examination and 25 marks shall be awarded based on the Internal Evaluation. The internal evaluation shall be made based on the **average** of the marks secured in the two Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Each mid term examination shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 10 marks, and it will be reduced to 25 marks. End semester examination is conducted for 75 marks for all FIVE (5) questions (one question from one unit) to be answered (either or).

5.2 For practical subjects, 75 marks shall be awarded based on the performance in the End Semester Examinations and 25 marks shall be awarded based on the day-to-day performance as Internal Marks. The internal evaluation based on the day to day work-5 marks, record- 5 marks and the remaining 15 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with a breakup marks of Procedure-20, Experimentation-30, Results-10, Viva-voce-15.

5.3 For Mini Project with Seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Project Review Committee consisting of Head of the Department, supervisor/mentor and two other senior faculty members of the department. For Mini Project with Seminar, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

5.4 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 semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Evaluation taken together.

5.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to re-appear for the End semester Examination in that subject. A candidate shall be given **one** chance to re-register for each subject provided the internal marks secured by a candidate **are less than 50% and has failed in the end examination.** In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt shall stands cancelled. For re- registration the candidates have to apply to the Institution by paying the requisite fees and get approval from the Institution before the start of the semester in which re-registration is required.

5.6 In case the candidate secures less than the required attendance in any re-registered subject(s), he shall not be permitted to write the End Examination in that subject. He shall again re-register the subject when next offered.

5.7 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher or teacher of the respective college and the second examiner shall be appointed by the Institution from the panel of examiners submitted by the respective college.

6.0 EVALUATION OF PROJECT/DISSERTATION WORK

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

6.1 A Project Review Committee (PRC) shall be constituted with Head of the Department and two other senior faculty members in the department.

6.2 Registration of Dissertation/Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical.

6.3 After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval. The student can initiate the Project work, only after obtaining the approval from the Project Review Committee (PRC).

6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Project Review Committee (PRC). However, the PRC shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

6.5 Continuous assessment of Dissertation-I and Dissertation-II during the Semester(s) will be monitored by the PRC.

6.6 A candidate shall submit his status report in two stages to the PRC, at least with a gap of 3 months between them.

6.7 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration

of the project work. The candidate has to pass all the theory and practical subjects before submission of the Thesis.

6.8 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute.

6.9 The thesis shall be adjudicated by one examiner selected by the Institution. For this, the HoD of the concerned Dept shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned.

6.10 If the report of the examiner is not favorable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected. The candidate has to re- register for the project and complete the project within the stipulated time after taking the approval from the Institution.

6.11 The Head of the Department shall coordinate and make arrangements for the conduct of Viva-Voce examination.

6.12 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. The Board shall jointly report the candidate's work for a maximum of 100 marks.

6.13 If the report of the Viva -Voce is unsatisfactory (i.e., <50 % of marks), 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 after taking the approval from the Institution.

7.0 Cumulative Grade Point Average (CGPA)

Marks Range Theory/ Laboratory (Max – 100)	Marks Range Mini Project/ Project Work or Dissertation (Max – 100)	Letter Grade	Level	Grade Point
≥ 90	≥ 90	O	Excellent	10
≥80 to <90	≥80 to <90	S	Very Good	9
≥70 to <80	≥70 to <80	A	Good	8
≥60 to <70	≥60 to <70	B	Fair	7
≥50 to <60	≥50 to <60	C	Satisfactory	6
<50	<50	F	Fail	0
		AB	Absent	0

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) = $\sum$ (Ci X Gi) / $\sum$ Ci**

- Where Ci is the number of credits of the ith course and Gi is the grade point scored by the student in the ith 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 semester of a Programme, i.e.
- **CGPA = $\sum$ (Ci X Si) / $\sum$ Ci**
- Where Si is the SGPA of the i^{th} semester and Ci is the total number of credits in that semester.
- The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.
- Equivalent Percentage = (CGPA – 0.75) x 10

8.0 AWARD OF DEGREE AND 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 four classes:

Class Awarded	**CGPA to be secured**	
First Class with Distinction	$\geq$ 7.75 (Without any supplementary appearance)	**From the CGPA secured from 68 Credits.**
First Class	$\geq$ 7.75 (With any supplementary appearance) $\geq$ 6.75 and < 7.75 (Without any supplementary appearance)	
Second Class	$\geq$ 6.75 and < 7.75 (With any supplementary appearance) $\geq$ 6.0 to < 6.75 (Without any supplementary appearance)	
Pass Class	$\geq$ 6.0 to < 6.75 (With any supplementary appearance)	

The Grades secured, Grade points and Credits obtained will be shown separately in the memorandum of marks.

9.0 WITHHOLDING OF RESULTS

If the student is involved in indiscipline/malpractices/court cases, the result of the student will be withheld.

10.0 TRANSITORY REGULATIONS (for R19)

10.1 Discontinued or detained candidates are eligible for readmission (within the duration as mentioned in item 2.1) as and when next offered.

10.2 The readmitted students will be governed by the regulations under which the candidate has been admitted.

11.0 GENERAL

11.1 Wherever the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

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

11.3 In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Vice-Chancellor is final.

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

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. The Hall Ticket of the candidate is to be cancelled.
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 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 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 University 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	Cancellation of the performance in that subject.

	writes to the examiner requesting him to award pass marks.	
6.	Refuses to obey the orders of the Chief Superintendent/Controller of Examinations/ any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walkout 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.
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 University 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 college's 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.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Institution 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.

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE & SYLLABUS M.Tech ME

For

MACHINE DESIGN PROGRAMME

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I Semester

S.No.	Code	Subject		L	T	P	Credits
1	**MD101**	Advanced Mechanics of Solids		3	0	0	3
2	**MD102**	Mechanical Vibrations and Acoustics		3	0	0	3
3	**Programme Elective – I** **MD 103**	MD1031	Design of Modern Vehicle Systems	3	0	0	3
		MD 1032	Product Design				
		MD 1033	Computational Geometry				
		MD 1034	Fracture Mechanics				
		MD 1035	Advanced Mechanisms				
4	**Programme Elective –II** **MD 104**	MD 1041	Advanced Non Destructive Testing	3	0	0	3
		MD 1042	Advanced Robotics				
		MD 1043	Design for Manufacturing & Assembly				
		MD 1044	Multi Body Dynamics				
		MD 1045	Vision Systems and Image Processing				
5	**MD105**	Machine Dynamics Lab		0	0	4	2
6	**MD106**	Design Practice Lab-I		0	0	4	2
7	**MD107**	Research Methodology and IPR		2	0	0	2
8	**MD108**	Soft Skills		2	0	0	0
Total							**18**

