D.N.R.COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

DEPARTMENT OF MECHANICAL ENGINEERING

REGULATIONS, COURSE STRUCTURE & SYLLABUS for
M.Tech
MACHINE DESIGN PROGRAMME

(Applicable for batches admitted from 2025-2026)

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY,
BHIMAVARAM

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY (Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING

ACADEMIC REGULATIONS- DR25 FOR M.Tech (REGULAR) DEGREE COURSE

Applicable for the students admitted to M. Tech (Regular) Course from the Academic Year 2025-26 and onwards. The M.Tech Degree of Jawaharlal Nehru Technological University Kakinada shall be conferred on candidates who are admitted to the program and who fulfill 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 University from time to time.

Admissions shall be made on the basis of merit/rank obtained by the candidates (i) in national level qualifying Entrance Test (GATE), (ii) AP PGECET conducted by State Government and (iii) Few Sponsored seats notified by University on the basis of any order of merit as approved by the State Government / University, subject to reservations as laid down by the Government 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. Under any circumstances, permission shall not be given to complete the course work beyond four years.

2.2 The student shall register for all 80 credits and secure all the 80 credits.

2.3 The minimum instruction period in each semester is16 weeks.

3.0 PROGRAMME OF STUDY

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

M.Tech in

Machine Design

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

4.0 ATTENDANCE

4.1 Attendance is calculated separately for each course. Attendance in all classes (Lectures / Laboratories) is compulsory. The minimum required attendance in each course is 75%. A student shall not be permitted to appear for the Semester End Examinations (SEE), if his/her attendance is less than 75%.

4.2 Condoning of shortage of attendance (between 65% and 75%) up to a maximumof 10% (*considering the days of attendance in sports, games, NSS activities and medical exigencies*) in

each course (Theory/Lab/Seminar) is condoned on production of valid Certificates/documents in the stipulated time mentioned here with:

4.2.1 Students who are admitted as in patients for treatment are only eligible to claim condonation of attendance. Such students under medical exigencies need to Produce (a) Doctor Medical Prescription, (ii) Medical bills duly signed by Doctor/Hospitalauthorities,(c)Diagnosisreports,ifany,(d)Discharge summary issued at the time of discharge and any other supporting documents within two week(s) from the date of discharge to the respective institution.

Note: University at any point of time can inform the institution(s) to submit such list/proofs. *Hence, respective institution shall verify and accord condonation privilege scrupulously*.

4.2.2 Students participation in Sports/Games and NSS activities shall also be permitted for condonation of attendance. In such cases, they need to produce (a) invitation letter from the organizing institute/agency, (ii) participation certificate and any supporting documents within two week(s) from the date of participation to the respective institution

4.3 A prescribed fee per course shall be payable for condoning shortage of attendance after getting the approval of College Academic Committee for the same. The College Academic Committee shall maintain all the relevant documents along with the request from the students, whose attendance is condoned.

4.4 Shortage of Attendance below 65% in any course shall in no case be condoned.

4.5 A Student, whose shortage of attendance is not condoned in any course(s) (Theory/Lab/Seminar) in any Semester, is considered as '**Detained in that course(s)**, and is not eligible to write Semester End Examination(s) of such Course(s), (in case of Seminar, his/her Seminar Report or Presentation are not eligible for evaluation) in that Semester; and he/she has to seek re-registration for those course(s) in subsequent Semesters, and attend the same as and when offered.

4.6 A student shall put in a minimum required attendance in at least FOUR courses inI semester for promotion to II Semester; and at least FOUR courses in II semester for promotion to III Semester.

Re-admission/re-registration

4.7 A student shall not be permitted to appear for the Semester End Examinations (SEE) in a course unless they meet the prescribed attendance requirements for that course. Such students may take readmission for the course in the subsequent semester when it is offered by paying the prescribed fee, *at least 30 days before the commencement of classwork*. The college must obtain permission from the University by submitting the list of students eligible/applied for readmission before the commencement of classwork.

4.8 Students who fail due to **less internal marks (less than 50%)** may register for the course within the maximum permissible duration of the Program.

4.9 In such a case, the candidate must re-register for the course(s) and secure the required minimum attendance. The candidate's attendance in the re-registered course(s) shall be calculated separately to decide upon eligibility for writing the end examination in those course(s).

4.10 In a semester, students are permitted to re-register maximum of THREE courses.

4.11 Upon re-registration, the student's previous performance in the respective course(s) will be nullified. Re-registration must be completed by paying the prescribed fee at least 30 days prior

to the commencement of classwork. The college is required to obtain approval from the University by submitting a list of eligible and interested students before the start of commencement of classwork.

5.0 EVALUATION

The performance of the candidate in each semester shall be evaluated course-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 courses 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. The continuous / internal evaluation shall be made based on the **average** of the marks secured in the two CIE/Mid Term-Examinations conducted-one in the middle of the Semester and the other immediately after the completion of instruction. Each CIE/midterm examination shall be conducted for a total duration of 120 minutes with 4 questions (without choice) each question for 10 marks. End semester examination is conducted for 60 marks for all FIVE (5) questions (one question from one unit) to be answered (either or).

5.2 For practical courses, 60 marks shall be awarded based on the performance in the End Semester Examinations and 40 marks shall be awarded based on the day-to-day performance as Internal Marks. The internal evaluation based on the day to day work-10 marks, record- 10 marks and the remaining 20 marks to be awarded by conducting an internal laboratory test. The end examination shall be conducted by the examiners, with breakup marks of Procedure-**15,** Experimentation- **25,** Results- 10, Viva-voce-10.

5.3 For 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 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 course 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 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 University from the panel of examiners submitted by the respective college.

5.6 Students shall undergo mandatory summer internship / industrial training (3 credits) for a minimum of **eight weeks duration** at the end of second semester of the Programme/Summer Break. A student will be required to submit a summer internship/industrial training report to the concerned department and appear for an oral presentation before the committee. The Committee comprises of a HoD / Professor of the department and two faculties. The report and the oral presentation shall carry 40% and 60% weightages respectively. For summer internship /industrial training, there will be only internal evaluation of 100 marks. A candidate has to

secure a minimum of 50% of marks to be declared successful.

5.7 The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering/Specialization in the PG program. Viva will be conducted in 3rd semester. The examination committee will be constituted by the HoD and consist of Professor of the department and two faculty. For comprehensive viva-voce, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

6.0 EVALUATION OF SEMINAR / INTERNSHIP / DISSERTATION WORK

All the students admitted under these regulations have to mandatorily comply the requirements of (i) Seminar-I, (ii) Seminar-II, (iii) Comprehensive Viva, (iv) Dissertation Part-A and (v) Dissertation Part-B. Out of these, (i) to (iv) are evaluated by internally by Project Review Committee (PRC) and (v) External Evaluation.

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 Students are required to appear for Seminar-I and Seminar-II in First and Second semester respectively. They shall present before PRC on the topic of their choice/interest preferably on the courses listed in respective semesters. PRC shall advise the students in advance to select topics which strengthen their Dissertation Part-A and Dissertation Part-B.

6.3 Students shall undergo mandatory summer internship / industrial training (*2 credits*) for a minimum of eight weeks duration at the end of second semester of the Programme/Summer Break. A student will be required to submit a summer internship/industrial training report to the concerned department and appear for an oral presentation before PRC. The report and the oral presentation shall carry40% and 60% weightages respectively. For summer internship / industrial training, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

6.4 The objective of comprehensive viva-voce is to assess the overall knowledge of the student in the relevant field of Engineering/Specialization in the PG program. Viva will be conducted in 3rd semester. For comprehensive viva-voce, there will be only internal evaluation of 100 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

6.5 Registration of Dissertation/Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the courses, both theory and practical and duly approved by PRC.

6.6 After satisfying 6.5, student has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work for approval.

6.7 If a candidate wishes to change his/her supervisor or topic of the project, he/she can do so with the approval of 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.

6.8 Continuous assessment of Dissertation-Part A and Dissertation-Part B during the Semester(s) will be monitored by PRC. *Dissertation-Part A* will be only internal evaluation by PRC for 100

marks. A candidate has to secure a minimum of 50%of marks to be declared successful.

6.9 The candidate shall submit a status report to the PRC in two stages, each accompanied by an oral presentation, with a minimum interval of three months between the two.

6.10 The work on the project shall be initiated at the beginning of the III Sem and the durationoftheprojectistwosemesters.AcandidateispermittedtosubmitProject Thesis *(Dissertation – Part A &Part B)* only with the approval of PRC not earlier than 40 weeks from the date of registration of the project work.

6.11 Three copies of the project thesis, printed on both sides of the page and certified by the supervisor, shall be submitted to the College/Institute along with the plagiarism report.