II Semester

S.No.	Code	Subject		L	T	P	Credits
1	**MD201**	Advanced Finite Element Methods		3	0	0	3
2	**MD202**	Advanced Machine Design		3	0	0	3
3	**Programme Elective – III** **MD 203**	MD 2031	Theory of Plasticity	3	0	0	3
		MD 2032	Signal Analysis and Condition Monitoring				
		MD 2033	Computational Fluid Dynamics				
		MD 2034	Advanced Composite Materials				
		MD 2035	Soft Computing				
4	**Programme Elective – IV** **MD 204**	MD 2041	Experimental Techniques and data analysis	3	0	0	3
		MD 2042	Design with advanced Materials				
		MD 2043	Electro Mechanical Engineering				
		MD 2044	Advanced Tribology				
		MD 2045	Experimental Modal Analysis				
5	**MD205**	Computational Mathematics Lab		0	0	4	2
6	**MD206**	Design Practice Lab-II		0	0	4	2
7	**MD207**	Value Education		2	0	0	0
8	**MD208**	Mini Project with Seminar		0	0	4	2
Total							**18**

III Semester

S.No.	Code	Subject		L	T	P	Credits
1	**Programme Elective – V*** **MD 301**	MD 3011	Industrial Robotics	3	0	0	3
		MD 3012	Advanced Optimization Techniques				
		MD 3013	Additive Manufacturing				
		MD 3014	Mechanics of Composite Materials				
		MD 3015	Vehicle Dynamics				
2	**Open Elective**	1. Nano Technology 2. Optimization Techniques 3. Industrial Safety		3	0	0	3
3	**Dissertation**	Dissertation Phase -I		0	0	20	10
Total							**16**

* Students going for Industrial Project/ Thesis will complete programme elective and open elective coursesthrough MOOCs

IV Semester

S.No.	Code	Subject	L	T	P	Credits
1	**Dissertation**	Dissertation Phase -II	0	0	32	16
Total						**16**

Courses offered by Mechanical Engineering Department to other departments as Open electives.

S.No.	Code	Subject	L	T	P	Credits
1	**MD 3021**	Industrial Robotics	3	0	0	3
2	**MD 3022**	Operations Research	3	0	0	3
3	**MD 3023**	Additive Manufacturing	3	0	0	3
4	**MD 3024**	Experimental Techniques and Data Analysis	3	0	0	3

M.Tech - I Sem		L	T	P	C
		3	0	0	3
MD 101	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 ofYield, 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 which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contactstresses; 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. Theory of elasticity by Timoschenko S.P. and Goodier J.N. McGraw-Hill Publishers 3rdEdition
3. 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

M.Tech - I Sem		L	T	P	C
		3	0	0	3
MD 102	MECHANICAL VIBRATIONS AND ACOUSTICS				

UNIT-I: INTRODUCTION

Relevance of and need for vibrational analysis – Basics of SHM - Mathematical modelling of vibrating systems - Discrete and continuous systems - single-degree freedom systems - free and forced vibrations, damped and undamped systems.

UNIT-II: MULTI DEGREE FREEDOM SYSTEMS

Free and forced vibrations of multi-degree freedom systems in longitudinal, torsional and lateral modes - Matrix methods of solution- normal modes - Orthogonality principle-Energy methods, Eigen values and Eigen vectors

UNIT-III: CONTINUOUS SYSTEMS

Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams - Governing equations of motion - Natural frequencies and normal modes - Energy methods, Introduction to non linear and random vibrations.

UNIT-IV: BASICS OF ACOUSTICS

Speed of Sound, Wavelength, Frequency, and Wave Number, Acoustic Pressure and Particle Velocity, Acoustic Intensity and Acoustic Energy Density, Spherical Wave propagation, Directivity Factor and Directivity Index, Levels and the Decibel, Addition and subtraction of Sound levels, Octave Bands, Weighted Sound Levels.

UNIT-V: NOISE MEASUREMENT AND CONTROL

Sound Level Meters, Intensity Level Meters, Octave Band Filters Acoustic Analyzers, Dosimeter, Measurement of Sound Power, Impact of noise on humans, A-Weighting, Noise control strategy, sound absorption and insulation.

TEXT BOOKS:

1. S.S.Rao, “Mechanical Vibrations ", 5th Edition, Prentice Hall, 2011.
2. L.Meirovitch, “Elements of vibration Analysis", 2nd Edition, McGraw-Hill, New York, 1985.

REFERENCES:

1. W.T. Thomson, M.D. Dahleh and C Padmanabhan, “Theory of Vibration with Applications”, 5th Edition,Pearson Education, 2008.
2 M.L.Munjal, “Noise and Vibration Control”, World Scientific, 2013.
3. Beranek and Ver, “Noise and Vibration Control Engineering: Principles and Applications”, JohnWiley and Sons, 2006.
4. Randall F. Barron, “IndustrialNoise Controland Acoustics”,Marcel Dekker, Inc., 2003.

Web Resources:

http://www.nptel.ac.in/courses/112103111
http://www.nptel.ac.in/courses/112103112

M.Tech - I Sem		L	T	P	C
		3	0	0	3
MD 1031	DESIGN OF MODERN VEHICLE SYSTEMS (Programme 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. 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 II

Basics of Electric vehicles (EV) , Review of existing design of EV, EV design, Performance, Operation and charging.

Hybrid Vehicles Principles-serial, parallel, electrical, hydraulic

UNIT III

Definition of hybridness , Hybrid design philosophy , Hybridness: parallel hybrid, series, mixed and range extender (plug-in) hybrids , Range extender , Optimization and hybridness , Battery power and electric motor power

UNIT IV

Introduction to UAVs/Drones, Drone Applications, Working Principle and Design, Inertial Measurement Unit, Sensors and Calibration, PID - Implementation and Tuning, Flight controller, Remote Controller, Quadcopter dynamics

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 Donald E.Males, Fundamentals of automobile body structure design(R-394), SAE2011
2 W.F.Milliker,D.L.Milliker,Maurice Olly, Chassis design: principles an analysis (R-206)SAE2002
3. J.H Smith, Introduction to Modern Vehicle Design, Butterworth-Heinemann

REFERENCES:

(https://nptel.ac.in/downloads/108103009/)
(https://www.iith.ac.in/~raji/courses.html)

M.Tech - I Sem		L	T	P	C
		3	0	0	3
MD 1032	PRODUCT DESIGN (Programme Elective - I)				

UNIT I

Product Design Process: Design Process Steps, Morphology of Design. Problem Solving and Decision Making: Problem-Solving Process, Creative Problem Solving, Invention, Brainstorming, Morphological Analysis, Behavioral Aspects of Decision Making, Decision Theory, Decision Matrix,Decision Trees.

Modeling and Simulation: Triz, Role of Models in Engineering Design, MathematicalModeling, Similitude and Scale Models, Computer Simulation, Geometric Modeling on Computer, Finite-Element Analysis.

UNIT II

Product management:

The operation of product management: Customer focus of product management , product planning process, Levels of strategic planning, Wedge analysis, Opportunity search, Product life cycle Life cycle theory and practice.

Product development: Managing new products, Generating ideas, Sources of product innovation, Selecting the best ideas, The political dimension of product design, Managing the product launch and customer feedback.

Product managers and manufacturing: The need for effective relationships, The impact of manufacturing processes on product decisions, Prototype planning,, Productivity potentials, Management of product quality, Customer service levels.

UNIT III

Risk and Reliability: Risk and Society, Hazard Analysis, Fault Tree Analysis. Failure Analysis and Quality: Causes of Failures, Failure Modes, Failure Mode and Effect Analysis, FMEA Procedure, Classification of Severity, Computation of Criticality Index, Determination of Corrective Action, Sources of Information, Copyright and Copying. Patent Literature.

UNIT IV

Product Testing; thermal, vibration, electrical, and combined environments, temperature testing, vibration testing, test effectiveness. Accelerated testing and data analysis, accelerated factors. Weibull probability plotting, testing with censored data.

UNIT V

Design For Maintainability: Maintenance Concepts and Procedures, Component Reliability, Maintainability and Availability, Fault Isolation in design and Self-Diagnostics.

Product Design for Safety, Product Safety and User Safety Concepts, Examples of Safe Designs.

Design Standardization and Cost Reduction: Standardization Methodology, Benefits of Product Standardization; International, National, Association and Company Level Standards; PartsModularization

TEXT BOOKS:

1. Engineering Design , George E. Dieter, McGRAW-HILL
2. Product Integrity and Reliability in Design, John W. Evans and Jillian Y. Evans, Springer Verlag

REFERENCES:

1. The Product Management Handbook, Richard S. Handscombe, McGRAW-HILL
2. New Product Design, Ulrich Eppinger, 3. Product Design, Kevin Otto.

M.Tech - I Sem		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
MD 1033	**COMPUTATIONAL GEOMETRY (Programme Elective - I)**				

UNIT - I
Introduction: Definition, Explicit and implicit equations, parametric equations.

UNIT - II
Cubic Splines-1: Algebraic and geometric form of cubic spline, tangent vectors, parametric space of a curve, blending functions, four point form, reparametrization, truncating and subdividing of curves. Graphic construction and interpretation, composite pc curves.

UNIT - III
Bezier Curves: Bernstein basis, equations of Bezier curves, properties, derivatives.
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 of revolutions, 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, spatial cell, cell decomposition, classification problem.

TEXT BOOKS:
1. CAD/CAM by Ibrahim Zeid, Tata McGraw Hill.
2. Elements of Computer Graphics by Roger & Adams Tata McGraw Hill.

REFERENCES:
1. Geometric Modeling by Micheal E. Mortenson, McGraw Hill Publishers
2. Computer Aided Design and Manufacturing, K.Lalit Narayan, K.MallikarjunaRao,MMM Sarcar, PHI Publishers

M.Tech - I Sem		L	T	P	C
		3	0	0	3
MD 1034	**FRACTURE MECHANICS (Programme Elective - I)**				

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

Griffiths 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. 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.

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.

REFERENCES:

1. J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths (1973)
2. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials.
3. H.L.Ewald and R.J.H. Wanhill Fracture Mechanics, Edward Arnold, (1984).
4. S. Suresh, Fatigue of Materials, Cambridge University Press, (1998)
5. L.B. Freund and S. Suresh, Thin Film Materials Cambridge University Press,(2003).

M.Tech - I Sem		L	T	P	C
		3	0	0	3
MD 1035	ADVANCED MECHANISMS (Programme Elective - I)				

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; Polode curvature in the four bar mechanism; coupler motion; relative motion of the output and input links; Determination of the output angular acceleration and its Rate of change; Freudenstein's collineation –axis theorem; Carter –Hall circle; The circling – point curve for the Coupler of 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 Rotocenter 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.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. Joseph Duffy, Analysis of mechanisms and Robot manipulators, Edward Arnold,1980

M.Tech - I Sem		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
MD 1041	**ADVANCED NON DESTRUCTIVE TESTING (Programme 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

M.Tech - I Sem		**L**	**T**	**P**	**C**
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MD 1042	**ADVANCED ROBOTICS (Programme Elective - II)**				

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-representationof 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.

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 – III

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.

UNIT – IV

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

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 – V

Robot Actuators: Introduction,charecterics of Actuating systems-weight, power to weight ratio, operating pressure, stiffness Vs compliance,comparision of actuating systems, hydraulic devices, pneumatic devices, Electric motors-DC motorcar motors, Brushless DC motors, direct Drive electric motors, servomotors, stepped motors.

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, PHIPublications
2. Industrial Robotics – Mikell P. Groover & Mitchell Weiss, Roger N. Nagel,NicholasG.Odrey – Mc Graw Hill, 1986

REFERENCES:

1. Robot Modeling and Kinematics – Rachid Manseur, Firewall Media Publishers (An imprint ofLaxmi Publications Pvt. Ltd., New Delhi)
2 Robot Analysis and Control - H. Asada and J.J.E. Slotine John Willey & 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.
8.ROBOTICS (Fundamental concepts and analysis)ASHITAVA GHOSAL.Oxford university press

M.Tech - I Sem		L	T	P	C
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MD 1043	DESIGN FOR MANUFACTURING & ASSEMBLY (Programme Elective - II				

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-productdesign 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
1. Design for Manufacture by Boothroyd,
2. Design for manufacture, James Bralla

REFERENCE:

ASM Hand book Vol.20

M.Tech - I Sem		**L**	**T**	**P**	**C**
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MD 1044	**MULTI BODY DYNAMICS (Programme Elective – II)**				

UNIT-I

Review of kinematics and dynamics of point mass and rigid body - types of constraints - constraintsfor revolute joints, translational joints, composite joints

UNIT-II

Formulation of planar multi-body systems, kinematics and dynamics in point coordinates, bodycoordinates, and joint coordinates

UNIT-III

Numerical methods for solution - analysis of planar multi-body systems, kinematic analysis in various formulations.