6.12 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned and head of the department.

6.13 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 *not favorable* again, the thesis shall be summarily rejected. The candidate has to reregister for the project and complete the project within the stipulated time after taking the approval from the University.

6.14 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 Head of the Department shall coordinate and make arrangements for the conduct of Viva-Voce examination. The Board shall jointly report the candidate's work for a maximum of 100 marks. Corresponding grade will be awarded by the University.

6.15 If the report of the Viva-Voce is unsatisfactory (i.e., < 50 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 University.

7.0 Cumulative Grade Point Average (CGPA)

Marks Range (Max – 100)	Letter Grade	Level	Grade Point
≥ 90	S	Outstanding	10
≥80 to <90	A	Excellent	9
≥70 to <80	B	Very Good	8
≥60 to <70	C	Good	7
≥50 to <60	D	Fair	6
<50	F	Fail	3
		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) = ∑(Ci X Gi) / ∑Ci

- Where Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

Computation of CGPA

- The **CGPA** is also calculated in the same manner taking into account all the courses undergone by a student over all the semester of a Programme,
  i.e. CGPA=∑(Ci X Si) /∑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 2decimal points and reported in the transcripts.
- Equivalent Percentage = (CGPA-0.5) x10.

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 Division with Distinction	≥ 7.5 (without supplementary History)	From the CGPA securedfrom80 credits
First Class	≥6.5	
Second Class	≥6.0to <6.5	

The secured grade, grade points, status and credits obtained will be shown separately in the memorandum of marks.

If a student wants to leave the program / exit after successful completion of first two semesters, he/she will be awarded Post Graduate Diploma in the specialization concerned.

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 GENERAL

10.1 Wherever the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

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

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

10.4 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 University.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

MALPRACTICESRULES

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 and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	Both the candidates involved in the malpractice will forfeit their 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 writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a 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 colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.

10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis ofinternal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the University for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators:

1. Punishments to the candidates as per the above guidelines.
2. Punishment for institutions: (if the squad reports that the college is also involved in encouraging malpractices)
   - (i) A show cause notices hall 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.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

Programme Structure

R25 M.Tech (XXXX)Structure

M.Tech (XXXX) I – Semester

S. No.	Course Code	Course Title	L	T	P	C
1		Program Core–1	3	1	0	4
2		Program Core–2	3	1	0	4
3		Program Core–3	3	1	0	4
4		Program Elective –I	3	0	0	3
5		Program Elective –II	3	0	0	3
6		Laboratory–1	0	1	2	2
7		Laboratory–2	0	1	2	2
8		Seminar-I	0	0	2	1
		TOTAL	**15**	**5**	**6**	**23**

List of Professional Elective Courses in I Semester (Electives– I & II)

S. No.	Course Code	Course Title
1		
2		
3		
4		
5		
6		
7		
8		

@ Minimum 2/3 themes per elective

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

M.Tech (XXXX) II – Semester

Sl. No.	Course Code	Course Title	L	T	P	C
1		Program Core–4	3	1	0	4
2		Program Core–5	3	1	0	4
3		Program Core–6	3	1	0	4
4		Program Elective –III	3	0	0	3
5		Program Elective -IV	3	0	0	3
6		Laboratory–3	0	1	2	2
7		Laboratory–4	0	1	2	2
8		Seminar–II	0	0	2	1
		TOTAL	**15**	**5**	**6**	**23**

List of Professional Elective Courses in II Semester (Electives III & IV)

S. No.	Course Code	Course Title
1		
2		
3		
4		
5		
6		
7		
8		

@ Minimum 2/3 themes per elective

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

M.Tech (XXXX) - III Semester

Sl. No.	Course Code	Course Title	L	T	P	C
1		Research Methodology and IPR / *Swayam 12 week MOOC course– RM&IPR*	3	0	0	3
2		Summer Internship / Industrial Training (8-10 weeks)*	-	-	-	3
3		Comprehensive Viva#	-	-	-	2
4		Dissertation Part– A$	-	-	20	10
		TOTAL	**3**	**-**	**20**	**18**

*Student attended during summer/ year break and assessment will be done in 3rd Sem.
Comprehensive viva can be conducted courses completed upto second sem.
$ Dissertation – Part A, internal assessment.

M.Tech. (XXXX) – IV Semester

Sl. No.	Course Code	Course Title	L	T	P	C
1		Dissertation Part– B%	-	-	32	16
		TOTAL	**-**	**-**	**32**	**16**

% External Assessment

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSE STRUCTURE AND SYLLABUS

Revised Bloom's Taxonomy Action Verbs

Definitions	I. Remembering	II. Understanding	III. Applying	IV. Analyzing	V. Evaluating	VI. Creating
Bloom's Definition	Exhibit memory of previously learned material by recalling facts, terms, basic concepts, and answers.	Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas.	Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.	Present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria.	Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.
Verbs	• Choose • Define • Find • How • Label • List • Match • Name • Omit • Recall • Relate • Select • Show • Spell • Tell • What • When • Where • Which • Who • Why	• Classify • Compare • Contrast • Demonstrate • Explain • Extend • Illustrate • Infer • Interpret • Outline • Relate • Rephrase • Show • Summarize • Translate	• Apply • Build • Choose • Construct • Develop • Experiment with • Identify • Interview • Make use of • Model • Organize • Plan • Select • Solve • Utilize	• Analyze • Assume • Categorize • Classify • Compare • Conclusion • Contrast • Discover • Dissect • Distinguish • Divide • Examine • Function • Inference • Inspect • List • Motive • Relationships • Simplify • Survey • Take part in • Test for • Theme	• Agree • Appraise • Assess • Award • Choose • Compare • Conclude • Criteria • Criticize • Decide • Deduct • Defend • Determine • Disprove • Estimate • Evaluate • Explain • Importance • Influence • Interpret • Judge • Justify • Mark • Measure • Opinion • Perceive • Prioritize • Prove • Rate • Recommend • Rule on • Select • Support • Value	• Adapt • Build • Change • Choose • Combine • Compile • Compose • Construct • Create • Delete • Design • Develop • Discuss • Elaborate • Estimate • Formulate • Happen • Imagine • Improve • Invent • Make up • Maximize • Minimize • Modify • Original • Originate • Plan • Predict • Propose • Solution • Solve • Suppose • Test • Theory

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

DEPARTMENT OF MECHANICAL ENGINEERING

COURSE STRUCTURE & SYLLABUS for
M.Tech
MACHINE DESIGN PROGRAMME

(Applicable for batches admitted from 2025 - 2026)

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY, BHIMAVARAM

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

M.Tech (MACHINE DESIGN)

I -SEMESTER

S.No		Course Code	Course Title	L	T	P	C
1	Program Core - 1	D2511500	Mechanical Vibrations and Acoustics	3	1	0	4
2	Program Core - 2	D2511501	Advanced Mechanics of Solids	3	1	0	4
3	Program Core - 3	D2511502	AI & ML for Mechanical Engineering	3	1	0	4
4	Programme Elective–I	D25115A0	Advanced Finite Element Methods	3	0	0	3
		D25115A1	Product Design & Development				
		D25115A2	Geometric Modeling				
		D25115A3	Numerical methods for Mechanical Engineering				
5	Programme Elective–II	D25115B0	Design for Manufacturing & Assembly	3	0	0	3
		D25115B1	MultiBody Dynamics				
		D25115B2	Vision Systems and Image Processing				
		D25115B3	Engineering Tribology				
6	Laboratory - 1	D2511503	Machine Dynamics Lab	0	0	4	2
7	Laboratory - 2	D2511504	Design Practice Lab-I	0	0	4	2
8	Seminar - I	D2511505	Seminar I	0	0	2	1
			Total	15	5	6	23

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II-SEMESTER

S.No		Course Code	Course Title	L	T	P	C
1	Program Core – 4	D2521500	Advanced Mechanisms & Robotics	3	1	0	4
2	Program Core – 5	D2521501	Advanced Machine Design	3	1	0	4
3	Program Core – 6	D2521502	Signal Analysis and Condition Monitoring	3	1	0	4
4	Programme Elective–III	D25215C0	Theory of Plasticity	3	0	0	3
		D25215C1	Advanced Optimization Techniques				
		D25215C2	Computational Fluid Dynamics				
		D25215C3	Mechanics of Composite Materials				
5	Programme Elective–IV	D25215D0	Experimental stress analysis	3	0	0	3
		D25215D1	Fracture Mechanics				
		D25215D2	Mechatronics				
		D25215D3	Introduction to Quantum Technologies				
6	Laboratory–3	D2521503	Computational Mathematics Lab	0	0	4	2
7	Laboratory–4	D2521504	Design Practice Lab-II	0	0	4	2
8	Seminar–II	D2521505	Seminar II	0	0	2	1
			Total	**15**	**5**	**6**	**23**