UNIT-IV

Inverse dynamic analysis, forward dynamic analysis, constraint stabilization - case studies, McPherson strut suspension, Double A-arm suspension, planar robot manipulator

UNIT-V

Spatial multi-body systems-formulation- joints: - revolute, prismatic, cylindrical, spherical, universal-case studies.

TEXT BOOKS:

1. Planar Multibody Dynamics Formulation, Programming and Applications by Parviz E.Nikravesh, CRC Press
2. Dynamics of Multibody Systems by Ahmed A. Shabana, Cambridge University Press.

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M.Tech - I Sem		**3**	**0**	**0**	**3**
MD 1045	**VISION SYSTEMS AND IMAGE PROCESSING (Programme Elective – II)**				

UNIT – I

Machine vision: Vision sensors - Comparison with other types of sensors - Image acquisition and recognition - Recognition of 3D objects - Lighting techniques - Machine vision applications.

UNIT – II

Image representation: Application of image processing - Image sampling, Digitization and quantization - Image transforms.

UNIT – III

Spatial domain techniques: Convolution, Correlation. Frequency domain operations - Fast Fourier transforms, FFT, DFT, Investigation of spectra. Hough transform

UNIT – IV

Image enhancement: Filtering, Restoration, Histogram equalisation, Segmentation, Region growing.

UNIT – V

Image compression: Edge detection - Thresholding - Spatial smoothing - Boundary and Region representation - Shape features - Scene matching and detection - Image classification.

TEXT BOOKS:

1. Digital Image Processing by Gonzalez, R.C. and Woods, R.E., Addison Wesley Publications.

2 Robot Vision by Prof. Alan Pugh (Editor), IFS Ltd., U.K. 3. Digital Image Processing by A.Rosenfled and A. Kak, Academic Press.

REFERENCES:

1. The Psychology of Computer Vision by P. Winstan, McGraw-Hill.

2. Algorithms for Graphics and Image Processing by T. Pavidis, Springer Verlag.

M.Tech - I Sem		L	T	P	C
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MD 105	MACHINE DYNAMICS LAB				

1. Determination of damped natural frequency of the vibrating system with different viscous oils.
2. Determination of steady state amplitude of a forced vibratory system.
3. Determination of natural frequency and mode shape of multi degree freedom system
4. Static balancing of disc
5. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
6. Field balancing of the thin rotors using vibration pickups.
7. Determination of the magnitude of gyroscopic couple, angular velocity of precession, and representation of vectors.
8. Diagnosis of a machine using FFT analyzer.(FFT)
9. Direct kinematic analysis of a robot.
10. Inverse kinematic analysis of a robot.
11. Determination of friction, wear using pin-on-disc.
12. Experimental modal analysis of Beams
    - Estimation of Natural frequency
    - Extraction of mode shape
    - Estimation of Damping
    - Modal Assurance Criteria (MAC) analysis between experimental data and numerical method
13. An experiment on evaluation of stress intensity factor
    - Computation of stresses by mounting 3 axis strain gauges (Rosettes)

M.Tech - I Sem		L	T	P	C
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MD 106	DESIGN PRACTICE LAB - I				

I. Modeling

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

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

REFERENCE:

User manuals of ANSYS package Version 9.0

M.Tech - I Sem		L	T	P	C
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MD 107	RESEARCH METHODOLOGY AND IPR				

UNIT-I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT-III

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT-IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.

M.Tech - I Sem		L	T	P	C
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MD 108	SOFT SKILLS				

UNIT-I
Planning and Preparation, Word Order, Breaking up long sentences. Structuring Paragraphs and Sentences, Being concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT-II
Clarifying Who Did What, Highlighting your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

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

UNIT-IV
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, useful phrases, how to ensure paper is as good as it could possibly be the first-time submission.

UNIT-V
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

REFERNCES:
1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht HeidelbergLondon, 2011

M.Tech - II Sem		L	T	P	C
		3	0	0	3
MD 201	ADVANCED FINITE ELEMENT METHODS				

UNIT - I

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

UNIT – II

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

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

Isoparametric 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

M.Tech - II Sem		L	T	P	C
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MD 202	ADVANCED MACHINE DESIGN				

UNIT-I

Design philosophy: Design process, Problem formation, Introduction to product design, Various design models-Shigley model, Asimov model and Norton model, Need analysis, Strength considerations -standardization. Creativity and Creative techniques, Material selection in machine design, design for safety and Reliability, concept of product design

UNIT-II

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

UNIT-III

Fatigue failure theories: cumulative fatigue damage, thermal fatigue and shock, harmful and beneficial residual stresses, Yielding and transformation

UNIT-IV

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

UNIT-V

Economic factors influencing design: Economic analysis, Break-even analysis, Human engineering considerations, Ergonomics, Design of controls, Design of displays. Value engineering, Material and process selection in value engineering, Modern approaches in design. Team work and Ethics in engineering design: Team formation, functioning, discharge, team dynamics, Ethical issues considered during engineering design process

TEXT BOOKS:

1. Machine Design An Integrated Approach by Robert L. Norton, Prentice-Hall New Jersey, USA.
2. Mechanical Engineering Design by J.E. Shigley and L.D. Mitchell published by McGrawHillInternational Book Company, New Delhi.

REFERENCES:

1. Fundamentals of machine elements by Hamrock, Schmid and Jacobian, 2nd edition, McGraw-HillInternational edition.
2. Product design and development by Karl T. Ulrich and Steven D. Eppinger. 3rd edition, TataMcGraw Hill.
3. Product Design and Manufacturing by A.K. Chitale and R.C. Gupta, Prentice Hall
4. Engineering Design / George E Dieter / McGraw Hill /2008
5. Fundamentals of machine elements/ Hamrock, Schmid and Jacobian/ 2nd edition /McGrawHillInternational edition.

M.Tech - II Sem		L	T	P	C
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MD 2031	THEORY OF PLASTICITY (Programme 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 non linear equations, Convergence criteria, Numerical implementations of the elastic plastic incremental constitutive relations

UNIT – V

Bounding surface theory: Uniaxial and multiaxial loading anisotropic material behaviour

Theroms of limit analysis : Statically admissible stress field and kinematically admissible velocity field. Upper and lower bound theorms, examples and problems.

TEXT BOOK:

1. Theory of Elasticity by S.P. Timoshenko & J.K Goodier, MGH

REFERENCES:

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

M.Tech - II Sem		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
MD 2032	**SIGNAL ANALYSIS AND CONDITION MONITORING (Programme Elective - III)**				

UNIT-I
Introduction, Basic concepts.Fourier analysis.Bandwidth. Signal types. Convolution.
Signal analysis: Filter response time. Detectors.Recorders.Analog analyzer types.

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

UNIT-III
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
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 monitoring of 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 / Colcote.

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

M.Tech - II Sem		L	T	P	C
		3	0	0	3
MD 2033	COMPUTATIONAL FLUID DYNAMICS (Programme Elective - III)				

UNIT – I

Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions. Derivation of finite difference equations.

Solution methods: Solution methods of elliptical equations – finite difference formulations, interactive solution methods, direct method with Gaussian elimination.

Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT – II

Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations.

Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT – III

Formulations of incompressible viscous flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

Formulations of compressible flows: potential equation, Eluer equations, Navier-stokes system of equations, flowfield-dependent variation methods, boundary conditions, example problems.

UNIT – IV

Finite volume method: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT – V

Standard variational methods: Linear fluid flow problems, steady state problems, Transient problems.

TEXT BOOK:

1. Computational fluid dynamics, T. J.Chung, Cambridge University press, 2002.

REFERENCE:

1. Text book of fluid dynamics, Frank Chorlton, CBS Publishers &distributors, 1985.

M.Tech - II Sem		L	T	P	C
		3	0	0	3
MD 2034	ADVANCED COMPOSITE MATERIALS (Programme Elective - III)				

UNIT I

Introduction: History and basic concept of composites. Definition and Classification of Composites, MMC, PMC, CMC. Reinforcing fibres- Natural fibres (cellulose, jute, coir etc), boron, carbon, ceramic glass, aramids, polyethylene (UHMWPE), polybenzthiazoles etc.

UNIT II

Fundamental concepts:

Particulate fillers-importance of particle shape and size. Matrix resins-thermoplastics and thermosetting matrix resins. Coupling agents-surface treatment of fillers and fibres, significance of interface in composites. Nanocomposites, short and continuous fibre reinforced composites, critical fibre length, and anisotropic behaviour.

UNIT III

Fabrication techniques: pultrusion, filament winding, prepreg technology, injection and compression moulding, bag moulding, resin transfer moulding, reaction injection moulding.

UNIT IV

Properties and performance of composites: Properties and microstructure of high-strength fiber materials (glass, carbon, polymer, ceramic fibers) and matrix materials (polymer, metal, ceramic, and carbon matrices). Specific strength and stiffness of high-performance composites. Rule ofmixtures. Stress, strain transformations.

UNIT V

Failure criteria: Hygrothermal stresses, bending of composite plates, analysis of sandwich plates, buckling analysis of laminated composite plates, inter-laminar stresses, First Order Shear Deformation Theory (FSDT). Applications: Industrial, aerospace, automobile, house hold etc.

TEXT BOOKS:

1. Steven L. Donaldson, ASM Handbook Composites Volume 21, 2001.
2. Krishan K. Chawla, Composite Materials, Science and Engineering, Springer, 2001.
3. Suresh G. Advani, E. Murat Sozer, Process Modelling in Composites Manufacturing, 2nd Ed. CRCPress, 2009

M.Tech - II Sem		**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
MD 2035	**SOFT COMPUTING (PROGRAMME ELECTIVE - III)**				

UNIT I

Introduction to Soft Computing: Concept of computing systems, "Soft" compiting versus "Hard" computing, Characteristics of Soft computing Some applications of Soft computing techniques.

UNIT II

Fuzzy logic: Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Fuzzy logic controller design, Some applications of Fuzzy logic.

UNIT III

Genetic Algorithms: Concept of "Genetics" and "Evolution" and its application to proablistic search techniques Basic GA framework and different GA architectures,GA operators: Encoding,

UNIT IV

Multi-objective Optimization Problem Solving: Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Paretoapproaches to solve MOOPs, Pareto-based approaches to solve MOOPs
Some applications with MOEAs.

UNIT V

Artificial Neural Networks: Biological neurons and its working, Simulation of biolgical neurons to problem solving, Different ANNs architectures, Training techniques for ANNs,
Applications of ANNs to solve some real life problems.

TEXT BOOKS:

1. Fuzzy Logic: A Pratical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional, 2000.
2. Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.

REFERENCES:

1. Foundations of Neural Networks, Fuzzy Systems, and Knowldge Engineering, Nikola K.Kasabov, MIT Press, 1998.
2. Fuzzy Logic for Embedded Systems Applications, Ahmed M. Ibrahim, Elesvier Press, 2004.
3. An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
4. Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, PearsonEducation, 2002.
5. Practical Genetic Algorithms, Randy L. Haupt and sue Ellen Haupt, John Willey & Sons, 2002.
6. Neural Networks, Fuzzy Logis and Genetic Algorithms : Synthesis, and Applications, S.Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007.
7. Soft Computing, D. K. Pratihar, Narosa, 2008.

M.Tech - II Sem		L	T	P	C
		3	0	0	3
MD 2041	EXPERIMENTAL TECHNIQUES AND DATA ANALYSIS (Programme Elective - IV)				

UNIT-I

Measurement of cutting forces: Strain gauge and piezoelectric transducers and their characteristics. Dynamometer construction, Bridge circuits. Instrumentation and calibration. Displacement and Strain measurements by photoelasticity, Holography, interferometer, Moir techniques, strain gauge rosettes.

UNIT-II

Temperature Measurement: Circuits and instrumentation for different transducers viz., bimetallic, expanding fluid, electrical resistance, thermister, thermocouples, pyrometers.

Flow Measurement: Transducers for flow measurements of Non-compressible fluids, Obstruction anddrag methods. Vortex shredding flow meters. Ultrasonic, Laser Dopler and Hotwire anemometer. Flow visualization techniques, Shadow graphs, Schilieren photography. Interferometer.

UNIT-III

Metallurgical Studies: Optical and electron microscopy, X-ray diffraction, Bragg's Law and its application for studying crystal structure and residual stresses. Electron spectroscopy, electron microprobe.

Surface Measurement: Micro hardness, roughness, accuracy of dimensions and forms. 3-D Co-ordinate measuring machines.

UNIT-IV

Experiment design & data analysis: Statistical methods, Randomised block design, Latin and orthogonal squares, factorial design. Replication and randomization.

Data Analysis: Deterministic and random data, uncertainty analysis, test of significance: Chi-square, student's 't' test. Regression modeling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modeling.