Note: Students are informed to complete Summer Internship (duration 8-10 weeks) at the end of the II Semester.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

M.Tech (MACHINE DESIGN)

III-SEMESTER

S.No		Course Code	Course Title	L	T	P	C
1		D2535800	Research Methodology and IPR/Swayam12Week MOOC Course RM & IPR	3	0	0	3
2		D2531501*	Summer Internship / Industrial Training	-	-	-	3
3		D2531502	Comprehensive Viva	-	-	-	2
4		D2531503	Dissertation Part-A	-	-	20	10
TOTAL				3	-	20	18

IV–SEMESTER

S.No		Course Code	Course Title	L	T	P	C
1		D2541500	Dissertation Part-B	-	-	32	16
TOTAL				-	-	32	16

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D2511500	L	T	P	C
		3	1	0	4
MECHANICAL VIBRATIONS AND ACOUSTICS					

Course Objectives:

1. To introduce the fundamentals and importance of vibration analysis in engineering systems.
2. To study free and forced vibrations of single degree of freedom systems.
3. To analyze vibration behavior of multi-degree freedom systems using matrix methods.
4. To understand vibration characteristics of continuous systems such as rods, shafts, and beams.
5. To introduce basic concepts of acoustics and sound propagation.

COURSE OUTCOMES: At the end of the course, student will be able

CO1: Explain and idealize the properties of complex structures into lumped parameter models for the overall vibration characteristics in design systems which require dynamical properties like damping, free and forced vibrations response.

CO2: Compute the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system

CO3: Evaluating the vibration parameters of continuous/elastic body systems for natural frequencies and subsequent mode shapes

CO4: Make a practical experience of basics of sound, noise and vibration; as well as their measurement and control strategies.

CO5: Describe the vibration measurement by using transducers and vibration exciters and able to assess occupational and environmental noise problems

UNIT –I

INTRODUCTION : Relevance 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 nonlinear 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 pressure Levels.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

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, Loudness, sound absorption and insulation and Noise control.

TEXT BOOKS:

1. S.S.Rao, “Mechanical Vibrations ", 5th Edition, Prentice Hall, 2011.
2. M.L.Munjal B. Venkatesham, “Noise and Vibration Control”, Second Edition, World Scientific,2024.

REFERENCES:

1. W.T. Thomson, M.D. Dahleh and C Padmanabhan, “Theory of Vibration with Applications”, 5th Edition, Pearson Education, 2008.
2 L.Meirovitch, “Elements of vibration Analysis", 2nd Edition, McGraw-Hill, New York, 1985.
3. Beranek and Ver, “Noise and Vibration Control Engineering: Principles and Applications”, John Wiley and Sons, 2006.
4. Randall F. Barron, “Industrial Noise Control and Acoustics”,Marcel Dekker, Inc., 2003.

Web Resources:

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D2511501	L	T	P	C
		3	1	0	4
ADVANCED MECHANICS OF SOLIDS					

COURSE OBJECTIVES:

1. To understand stress–strain theories and elastic behavior of solids.
2. To study yield criteria and material failure mechanisms.
3. To analyze fatigue, fracture, and buckling of structural members.
4. To apply energy methods for deflection analysis of structures.
5. To analyze unsymmetrical bending and curved beam behavior.

COURSE OUTCOMES: At the end of the course, student will be able to

CO1: Able to calculate stress in the machine components and analyze the failure modes

CO2: Able to identify the failure modes of different structural members and applying various energy methods for statically determinant and indeterminate structures

CO3: Able to calculate bending stresses in curved beams and beams subjected to non-symmetrical bending

CO4: Able to calculate torsional stresses in circular and non-circular cross section members and multi walled thin-walled tubes

CO5: Able to calculate and analyze contact stress when two bodies are in contact.

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 response of a solid, Hooke's Law, isotropic elasticity, Anisotropic elasticity, initiation of Yield, Yield criteria

UNIT –II

Failure criteria: Modes of failure, Failure criteria, Excessive deflections, Yield initiation, fracture, Progressive fracture, (High Cycle fatigue for number of cycles $N > 10^6$, buckling.

Application of energy methods: Elastic deflections and statically indeterminate members and structures: Principle of stationary potential energy, Castiglione's theorem on deflections, Castiglione's theorem on deflections for linear load deflection relations, deflections of statically determinate structures

UNIT –III

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

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

UNIT –IV

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT –V

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D2511502	L	T	P	C
		3	1	0	4
AI & ML FOR MECHANICAL ENGINEERING					

Course Objectives:

1) To impart the basic concepts of artificial intelligence and the principles of knowledge representation and reasoning.
2) To introduce the machine learning concepts and supervised learning methods
3) To enable the students gain knowledge in unsupervised learning method and Bayesian algorithms.
4) To make the students learn about neural networks and genetic algorithms.
5) To understand the machine learning analytics and applications of deep learning techniques to mechanical engineering.

Course Outcomes: At the end of the course, student will be able to

CO1: Explain the basic concepts of artificial intelligence
CO2: Learn about the principles of supervised learning methods
CO3: Gain knowledge in unsupervised learning method and Bayesian algorithms
CO4: Get knowledge about neural networks and genetic algorithms.
CO5: Understand the machine learning analytics and apply deep learning techniques to mechanical engineering applications

UNIT– I:

Introduction: Definition of Artificial Intelligence, Evolution, Need, and applications in real world. Intelligent Agents, Agents and Environments; Good Behaviour - concept of rationality, the nature of environments, structure of agents.

Introduction to Machine Learning (ML): Definition, Evolution, Need, applications of ML in industry and real-world, regression and classification problems, performance metrics, differences between supervised and unsupervised learning paradigms, bias, variance, overfitting and under fitting.

Supervised Learning: Linear regression, logistic regression, Distance-based methods, Nearest-Neighbours, Decision Trees, Support Vector Machines, Nonlinearity and Kernel Methods.

UNIT– II:

Unsupervised Learning: Clustering, K-means, Dimensionality Reduction, PCA and Kernel. Bayesian and Computational Learning: Bayes theorem, concept learning, maximum likelihood of normal, binomial, exponential, and Poisson distributions, minimum description length principle, Naïve Bayes Classifier, Instance-based Learning- K-Nearest neighbour learning.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT– III:

Neural Networks and Genetic Algorithms: Neural network representation, problems, perceptron, multilayer networks and backpropagation, steepest descent method, Convolutional neural networks and their applications, Local vs Global optima, Introduction to Genetic algorithms.

UNIT– IV:

Deep Learning: Recurrent Neural Networks and their applications, LSTM, Deep generative models, Deep auto-encoders, Applications of Deep Networks.

Machine Learning Algorithm Analytics: Evaluating Machine Learning algorithms, Model, Selection, Ensemble Methods - Boosting, Bagging, and Random Forests.

UNIT– V

Overview of Applications to Mechanical Engineering: Introduction to Machine learning packages, preparation of dataset for machine learning (cleansing and featuring)

Design of1D mechanical structures, Crack detection, fatigue life and creep estimation, Defect detection in casting and welding, Tool wear and Surface roughness prediction in CNC machining, Heat exchanger design optimization, fault classification.

TEXT BOOKS:

1) Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2/e, Pearson Education, 2010.
2) Tom M. Mitchell, Machine Learning, McGraw Hill, 2013.
3) EthemAlpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press, 2004.

REFERENCE BOOKS:

1) Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, 3/e, McGraw Hill Education, 2008.
2) Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI Learning, 2012.

ONLINE RESOURCES:

https://www.tpointtech.com/artificial-intelligence-ai
https://www.geeksforgeeks.org/

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D25115A0	L	T	P	C
		3	0	0	3
ADVANCED FINITE ELEMENT METHODS					

Course Objectives:

1. To understand formulation techniques and variational methods used in finite element analysis.
2. To analyze one-dimensional structural elements for displacement, stress, and temperature effects.
3. To model and analyze two-dimensional, axisymmetric, and heat transfer problems using finite elements.
4. To apply isoparametric formulation, numerical integration, and convergence requirements in FEM.
5. To introduce nonlinear finite element analysis for material and geometric nonlinear problems.

Course Outcomes: At the end of the course, student will be able to

CO1 : Understand the methodology, applications and types of finite element method
CO2 : Solve the problems of bars, trusses, beams and frames using finite element method
CO3 : Apply the finite element method to plates and axisymmetric problem
CO4 : Understand the isoparametric formulation and requirements for convergence
CO5 : Solve the dynamic problems and learn about the commericial finite element packages.