UNIT-V

Taguchi Methods: Experimental design and planning with orthogonal arrays and linear graphs. Additive cause-effect model, Optimization of response level. Identification of Design and noise factors. Performance evaluation and Optimization by signal to noise ratios. Concepts of loss function and its application.

TEXT BOOKS:

1. Jack Philip Holman, Experimental Methods for Engineers, 7th edition, McGraw-Hill, 2001
2. V. C. Venkatesh, H. Chandrasekaran, Experimental Techniques in Metal Cutting, Eastern economyedition, Prentice-Hall of India, 1987

REFERENCES:

1. George E. P. Box, Gwilym M. Jenkins, Gregory C. Reinsel, Greta M. Ljung, Time Series Analysis:Forecasting and Control, 5th Edition, John Wiley & Sons, 2015
2. Richard C. Dove, Paul H. Adams, Experimental stress analysis and motion measurement: theory,instruments and circuits, techniques, C. E. Merrill Books, 1964
3. Bagchi Tapan P, Taguchi Methods Explained: Practical Steps to Robust Design, Prentice-Hall(India), 1993.

M.Tech - II Sem		L	T	P	C
		3	0	0	3
MD 2042	DESIGN WITH ADVANCED MATERIALS (Programme Elective - IV)				

UNIT – I

Fundamentals of material science: Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening.

Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material.

UNIT – II

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

UNIT – III

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

UNIT – IV

Non metallic 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

Smart materials, shape memory alloys, metallic glass, quasi crystal and nano crystalline 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 selction in mechanical design by M.F Ashby. Bott

REFERENCES:

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

M.Tech - II Sem		L	T	P	C
		3	0	0	3
MD 2043	ELECTRO MECHANICAL ENGINEERING (Programme Elective - IV)				

UNIT – I

Introduction: Definition of Mechatronics products, design considerations and trade offs. Overview of Mechtronic 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

Micromechatronic Sytems: Micro sensors, micro actuators, smart instrumentation, micro-fabrication methods – lithography, etching, micro-joing.

TEXT BOOKS:

1. "Designing intelligent machines", open university, London.MichelB.Histand and david G. Alciatore.
2. Introduction to Mechatronics and Measurement systems, Tata McGraw Hill.3.C.W.desilva, " Control sensors and actuators, Prentice Hall.

M.Tech - II Sem		L	T	P	C
		3	0	0	3
MD 2044	ADVANCED TRIBOLOGY (Programme Elective - IV)				

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 – 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 multiplepad 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, gears and seals, wear analysis using soap and Ferrography.

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

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", McGraw-Hill Co.,1994.

REFERENCES:

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

M.Tech - II Sem		L	T	P	C
		3	0	0	3
MD 2045	EXPERIEMNTAL MODAL ANALYSIS (Programme Elective - IV)				

UNIT I

Theoretical basis for modal analysis:
Overview of modal analysis, Vibrations of single and multiple degree of freedom (SDOF, MDOF) systems, Frequency response functions (FRFs) for SDOF/MDOF systems. Types of FRFs. Orthogonality of modes and their application in modal analysis, Theory of undamped, proportionally damped, and non-proportionally damped SDOF/MDOF systems, Analyses for complex modes and sensitivity analysis of modal models

UNIT II

FRF measurement considerations:
Introduction to test planning, Excitation of structures (electromagnetic and electrohydraulic shakers, hammers, etc.), Transducers and amplifiers for measurements (force transducer, accelerometers, laser vibrometers, signal conditioners, amplifiers etc.), Actuator/sensor placement considerations, Revision of Fourier analysis and Fourier transforms, Discussions on aliasing, leakage, windowing, filtering andaveraging, Role of excitations signals in structural testing

UNIT III

Modal Parameter Extraction Methods: Introduction – Preliminary checks of FRF Data – SDOF Modal Analysis-I – Peak-amplitude – SDOF Modal Analysis-II – Circle Fit Method – SDOF Modal Analysis III

UNIT IV

Inverse Method – Residuals – MDOF curve-fitting procedures – MDOF curve fitting in the Time Domain – Global or Multi-Curve fitting – Non linear systems.

UNIT V

Applications and advanced topics: Model correlation. Concepts of modal assurance criterion and some of its variants, Dynamic substructuring, Modal reduction and expansion, Model updating, Advanced curve fitting for modal parameter extractions, Testing of weakly nonlinear structures

TEXT BOOKS

1. W T Thomson., " Theory of Vibrations with Applications", CBS Publishers
2. S S Rao, " Mechanical Vibrations", Addison-Wesley Publishing Co.

REFERENCES

3. Leonard Meirovitch, " Fundamentals of Vibration", McGraw Hill International Edison.
4. J P Den Hartog, "Mechanical Vibrations", Mc Graw Hill.
5. Srinivasan, " Mechanical Vibration Analysis", Mc Graw Hill.
6. Nuno Manuel Mendes Maia et al," Theoretical and Experimental Modal Analysis", WileyJohn & sons, 1999
7. Modal Analysis, by Jimin He and Zhi-Fang Fu, Butterworth-Heinemann

M.Tech - II Sem		L	T	P	C
		0	0	4	2
MD 205	COMPUTATIONAL MATHEMATICS LAB				

1. Generate a MATLAB and Python code for solving a system of linear equation using GaussElimination Method.
2. Generate a MATLAB and Python code for LU Decomposition (Factorization)
3. Generate a MATLAB and Python code for Iterative methods to solve equations using JacobiIteration.
4. Generate a MATLAB and Python code for Curve fitting
    i. Straight line fit
    ii. Polynomial Curve fit
5. Generate a MATLAB and Python code for Fourier transformation
    i. FFT Vs DFT
    ii. Interpolation by DFS
6. Generate a MATLAB and Python code for Euler's method differential equations
7. Generate a MATLAB and Python code for Runge – Kutta method differential equations
8. Generate a MATLAB and Python code for Matrices and Eigen values
    i. Eigen values and Eigen vectors
    ii. Jacobi method
9. Generate a MATLAB and Python code for Partial Differential equations
    i. Elliptical PDE
    ii. Parabolic PDE
    iii. The Crank – Nicholson method
    iv. Two dimensional parabolic PDE

M.Tech - II Sem		L	T	P	C
		0	0	4	2
MD 206	DESIGN PRACTICE LAB – II				

OBJECTIVES:

To know the method of programming the microprocessor and pneumatic experiments in basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept.