UNIT – 1

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 – 2

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

UNIT – 3

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 – 4

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

UNIT – 5

Introduction to Non-linear finite element Analysis (Syllabus from Ref. 3)

Nonlinear Material Problems (Syllabus from Ref. 2): Introduction, General procedure for solutions of Non-linear Discrete Problems, Nonlinear Constitutive problems in solid mechanics. Non-linear elasticity, Plasticity. Geometrically Non-linear problems(Syllabus from Ref. 2): General considerations

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

TEXT BOOKS:

1. Chandrubatla & Belagondu ,Finite element methods .
2. S.S. Rao,The Finite Element Method in Engineering, Fifth Edition

REFERENCES:

1.J.N. Reddy, Finite element method in Heat transfer and fluid dynamics, CRC press, 1994.
2. Zienkiewicz O.C. Finite Element Method, McGraw-Hill, Third Edition, 1977.
3. K. J. Bathe, Finite element procedures, Prentice-Hall, 1996

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D25115A1	L	T	P	C
		3	0	0	3
PRODUCT DESIGN AND DEVELOPMENT					

Course Objectives

1. To develop creative thinking skills for effective idea generation.
2. To train students to convert conceptual ideas into clear sketches and concepts.
3. To enable presentation of ideas using IT tools and physical models.
4. To introduce failure identification methods and fault-free analysis techniques.
5. To familiarize students with product testing under thermal, vibration, electrical, and combined environments.

Course Outcomes: At the end of the course, student will be able to

CO1 : Apply creative thinking skills for idea generation
CO2 : Translate conceptual ideas into clear sketches
CO3 : Present ideas using IT application software and physical model
CO4 : Able to identify causes of failure through fault free analysis and perform failure analysis
CO5 : To carryout perform product testing under thermal, vibration, electrical and combined environments.

UNIT – 1

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

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

UNIT – 2

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 – 3

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.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT – 4

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 – 5

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; Parts Modularization

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.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D25115A2	L	T	P	C
		3	0	0	3
GEOMETRIC MODELING					

Course Objectives

1. To introduce parametric representation of simple geometric entities and cubic splines.
2. To develop mathematical formulation of Bézier curves.
3. To understand and formulate B-spline curves for geometric modeling.
4. To introduce parametric representation of analytic and synthetic surfaces.
5. To understand and apply various solid modeling schemes in CAD systems.

Course Outcomes: At the end of the course, student will be able to

CO1 : Develop parametric equations for simple geometric entities, formulate algebraic and geometric form of a cubic spline.
CO2 : Develop equations for Bezier curve.
CO3 : Develop equations for B-Spline curve
CO4 : Develop parametric representation of analytic and synthetic surfaces
CO5 : Understand and implement various schemes used for construction of solid models

UNIT – 1
Introduction: Definition, Explicit and implicit equations, parametric equations.
UNIT – 2
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 – 3
Bezier Curves: Bernstein basis, equations of Bezier curves, properties, derivatives.
B-Spline Curves: B-Spline basis, equations, knot vectors, properties, and derivatives.
UNIT – 4
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 – 5
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.Mallikarjuna Rao, MMM Sarcar, PHI Publis

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D25115A3	L	T	P	C
		3	0	0	3
NUMERICAL METHODS FOR MECHANICAL ENGINEERING					

Course Objectives:

1. To introduce numerical methods for engineering analysis and scientific computing.
2. To study numerical techniques for solving linear and nonlinear equations.
3. To understand data approximation, curve fitting, and regression methods.
4. To analyze boundary value problems, eigenvalue problems, and partial differential equations numerically.
5. To develop programming skills for implementing numerical algorithms effectively.

Course Outcomes: At the end of the course, student will be able to

CO1: Apply numerical methods to solve engineering and computational problems.
CO2: Solve linear and nonlinear algebraic equations using numerical techniques.
CO3: Perform data fitting using regression methods and interpolation techniques.
CO4: Solve boundary value, eigen value, and partial differential equations using numerical methods.
CO5: Apply Fourier and Laplace transforms and implement numerical algorithms using programming.

UNIT – 1

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

UNIT – 2

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

UNIT – 3

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

UNIT – 4

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT – 5

Partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria. Solving wave equation by finite differences-stability of numerical method –method of characteristics-wave equation in two space dimensions-computer programs

TEXT BOOKS:

1. Steven C.Chapra, Raymond P.Canale "Numerical Methods for Engineers" Tata Mc-Graw Hill
2. 2.Curtis F.Gerald, Partick.O.Wheatly,"Applied numerical analysis" Addison-Wesley,1989
3. 3.Douglas J.Faires, Riched Burden" Numerical methods", Brooks/Cole publishing
4. company,1998.Second edition.

REFERENCES:

1. Ward Cheney and David Kincaid "Numerical mathematics and computing" Brooks/Cole publishing company1999, Fourth edition.
2. Riley K.F,. M.P.Hobson and Bence S.J,"Mathematical methods for physics and engineering", Cambridge University press,1999.
3. Kreysis, Advanced Mathematics

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D25115B0	L	T	P	C
		3	0	0	3
DESIGN FOR MANUFACTURING AND ASSEMBLY					

Course Objectives

1. To introduce the concepts and applications of Design for Manufacturing and Assembly (DFMA).
2. To understand design guidelines for ease of manual assembly and machining.
3. To study design rules, simulation, and selection of casting, extrusion, and forming processes.
4. To understand design considerations in welding and forging, including thermal stress effects.
5. To analyze design requirements for automatic assembly and evaluate assembly systems quantitatively.

Course Outcomes: At the end of the course, student will be able to

CO1 : Understand the basic concepts of DFMA and their applications. Apply design rules to manual assembly.
CO2 : Apply design rules for ease of machining and understand the design recommendations for machined parts
CO3 : Understand the selection, simulation and design rules of casting processes. Also to understand the design considerations for extruded sections and various forming processes.
CO4 : Understand the design considerations and effect of thermal stresses in welded joints. Understand the design factors for forging.
CO5 : Understand the design considerations for automatic assembly and to do quantitative analysis of assembly systems.

UNIT – 1

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, ISO Standards.

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

UNIT – 2

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

UNIT – 3

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

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT – 4

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 – 5

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

TEXT BOOKS:

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

REFERENCE:

ASM Hand book Vol.20

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D25115B1	L	T	P	C
		3	0	0	3
MULTI BODY DYNAMICS					

Course Objectives

1. To introduce kinematics and dynamics of constrained multibody systems.
2. To formulate and analyze planar multibody mechanical systems.
3. To apply numerical methods for analysis of multibody systems.
4. To perform forward and inverse dynamic analysis of mechanisms.
5. To model and analyze spatial multibody systems.

Course Outcomes: At the end of the course, student will be able to

CO1 : Apply kinematics and dynamics to constrained multibody systems.
CO2 : Formulate and analyze planar multibody systems.
CO3 : Use numerical methods for multibody analysis.
CO4 : Perform inverse and forward dynamic analysis.
CO5 : Model and analyze spatial multibody systems.

UNIT – 1
Review of kinematics and dynamics of point mass and rigid body - types of constraints - constraints for revolute joints, translational joints, composite joints

UNIT – 2
Formulation of planar multi-body systems, kinematics and dynamics in point coordinates, body coordinates, and joint coordinates

UNIT – 3
Numerical methods for solution - analysis of planar multi-body systems, kinematic analysis in various formulations.

UNIT – 4
Inverse dynamic analysis, forward dynamic analysis, constraint stabilization - case studies, McPherson strut suspension, Double A-arm suspension, planar robot manipulator

UNIT – 5
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.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

REFERNCES:

1. Planar Multibody Dynamics Formulation, Programming and Applications – Parviz E. Nikravesh, CRC Press
2. Computer-Aided Analysis of Mechanical Systems – Parviz E. Nikravesh, Prentice Hall, 1988
3. Dynamics of Multibody Systems – A. A. Shabana, Cambridge University Press, 1998

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D25115B2	L	T	P	C
		3	0	0	3
VISION SYSTEMS AND IMAGE PROCESSING					

Course Objectives

1. To introduce the fundamentals of machine vision systems, sensors, lighting, and applications.
2. To understand digital image representation, sampling, and image transformations.
3. To study spatial and frequency domain techniques for image analysis.
4. To apply image enhancement, restoration, and segmentation methods.
5. To understand image compression, feature extraction, and classification techniques.