LIST OF EXPERIMENTS:

Part: A- MECHATRONICS

1) Simulation of basic Hydraulic, Pneumatic and Electric circuits using software.
2) Testing of circuits using basic pneumatic trainer kits.
3) Tircuits with logic sequence using Electro pneumatic trainer kit.
4) Tequential circuits in Electro pneumatic kit using PLC.
5) Testing of fluid power circuits to control (i) Velocity (ii) direction and (iii) forceof single and double acting actuators.
6) Study of sequential and hydraulic motor circuit using hydraulic systems.
7) Servo controller interfacing for open loop.
8) Servo controller interfacing for closed loop.
9) PID controller interfacing.
10) Stepper motor interfacing with 8051 Micro controller.
(i) Full step resolution (ii) half step resolution

Part: B – Material Characterization

1) Microscopy: Different microscopy techniques, Resolution, Magnification, Depth of field Imaging – theory and concepts.
2) Optical Microscopy: Grain size estimation, Phase Percentage Estimation
3) XRD- Estimation of Crystal planes, Crystal size, phase analysis etc.
4) X-ray microanalysis: EDS, EPMA (Surface analysis)
5) XRD, EBSD, SEM (Applications to crystallography)
6) X-ray methods (EDS, XRF)
7) Spectroscopy (IR, Raman)
8) FTIR, UV Visible Spectrophotometer
9) Sputtering, PVD/CVD Coatings
10) Testing of Materials- Micro hardness, Tensile strength, Flexural strength, Wear, Abrasion

M.Tech - II Sem		L	T	P	C
		2	0	0	0
MD 107	VALUE EDUCATION				

UNIT I

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

UNIT II

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

UNIT III

Personality and Behavior Development - Soul and Scientific attitude, Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship.

UNIT IV

Happiness Vs suffering, love for truth, Aware of self-destructive habits, Association and Cooperation. Doing best for saving nature

UNIT V

Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively.

TEXT BOOK:

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

M.Tech - II Sem		**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**
MD 208	**MINI PROJECT**				

M.Tech - III Sem		L	T	P	C
		3	0	0	3
MD 3011	INDUSTRIAL ROBOTICS (Programme Elective - V)				

UNIT - I

INTRODUCTION: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation scheme, work volume, robot drive systems, control systems and dynamic performance, precision of movement.

CONTROL SYSTEM AND COMPONENTS: basic concepts and motion controllers, controlsystem analysis, robot actuation and feedback components.

SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics. Positions sensors, velocity sensors, actuators, power transmission systems

UNIT - II

MOTION ANALYSIS AND CONTROL: Manipulator kinematics, position representation, forwardand inverse transformations, homogeneous transformations, manipulator path control, robot arm dynamics, configuration of a robot controller. Robot joint control design.

UNIT - III

END EFFECTORS: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design.

MACHINE VISION: Functions, Sensing and Digitizing-imaging devices, Lighting techniques, Analog to digital single conversion, image storage: Image processing and Analysis-image data reduction, Segmentation, feature extraction, Object recognition. Training the vision system, Robotic application.

UNIT - IV

ROBOT PROGRAMMING: Lead through programming, Robot program as a path in space, Motion interpolation, WAIT, SIGNAL AND DELAY commands, Branching, capabilities andLimitations of lead through methods.

ROBOT LANGUAGES: Textual robot Languages, Generations of robot programming languages,Robot language structures, Elements and function.

UNIT - V

ROBOT CELL DESGIN AND CONTROL: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detection, Work cell controller.

ROBOT APPLICATION: Material transfer, Machine loading/unloading, Processing operation, Assembly and Inspection, Future Application.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.

REFERENCES:

1 Robotics / Fu K S/ McGraw Hill.
2 Robotic Engineering / Richard D. Klafter, Prentice Hall
3 Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
4 Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley
5 Introduction to Robotics by SK Saha, The McGrah Hill Company, 6th, 2012
6 Robotics and Control / Mittal R K & Nagrath I J / TMH

M.Tech - III Sem		L	T	P	C
		3	0	0	3
MD 3012	ADVANCED OPTIMIZATION TECHNIQUES (Programme Elective - V)				

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.

UNIT - II

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 - 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,

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

UNIT – IV

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

UNIT V

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 and general optimization model of a machining process.

TEXT BOOKS:

1. Optimal design – JasbirArora, McGraw 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

M.Tech - III Sem		L	T	P	C
		3	0	0	3
MD 3021	INDUSTRIAL ROBOTICS (Open Elective)				

UNIT - I

INTRODUCTION: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

CONTROL SYSTEM AND COMPONENTS: basic concept and modais controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

UNIT - II

MOTION ANALYSIS AND CONTROL: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.

UNIT - III

END EFFECTORS: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics.

MACHINE VISION: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT - IV

ROBOT PROGRAMMING: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations.

ROBOT LANGUAGES: Textual robot Languages, Generation, Robot language structures, Elementsin function.

UNIT - V

ROBOT CELL DESGIN AND CONTROL: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations inwork design, Work and control, Inter locks, Error detection, Work cell controller.

ROBOT APPLICATION: Material transfer, Machine loading/unloading, Processing operation, Assembly andInspection, Future Application.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.

REFERENCES:

1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klafter, Prentice Hall
3. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
4. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley
5. Introduction to Robotics by SK Saha, The McGrah Hill Company, 6th, 2012
6. Robotics and Control / Mittal R K & Nagrath I J / TMH

M.Tech - III Sem		L	T	P	C
		3	0	0	3
MD 3022	OPERATIONS RESEARCH (Open Elective)				

UNIT I:
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplexmethod - sensitivity analysis - parametric programming

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

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

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

TEXT BOOKS:
1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.

REFERENCES:
1. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
2. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
3. Pannerselvam, Operations Research: Prentice Hall of India 2010
4. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

M.Tech - III Sem		L	T	P	C
		3	0	0	3
MD 3013	ADDITIVE MANUFACTURING (Programme Elective - V)				

UNIT I

Additive Manufacturing Process: Basic Principles of the Additive Manufacturing Process, Generationof Layer Information, Physical Principles for Layer Generation. Elements for Generating the Physical Layer, Classification of Additive Manufacturing Processes, Evaluation of the Theoretical Potentials of Rapid Prototyping Processes.

UNIT II

Machines for Rapid Prototyping: Overview of Polymerization: Stereolithography (SL), Sintering/Selective Sintering: Melting in the Powder Bed, Layer Laminate Manufacturing (LLM) andThree-Dimensional Printing (3DP).

UNIT III

Rapid Prototyping: Classification and Definition, Strategic Aspects for the Use of Prototypes, Applications of Rapid Prototyping in Industrial Product Development. Rapid Tooling: Classification and Definition of Terms, Properties of Additive Manufactured Tools, Indirect Rapid

UNIT IV

Tooling Processes: Molding Processes and Follow-up Processes, Indirect Methods for the Manufacture of Tools for Plastic Components, Indirect Methods for the Manufacture of Metal Components.

UNIT V

Direct Rapid Tooling Processes: Prototype Tooling: Tools Based on Plastic Rapid Prototyping Models and Methods, Metal Tools Based on Multilevel AM Processes, Direct Tooling: Tools Based on Metal Rapid Prototype Processes.

TEXT BOOKS:

1. Andreas Gebhardt Jan-Steffen Hötter, Additive Manufacturing: 3D Printing for Prototyping and Manufacturing, Hanser Publications, 6915 Valley Avenue, Cincinnati, Ohio.
2. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Second Edition, Springer New York Heidelberg Dordrecht London.

REFERENCES:

1. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications : A tool boxfor prototype development”, CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer,2006. 3. Hilton P.D. and Jacobs P.F., “Rapid
3. Tooling: Technologies and Industrial Applications”, CRC press, 2000.

		L	T	P	C
M.Tech - III Sem		**3**	**0**	**0**	**3**
MD 3014	**MECHANICS OF COMPOSITE MATERIALS (Programme Elective - V)**				

UNIT-I

Introduction to Composites, 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

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-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

Failure, Analysis, and Design of Laminates: Introduction , Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, static analysis of laminated plates

TEXT BOOKS:

1.Engineering Mechanics of Composite Materials by Isaac and M Daniel, OxfordUniversity 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, McGraw Hill Company, New York,1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van NostrandRainfold, New York, 1969.

		L	T	P	C
M.Tech - III Sem		**3**	**0**	**0**	**3**
MD 3015	**VEHICLE DYNAMICS (Programme Elective - V)**				

UNIT-I

Introduction to Vehicle Dynamics: Various kinds of vehicles, Motions, Mathematical modelling methods, Multibody system approach, Lagrangian formulations, Methods of investigations, Stability concepts.

UNIT-II

Mechanics of pneumatic tyres: Tyre construction, SAE recommended practice, Tyre forces and moments, Rolling resistance of tyres, Tractive effort and longitudinal slip, Cornering properties of tyres, Performance of tyre traction on dry and wet surfaces, Ride properties of tyres.

UNIT-III

Performance characteristics of road vehicle: Equation of motion and maximum tractive effort, Aerodynamic forces and moments, Vehicle power plant and transmission characteristics, Prediction of vehicle performance, Operating fuel economy, Braking performance.

UNIT-IV

Handling and stability characteristics of road vehicles: Steering geometry, Steady state handling characteristics, Steady state response to steering input, Testing of handling characteristics, Transient response characteristics, Directional stability, Effects of tyre factors, Mass distribution and engine location on stability of handling.

UNIT-V

Vehicle ride characteristics: Human response to vibration, Vehicle ride models, Introduction to random vibration - 1) Road suirface profile as a random function, 2) Frequency response function, 3) Evaluation of vehicle vertical vibration in relation to ride comfort criteria, 4) Active and semi active systems, 5) Optimum design for ride comfort and road holding.

TEXT BOOKS:

1. Theory of Ground Vehicles by Wong, J.Y., John Wiley and Sons, NY, 1993.

REFERENCES:

1. Fundamentals of Vehicle Dynamics by Gillespie, T.D., SAE Publication, Warrendal, USA,1992.

2. Tyres, Suspension and Handling by Dixon, J.C., SAE Publication, Warrendal, USA andArnold Publication, London, 1997.

II Year I Semester	NANO TECHNOLOGY (OPEN ELECTIVE)	L	P	C
		3	0	3

UNIT-I

Introduction, Size and shape dependence of material properties at the nanoscale, scaling relations, can nanorobots walk and nanoplanes fly, Nano scale elements in conventional technologies, Mechanics at nanoscale Enhancement of mechanical properties with decreasing size, Nano electromechanical systems, nano machines, Nano fluidics, filtration, sorting, Molecular motors, Application of Nano Technology.

UNIT-II

Nano material Synthesis Techniques: Top-down and bottom-up nanofabrication, Synthesis of nano composites, The Intel-IBM approach to nanotechnology: lithography, etching, ion implantation, thin film deposition, nano coatings and nano indentation, Electron beam lithography, Soft lithography: nanoimprinting and microcontact printing, Solution/plasma-phase nanofabrication, sol-gel methods, template techniques.

UNIT-III

Imaging/characterization of nanostructures General considerations for imaging, Scanning probe techniques: XRD, SEM, TEM, AFM and NSOM.

UNIT-IV

Metal and semiconductor nanoparticles Synthesis, stability, control of size, Optical and electronic properties, Ultra-sensitive imaging and detection with nano particles, bioengineering applications, Catalysis. Semiconductor and metal nanowires Vapor/liquid/solid growth and other synthesis techniques, Nanowire transistors and sensors.

UNIT-V

Carbon nanotubes

Structure and synthesis, Electronic, vibrational, and mechanical properties, How can C nanotubes enable faster computers, brighter TV screens, and stronger mechanical reinforcement?

TEXT BOOKS:

1. Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley (2005)
2. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, KluwerAcademic Publishers (2004).

REFERENCES:

1. Introduction to Nanotechnology by Poole and Owens, Wiley (2003)
2. Nanochemistry: A Chemical Approach to Nanomaterials, Ozin and Arsenault, RSCPublishing (2006).

II Year I Semester	OPTIMIZATION TECHNIQUES (OPEN ELECTIVE)	L	P	C
		3	0	3

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 equationsusing 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 PrintersInc., 2009
5. Reliability Theory and , Dover Publications, 2013

M.Tech - III Sem		L	T	P	C
		3	0	0	3
	INDUSTRIAL SAFETY (open Elective)				

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

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

Unit-III:

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

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

Unit-V:
Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da InformationServices.
2. Maintenance Engineering, H. P. Garg, S. Chand andCompany.
3. Pump-hydraulic Compressors, Audels, McgrewHillPublication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman &HallLondon

M.Tech - III Sem		**L**	**T**	**P**	**C**
		0	**0**	**20**	**10**
	DISSERTATION **(Phase I)**				

M.Tech - IV Sem		L	T	P	C
		0	0	32	16
	DISSERTATION (Phase II)				