Course Outcomes: At the end of the course, student will be able to

CO1 : Explain machine vision systems, sensors, lighting, and applications.
CO2 : Represent and transform digital images using sampling and transforms.
CO3 : Apply spatial and frequency domain techniques for image analysis.
CO4 : Perform image enhancement, restoration, and segmentation.
CO5 : Implement image compression, feature extraction, and image classification.

UNIT – 1
Machine vision: Vision sensors - Comparison with other types of sensors - Image acquisition and recognition - Recognition of 3D objects - Lighting techniques - Machine vision applications.

UNIT – 2
Image representation: Application of image processing - Image sampling, Digitization and quantization - Image transforms.

UNIT – 3
Spatial domain techniques: Convolution, Correlation. Frequency domain operations - Fast Fourier transforms, FFT, DFT, Investigation of spectra. Hough transform

UNIT – 4
Image enhancement: Filtering, Restoration, Histogram equalization, Segmentation, Region growing.

UNIT – 5
Image compression: Edge detection - Thresholding - Spatial smoothing - Boundary and Region representation - Shape features - Scene matching and detection - Image classification

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

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.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D25115B3	L	T	P	C
		3	0	0	3
ENGINEERING TRIBOLOGY					

Course Objectives

1. To understand friction, wear mechanisms, lubrication principles, and lubrication system selection.
2. To study selection, load capacity, and condition monitoring of rolling element bearings.
3. To design hydrostatic thrust and journal bearings for engineering applications.
4. To evaluate load capacity and life of hydrodynamic thrust and journal bearings.
5. To understand types of seals, bearing failures, and selection of seals for applications.

Course Outcomes: At the end of the course, student will be able to

CO1 : To must be able to understand friction and wear mechanism and the effects of lubrication. To must be able to describe lubrication systems and their selection criteria.

CO2 : To must be able to select rolling element bearing based on their static and dynamic load carrying capacity and must be able to understand condition monitoring procedures of the bearing.

CO3 : To must be able to design hydrostatic thrust and journal bearings for different applications.

CO4 : To must be able to understand to evaluate load carrying capacity and life of hydrodynamic thrust and journal bearing.

CO5 : To describe different type of seals and select suitable seals for given application and illustrate the failures of different types of bearing.

UNIT – 1

Introduction: History of Tribology, 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,EHL(Elasto Hydrodynamic Lubrication), types of oil, Grease and solid lubricants- additives- lubrication systems and their selection.

UNIT – 2

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 – 3

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

UNIT – 4

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT – 5

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 Ferrogr
aphy.

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

TEXT BOOKS:

1. Rowe WW& O' Dionoghue,"Hydrostatic and Hybrid bearing design " 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,Mc Graw Hill Book & Co.,1968
3. Shigley J, E Charles," Mechanical Engineering Design", McGraw Hill Co., 1989

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D2511503	L	T	P	C
		0	0	4	2
MACHINE DYNAMICS LAB					

Course Objectives:

1. To understand the effect of damping on structures under different vibration excitations.
2. To perform experimental analysis of free and forced vibrations in discrete and continuous systems.
3. To conduct experimental modal analysis on beams and plates with various boundary conditions.
4. To measure sound pressure levels and study sound directivity characteristics.
5. To learn experimental methods for acoustic material characterization.

Course Outcomes: At the end of the course, students will be able to

CO1 : Practically observe the phenomenon of damping on structures under various vibration excitations.
CO2 : Perform free and forced vibration analysis of discrete and continuous systems using measurement instruments
CO3 : Practice the experimental modal analysis on different beams and plates with variable boundary condition.
CO4 : Practice the measurement of sound pressure and directivity
CO5 : Learn the measurement methodologies of acoustic material characterization

LIST OF EXPERIMENTS:

1. Determination of damped natural frequency of the vibrating system with different viscous oils.
2. Determination of steady state amplitude of a vibratory system with base excitation.
3. Determination of natural frequency and mode shape of multi degree freedom system.
4. Field balancing of the thin rotors using vibration pickups using MFS.
5. Determination of the magnitude of gyroscopic couple, angular velocity of procession and representation of vectors.
6. Experimental modal analysis of Beams.
7. Experimental modal analysis of plates.
8. Source directivity measurement.
9. Sound power and intensity measurement.
10. Sound absorption measurement by impedance tube.
11. Sound transmission loss measurement by impedance tube.
12. Outdoor Noise Measurements and hemispherical divergence

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D2511504	L	T	P	C
		0	0	4	2
DESIGN PRACTICE LAB - 1					

Course Objectives

1. To inculcate a culture of research among faculty and students in composite materials.
2. To fabricate different types of composites using suitable matrices, reinforcements, and fillers through hand layup and other methods.
3. To characterize and evaluate the mechanical and tribological behavior of composite materials.
4. To study the influence of reinforcement on mechanical, tribological, and wear characteristics of composites.
5. To perform fractographic studies to understand failure and wear mechanisms and recommend optimal conditions for desired performance and applications.

Course Outcomes: At the end of the course, student will be able to

CO1: Fabricate composite materials using different matrices, reinforcements, and fillers through suitable processing techniques.
CO2: Characterize the mechanical and tribological properties of composite materials using standard testing methods.
CO3: Analyze the influence of reinforcement on the mechanical, tribological, and wear behavior of composites.
CO4: Interpret fractographic results to identify failure and wear mechanisms under different loading conditions.
CO5: Recommend optimal material combinations and processing conditions for desired performance and potential commercial applications.

LIST OF EXPERIMENTS

PART-A: Fabrication and Specimen Preparation Experiments
The Crafting, Creation and Construction of objects, parts, items of a product using proposed materials and systematic procedure.

1. Fabrication of PMC by
   a) Hand Layup Open Moulding
   b) Vacuum Bag Moulding
2. Fabrication of MMC by
   a) Muffle Furness and Stir Casting Process
3. Fabrication of CMC by
   a) Milling, Blending and Sintering Techniques
4. Test Specimen Preparation for Characterization as per ASTM Standards

PART-B: Characterization Experiments

The *process of measuring and determining physical, chemical, mechanical and microstructural* properties of materials using a variety of analytical methods, techniques and tools under various operational conditions and environments.

5. Characterization of PMC test specimens on Tensile Tester, Fatigue Tester, TMA and FFT
6. Characterization of MMC test specimens on Tensile Tester, Fatigue Tester, Pin on Disc and FFT
7. Characterization of CMC test specimens on Tensile Tester, Fatigue Tester, Pin on Disc and FFT

TOOLS/EQUIPMENTS AND APPARATUS

The essential tools/equipments required for students to conduct experimentation includes

1. Test Specimen Preparation Kit
2. Micro Tensile/Impact/Hardness Testers
3. Dry Wear Test Rig (Pin Disc Apparatus/)
4. Fatigue Testing
5. Thermo Mechanical Analyzer
6. FFT Analyzer and ME-Scope Simulation
7. Furness and Stir Casting Apparatus
8. Millers and Sintering Equipments

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

I Semester	Course Code: D2511505	L	T	P	C
		0	0	2	1
SEMINAR - 1					

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D2521500	L	T	P	C
		3	1	0	4
ADVANCED MECHANISMS AND ROBOTICS					

Course Objectives

1. To introduce mobility criteria and degree of freedom analysis of mechanisms.
2. To study curvature theory and determine centers of curvature using Euler–Savary equations.
3. To analyze relative motion and synthesis of mechanisms using function generation methods.
4. To design four-bar mechanisms using Freudenstein's equation.
5. To understand the kinematics of manipulators used in real-life applications.

Course Outcomes: At the end of the course, student will be able to

CO1 : Develop the mobility criteria and use the criteria to find the degree of freedom of various mechanisms.
CO2 : Develop the Eulery savary equations using Hartmanns construction to determine the centre of curvature
CO3 : To locate the relative roto centre using the function generation approach for 2-positions and 3-positions scenarios
CO4 : Design the Freudenstein's equation to find the lengths of the links in a four bar mechanism
CO5 : To study the kinematics of different manipulators in daily life applications

UNIT – 1

Advanced Kinematics of plane motion: The Inflection circle; Euler – Savary Equation; Analytical and graphical determination of d_i; Bobillier's Construction; Collineastion axis ; Hartmann's Construction. 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

UNIT – 2

Synthesis-Graphical Methods: 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.

Function generation and Path generation: Overlay's method, Roberts's theorem

UNIT – 3

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 – 4

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT – 5

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.

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D2521501	L	T	P	C
		3	1	0	4
ADVANCED MACHINE DESIGN					

Course Objectives

1. To introduce design models and methodologies for mechanical product design.
2. To study failure modes, fatigue mechanisms, and life estimation of machine components.
3. To design machine components subjected to cyclic loading conditions.
4. To analyze and design components against surface fatigue failures.
5. To incorporate human ergonomic factors in machine component design.

Course Outcomes: At the end of the course, student will be able to

CO1: An ability to carry out and analyze various design models and product design.
CO2: Able to identify the failure modes and various fatigue mechanisms of different machine components and life estimation.
CO3: Ability to design the machine components against cyclic loads and their estimation
CO4: Ability to design the machine components against surface fatigue failures
CO5: Ability to design the machine components against human ergonomic factors.

UNIT – 1

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 – 2

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 – 3

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

UNIT – 4

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT – 5

Human engineering considerations, Ergonomics, Modern approaches in design, Ethics in engineering design, Ethical issues considered during engineering design process , Creep and damping, creep phenomenon, creep curve, creep parameters, time temperature parameters and life estimate, energy dissipation in materials.

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 McGrawHill International Book Company, New Delhi.
3. Mechanical Behaviour of Materials- NormanE.Dowling, Stephen L. Kampe, Milo V.Kral Pearson publishers, 5th edition.

REFERENCES:

1. Fundamentals of machine elements by Hamrock, Schmid and Jacobian, 2nd edition, McGraw- Hill International edition.
2. Product design and development by Karl T. Ulrich and Steven D. Eppinger. 3rd edition, Tata McGraw 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 **/McGrawHill International edition.**

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	**Course Code: D2521502**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**
SIGNAL ANALYSIS AND CONDITION MONITORING					

Course Objectives

1. To provide an understanding of signal characteristics generated by rotating and reciprocating machines.
2. To impart knowledge of condition monitoring techniques used for machine fault diagnosis.
3. To enable analysis of vibration signals for identifying faults in machinery.
4. To familiarize students with common faults occurring in rotating and reciprocating machines.
5. To develop the ability to apply fault detection and diagnostic techniques for machinery health assessment.

Course Outcomes: At the end of the course, student will be able to

CO1: Analyze the signals from rotating and reciprocating machines
CO2: Apply condition monitoring methods for fault diagnosis in machines
CO3: Analyze the vibration signals from rotating and reciprocating machines
CO4: Illustrate the faults in rotating and reciprocating machines
CO5: Apply fault detection techniques for fault diagnosis in rotating and reciprocating machines

UNIT – I

SIGNAL ANALYSIS OF CONTINUOUS STATIONARY SIGNALS: Introduction, Basic concepts, Signal types, Time domain Signal analysis, Data Acquisition, Filtering, Fourier series, FFT, Modulation and Sidebands.

UNIT – II

SIGNAL ANALYSIS OF CONTINUOUS NON-STATIONARY SIGNALS: Instrumentation, Data Recording, Order Analysis, Orbits, Envelope, Cepstrum, Short Term Fourier Analysis (STFT), Introduction to wavelets, Choice of window type, Choice of window length, Choice of incremental step, Practical details of signal processing.

UNIT – III

CONDITION MONITORING METHODS: Vibration Analysis, oil Analysis, wear debris analysis, thermography, performance analysis, noise monitoring, temperature monitoring, wear behaviour monitoring, Signals generated by rotating and reciprocating shafts.

UNIT – IV

VIBRATION 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.

UNIT – V

FAULT DIAGNOSIS: Signal based fault classification, signals generated by rotating and reciprocating machines, low shaft orders and subharmonics, vibrations from gears, rolling element bearings and electrical machines. Introduction to machine learning for signal interpretation, Pattern recognition and clustering methods, Feature extraction and dimensionality reduction, Health Index and Remaining Useful Life (RUL) estimation.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

TEXT BOOK:

1. Condition Monitoring of Mechanical Systems / Colcote.
2. Amiya Ranjan Mohanty, Machinery Condition Monitoring: Principles and Practices, 1st Edition, CRC press, 2014

REFERENCES:

1. John S. Mitchell, Introduction to Machinery Analysis and Monitoring, 1st Edition, Penn Well Books,1993
2. R. C. Mishra, K. Pathak, Maintenance Engineering and Management, 1st Edition, Prentice Hall of India Pvt. Ltd., 2002.
3. Robert Bond Randall, Vibration-Based Condition Monitoring: Industrial, Aerospace and Automotive applications, 1st Edition, John Wiley & Sons Ltd., 2011

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D25215C0	L	T	P	C
		3	0	0	3
THEORY OF PLASTICITY					

Course Objectives

1. To understand elastic and plastic behavior of materials using stress–strain relationships.
2. To study commonly used plastic yield criteria in constitutive modeling.
3. To interpret material constants involved in constitutive equations.
4. To analyze simple boundary value problems involving elasto-plastic material behavior.
5. To develop constitutive material models based on experimental observations.

Course Outcomes: At the end of the course, student will be able to

CO1 : Describe the elastic and plastic behaviour from stress-strain curves for materials;
CO2 : Recognize typical plastic yield criteria established in constitutive modeling
CO3 : Understand the physical interpretation of material constants in mathematical formulation of constitutive relationship
CO4 : solve analytically the simple boundary value problems with elasto-plastic properties
CO5 : Develop constitutive models based on experimental results on material behavior

UNIT – 1

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 – 2

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 – 3

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 – 4

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 – 5

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 theorems, 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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D25215C1	L	T	P	C
		3	0	0	3
ADVANCED OPTIMIZATION TECHNIQUES					

Course Objectives

1. To introduce classical optimization methods for single- and multi-variable constrained problems.
2. To study numerical optimization techniques and penalty methods for constrained optimization.
3. To apply genetic algorithms for solving single- and multi-objective optimization problems.
4. To understand genetic programming approaches for solving engineering and differential equation problems.
5. To explore non-traditional optimization techniques for complex engineering applications.

Course Outcomes: At the end of the course, student will be able to

CO1 : Apply classical optimization methods for single- and multi-variable problems with constraints.
CO2 : Use numerical optimization techniques and penalty methods for constrained problems.
CO3 : Implement genetic algorithms for single- and multi-objective optimization problems.
CO4 : Apply genetic programming to solve engineering and differential equation problems.
CO5 : Utilize non-traditional optimization techniques for complex engineering optimization tasks.

UNIT – 1

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 – 2

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 – 3

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-dominated sorted GA, convergence criterion, applications of multi-objective problems.

UNIT – 4

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

UNIT – 5

Non-Traditional optimization techniques: Goal programming, simulated annealing, Neural Networks based optimization.

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

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.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D25215C2	L	T	P	C
		3	0	0	3
COMPUTATIONAL FLUID DYNAMICS					

Course Objectives

1. To introduce classification of partial differential equations and solution methods for elliptic, parabolic, and hyperbolic equations.
2. To understand the basic principles and governing equations of computational fluid dynamics.
3. To apply finite difference methods to incompressible viscous and compressible flow problems.
4. To study finite volume formulations for two-dimensional and three-dimensional fluid flow problems.
5. To apply finite element methods for steady-state and transient fluid flow analysis.

Course Outcomes: At the end of the course, student will be able to

CO1: Understand classification of PDEs and differential solutions and methods for Elliptical, parabolic and hyperbolic equations.
CO2: Understand basic principles and governing equations of CFD
CO3: Apply finite differential method for incompressible viscous flow problems and compressible flow problems.
CO4: Understand finite volume formulations for two dimensional and three dimensional problems
CO5: Apply finite element methods for steady state and transient fluid flow problems

UNIT – 1

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.

UNIT – 2

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.

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 – 3

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, Euler equations-Central schemes, Navier-stokes system of equations, boundary conditions, example problems.

UNIT – 4

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT – 5

FINITE ELEMENT METHODS: Introduction to Finite Element Methods, Finite Element Interpolation Functions, Linear Problems- Steady-State Problems – Standard Galerkin Methods, Transient Problems– Generalized Galerkin Methods, Example 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.
2. Patankar, S. V., 2017, Numerical Heat Transfer and Fluid Flow, Special Indian ed., CRC Press.
3. Muralidhar K., and Sundararajan T. (Editors), 2017, Computational Fluid Flow and Heat Transfer, 2nd ed. tenth reprint, Narosa.
4. Anderson Jr., J. D., 2017, Computational Fluid Dynamics: The Basics with Applications, Indian ed., McGraw Hill Education.
5. Donea, J., and Huerta, A., 2003, Finite Element Methods for Flow Problems, John Wiley & Sons, Ltd.
6. Zienkiewicz, O. C, Nithiarasu, P., and Taylor, R. L, 2013, The Finite Element Method for Fluid Dynamics, 7th ed., Butterworth-Heinemann Ltd.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D25215C3	L	T	P	C
		3	0	0	3
MECHANICS OF COMPOSITE MATERIALS					

Course Objectives

1. To introduce composite materials and compare their properties with conventional materials.
2. To understand the mechanical behavior of composite materials for different application requirements.
3. To analyze micromechanical properties of fiber-reinforced composites and their constituent materials.
4. To derive stiffness parameters governing the design and analysis of composite materials.
5. To apply constitutive relations to predict the macromechanical behavior of composite laminates and understands their applications.

Course Outcomes: At the end of the course, student will be able to

CO1: Describe what are composite materials and their differences with respect to conventional materials such as metals.

CO2: Understands mechanical behavior various materials under different choices made for using certain types of composites in certain applications.

CO3: Analyze the micromechanical properties of fibre reinforced composites i.e. Identify, describe and evaluate the properties of fiber reinforcements, polymer matrix materials.

CO4: Derive the mathematical expressions for the various stiffness parameters which govern the design and analysis of the composites.

CO5: Apply constitutive equations of composite materials to predict the macro mechanical behavior composite laminates. Also appreciate the practical applications of structural composites.

UNIT – 1

COMPOSITE MATERIALS: History and evolution of basic concept of composite, Definition and Classification of Composites, Roles of constituents in composite, Interface and inter phase, Matrix Resins: Thermoplastics and thermosetting matrix resins and advanced matrix- polyethylene (UHMWPE). Composite Reinforcements: Particle, short fiber, continuous fibers, Natural fibers: cellulose, jute, coir etc, Manmade fibers: boron, carbon, ceramic, glass and aramids, advanced reinforcement-polybenzthiazoles.

UNIT – 2

MECHANICS OF GENERIC MATERIALS: Mechanical behavior various material systems, Hooks law for general anisotropic materials, Stress-Strain relations for various kinds of materials behavior, Derivation of the engineering constants of constitutive matrices using mechanics of materials approach for orthotropic material. Fundamental terms to understand composite structural members, Coordinates systems for analysis ofcomposite structures.

UNIT – 3

MICRO-MECHANICS OF COMPOSITES: Lamina, Calculation of fiber, matrix and void weight and volume fractions, Micromechanical analysis of composite lamina-Evaluation of four effective elastic moduli-Analytical rule of mixtures, Empirical models-Halpin-sai model, Chamis Model, Introduction to advanced micromechanical models (Numerical).

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT – 4

MECHANICS OF COMPOSITE LAMINATE: Derivation for the strength of unidirectional lamina, Lamina stiffness matrix [Q], Designation and configuration of composite laminate-Laminate code, Transformation matrices, On-axis stiffness and off-axis stiffness, Laminate stiffness matrix [$\bar{Q}$], Classical lamination theory (CLT)- Assumptions, [A][B][D] matrices, Effect of lamination schemes on[A][B][D] matrices

UNIT – 5

ANALYSIS OF COMPOSITES: Analysis of inter-laminar stresses and strains with various lamination schemes, Coefficients of thermal and moisture expansions, Effect of hydrothermal environment on stresses and strains, First order shear deformation theory (FSDT), Introduction to analysis of sandwiched composite structures. Applications-Industrial, aerospace, automobile, sports, medical and house hold etc.

TEXT BOOKS

1. Isaac M. Daniel, Ori Ishai, Mechanics of Composite Materials, 2006 by Oxford University Press; 2nd edition.
2. Autar K. Kaw, Mechanics of Composite Materials, 2006 by Taylor & Francis Group, LLC, 2nd edition.
3. Robert M. Jones, Mechanics of composite materials. 1998, McGraw-Hill, New York. 2nd edition.

REFERENCE TEXT BOOKS

1. Michael W. Hyer, 1998 by McGraw-Hill, New York. International Edition
2. Mechanics of Laminated Composite Plates and Shells, Theory and Analysis, Second Edition McGraw-Hill, New York. 2nd edition
3. Bhagwan D. Agarwal, Lawrence J. Broutman, Analysis and Performance of Fiber Composites, 2012 by John Wiley, 3rd Edition

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D25215D0	L	T	P	C
		3	0	0	3
EXPERIMENTAL STRESS ANALYSIS					

Course Objectives

1. To understand stress–strain relationships under plane stress, plane strain, and three-dimensional conditions.
2. To study strain measurement techniques using electrical and semiconductor strain gauges with data acquisition systems.
3. To apply photoelasticity and digital image correlation methods for experimental stress analysis.
4. To evaluate stresses using brittle coating and Moiré fringe techniques.
5. To determine stresses and strains using birefringent coating methods.

Course Outcomes: At the end of the course, student will be able to

CO1: Analyze stress–strain relations under plane stress, plane strain, and three-dimensional conditions.
CO2: Measure and record strain using electrical, semiconductor strain gauges and data acquisition systems.
CO3: Apply photoelastic and digital image correlation techniques for experimental stress analysis.
CO4: Evaluate stresses using brittle coatings and Moiré fringe methods.
CO5: Determine stresses and strains using birefringent coating techniques.

UNIT – I

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

UNIT – 2

Strain Measurement and Recordings: Various types of strain gauges, Electrical Resistance strain gauges, semiconductor strain gauges, strain gauge circuits. Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.

UNIT – 3

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

Three dimensional Photo elasticity : Introduction, locking in model deformation, materials for three-dimensional photo elasticity, machining cementing and slicing three-dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear- difference method in three dimensions, applications of the Frozen-stressmethod, the scattered-light method, Digital Image correlation.

UNIT – 4

Brittle coatings: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

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

UNIT – 5

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

TEXT BOOKS:

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

REFERENCES:

1. A treatise on Mathematical theory of Elasticity by LOVE .A.H
2. Photo Elasticity by Frocht
3. Experimental stress analysis, Video course by K.Ramesh / NPTEL

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D25215D1	L	T	P	C
		3	0	0	3
FRACTURE MECHANICS					

Course Objectives

1. To understand mechanical failure modes and fracture behavior of brittle and ductile materials.
2. To introduce Griffith's theory and linear elastic fracture mechanics concepts for crack analysis.
3. To study elastic–plastic fracture mechanics parameters such as CTOD and J-integral.
4. To analyze fatigue behavior, life prediction methods, and damage models.
5. To evaluate creep deformation, creep–fatigue interaction, and life assessment methods.

Course Outcomes: At the end of the course, student will be able to

CO1: Explain mechanical failure modes and fracture behavior in brittle and ductile materials.
CO2: Apply Griffith's theory and Linear Elastic Fracture Mechanics concepts to crack problems.
CO3: Use elastic–plastic fracture mechanics parameters such as CTOD and J-integral.
CO4: Analyze fatigue behavior using S–N curves, life prediction, and damage models.
CO5: Evaluate creep deformation, creep–fatigue interaction, and life prediction methods.

UNIT – 1

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

UNIT – 2

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 – 3

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 – 4

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. Good mans rule and Miners rule. Micro mechanisms of fatigue damage, fatigue limits and initiation and propagation control, leading to a consideration of factors enhancing fatigue resistance. Total life and damage tolerant approaches to life prediction.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT – 5

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).
6. Prashant Kumar, Elements of Fracture Mechanics, McGraw Hill Education; 1st edition (1 July 2017)

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D25215D2	L	T	P	C
		3	0	0	3
MECHATRONICS					

Course Objectives

1. To introduce mechatronics systems, design processes, and various sensors and transducers.
2. To understand solid-state devices, signal conditioning, and MEMS applications.
3. To study hydraulic, pneumatic, and electromechanical actuation systems.
4. To apply digital electronics, microcontrollers, and PLCs in control applications.
5. To design basic mechatronics systems using DAQ, SCADA, and system modeling concepts.

Course Outcomes: At the end of the course, student will be able to

CO1: Explain mechatronics systems, design process, and various sensors and transducers.
CO2: Analyze solid-state devices, signal conditioning circuits, and MEMS applications.
CO3: Apply hydraulic, pneumatic, and electromechanical actuation systems.
CO4: Use digital electronics, microcontrollers, and PLCs for control applications.
CO5: Design basic mechatronics systems using DAQ, SCADA, and system modeling concepts.

UNIT – 1

Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion , force, acceleration, torque, fluid pressure, liquidflow, liquid level, temperature and light sensors.

UNIT – 2

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS &typical applications.

UNIT – 3

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro- pneumatic, electro-hydraulic servo systems:Mechanical actuating systems and electrical actuating systems.

UNIT – 4

Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT – 5

System and interfacing and data acquisition, DAQS, SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

TEXT BOOKS:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India Edition/2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.

REFERENCES:

1 Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
2 Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
3 Mechatronics System Design / Devdas shetty/Richard/Thomson.
4 Mechatronics/M.D.Singh/J.G.Joshi/PHI.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	**Course Code: D25215D3**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
INTRODUCTION TO QUANTUM TECHNOLOGIES					

Course Objectives:

1. To introduce fundamental concepts of quantum mechanics and its mathematical formalism.
2. To explore quantum computing and communication principles and technologies.
3. To understand the physical implementation and limitations of quantum systems.
4. To enable students to relate quantum theory to practical applications in computing, cryptography, and sensing.
5. To familiarize students with the emerging trends in quantum technologies.

Course Outcomes: At the end of the course, student will be able to

CO1: Explain core principles of quantum mechanics and their technological implications.
CO2: Analyze quantum phenomena like superposition and entanglement.
CO3: Apply mathematical tools to model and solve quantum systems.
CO4: Demonstrate understanding of quantum algorithms and quantum circuits.
CO5: Evaluate potential applications and challenges in quantum communication and sensing.

UNIT – 1

Fundamentals of Quantum Mechanics: Historical background: Blackbody radiation, photoelectric effect, and Compton scattering; Dual nature of light and matter; De Broglie hypothesis; Schrodinger equation; Free particle, infinite potential well, step potential; Operators and observables: position, momentum, Hamiltonian; Commutation relations and uncertainty principle;Quantum postulates and measurement theory; Eigenvalues, eigenfunctions.

UNIT – 2

Quantum Information Theory: Classical vs. quantum information; Qubit representation using Bloch sphere; Quantum superposition and quantumentanglement; Dirac notation (bra-ket), tensor products, and composite systems; Bell states; Quantum gates: Pauli-X, Y, Z; Hadamard; Phase; T; CNOT; Quantum circuit models and notation; Measurement in computational basis; Quantum teleportation and no-cloning theorem; Quantum state tomography (introductory)

UNIT – 3

Quantum Computing: Classical computing review and limitations; Quantum parallelism and interference; Deutsch and Deutsch-Jozsa algorithms; Grover's search algorithm, Oracle and amplitude amplification; Shor's factoring algorithm (overview and significance); Quantum Fourier Transform (QFT); Quantum error correction: Bit-flip, phase-flip, Introduction to quantumprogramming: Qiskit(overview)

UNIT – 4

Quantum Communication: Introduction to quantum cryptography; Quantum key distribution (QKD): BB84 protocol; Entanglement-based QKD: Ekert protocol (E91); Eavesdropping and security of QKD; Quantum teleportation (circuit and protocol); Quantum dense coding; Quantum networks and entanglement swapping; Role of quantum repeaters; Single-photon sourcesand detectors; Implementation challenges (loss, decoherence, noise)

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

UNIT – 5

Quantum Technologies and Applications: Quantum sensors: magnetometry, gravimetry; Quantum metrology: standard time, atomic clocks; Quantum imaging and lithography; Quantum materials: topological insulators, graphene, quantum dots; NV centers in diamonds for sensing; Hardware platforms: Superconducting qubits, Trapped ions, Photonic quantum processors;Quantum supremacy and NISQ era.

Text Books:

1. **"Quantum Computation and Quantum Information"** by Michael A. Nielsen and Isaac L. Chuang
2. **"Quantum Mechanics: Concepts and Applications"** by Nouredine Zettili

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D2521503	L	T	P	C
		0	0	4	2
COMPUTATIONAL MATHEMATICS LAB					

Course Objectives

1. To apply numerical methods for solving engineering problems using programming tools.
2. To solve ordinary and partial differential equations using numerical techniques.
3. To implement numerical algorithms for eigen value and matrix problems.
4. To apply finite element methods for structural and vibration analysis.
5. To develop programming skills using MATLAB/Python for engineering applications.

Course Outcomes: At the end of the course, student will be able to
CO1: Develop codes in MATLAB and PYTHON.
CO2: Develop programmers to solve system of linear equations.
CO3: Understand various curve fitting methods.
CO4: Write various codes to solve differential and partial differential equations.
CO5: Understand and implement Fourier transformations.

Part: 1 Numerical Methods

1. Generate a MATLAB / Python code for solving a system of linear equation (Gauss Elimination Method.LU Decomposition (Factorization),Jacobi Iteration)
2. Generate a MATLAB / Python code for Euler's method, Runge – Kutta method to solve differential equations
3. Generate a MATLAB / Python code for Matrices and Eigen values
    i. Eigen values and Eigen vectors
    ii. Jacobi method
4. Generate a MATLAB / Python code to solve Partial Differential equations
    i. Elliptical PDE
    ii. Parabolic PDE
    iii. The Crank – Nicholson method
    iv. Two dimensional parabolic PDE

Part: 2 Finite Element Methods

1. Generate a MATLAB / Python code to solve 1D Bar problem
2. Generate a MATLAB / Python code to solve Plane Truss problem
3. Generate a MATLAB / Python code to solve Beam problem
4. Generate a MATLAB / Python code to solve 2D Plate problem (Plane Stress/Strain).
5. Generate a MATLAB / Python code to solve Free Vibration Problem.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D2521504	L	T	P	C
		0	0	4	2
DESIGN PRACTICE LAB - II					

Course Objectives

1. To understand forward and inverse kinematics of articulated robotic manipulators.
2. To program articulated robots for basic industrial operations such as pick-and-place and path traversal.
3. To design and synthesize planar mechanisms using kinematic principles.
4. To simulate and analyze robotic and mechanism motions using CAD/CAE tools such as CATIA/ADAMS.
5. To develop practical skills in robotics programming, mechanism design, and motion simulation.

Course Outcomes: At the end of the course, students will be able to

CO1: Perform forward and inverse kinematic analysis of articulated robots.
CO2: Program and execute industrial robot operations such as pick-and-place and welding paths.
CO3: Design RRRR and RRRP mechanisms to satisfy specified motion and path generation requirements.
CO4: Simulate and validate mechanism and robot motion using CATIA/ADAMS software.
CO5: Analyze and coordinate input–output motion of mechanisms for specified positional constraints.

ROBOTICS LAB
Experiments:

1. To demonstrate Forward and inverse Kinematics of articulated robot
2. To program and perform the following operation by using an articulated robot.
   - Pick and place operation
   - To traverse given path (for arc welding)

Design the following mechanisms and simulate using CATIA Software /ADAMS Software

1. a RRRR mechanism whose coupler curve will pass through 3 given point.
2. a RRRR mechanism whose coupler will guide a straight line segment through at least three given positions.
3. a RRRR mechanism whose input and output motion is coordinated at at least three given positions.
2. a RRRP mechanism whose coupler will guide a straight line segment through at least three given positions.
3. a RRRP mechanism whose input and output motion is coordinated at at least two given positions
4. a RRRP mechanism whose input and output motion is coordinated at at least three given positions.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

5. a RRRR mechanism whose input and output motion is coordinated at at least two given positions.
6. a RRRR mechanism whose coupler curve will pass through 4 given points.
7. a RRRR mechanism whose coupler curve will pass through 3 given points.

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

II Semester	Course Code: D2521505	L	T	P	C
		0	0	2	1
SEMINAR - II					

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

III Semester	Course Code: D2535800	L	T	P	C
		3	0	0	3
RESEARCH METHODOLOGY AND IPR					

Course Objectives:

1. To introduce the concepts and scope of engineering research and research frameworks.
2. To develop skills in literature review, technical reading, and research design formulation.
3. To understand patent laws and procedures for patent drafting and filing.
4. To familiarize students with copyright laws, designs, and related intellectual property rights.
5. To expose students to recent developments in IPR and the use of software tools for patent writing and filing.

Course Outcomes: At the end of the course, student will be able to

CO1 Explain the meaning of engineering research and apply to develop an appropriate framework for research studies

CO2: Identify the procedure of Literature Review, Technical Reading, etc. and apply to develop a research design during their project work.

CO3: Explain and apply the fundamentals of patent laws and drafting procedure in their research works.

CO4: Demonstrate the copyright laws, subject matters of copyrights, designs etc. to apply in patent filing

CO5: Identify the new developments in IPR and employ the applications of computer software in writing/filing patents in future.

UNIT – 1

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 – 2

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 – 3

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 – 4

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

UNIT – 5

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

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

TEXTBOOKS:

1. C.R. Kothari , 2nd Edition, "Research Methodology: Methods and Techniques".
2. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step-by-Step Guide for beginners"

REFERENCE BOOKS:

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. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
4. Mayall, "Industrial Design", McGraw Hill, 1992.
5. Niebel, "Product Design", McGraw Hill, 1974.
6. Asimov, "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
8. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

WEB REFERENCES:

- Please include hyperlinks related to NPTEL/VLabs etc.,

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

III Semester	**Course Code: D2531501**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**3**
SUMMER INTERNSHIP/INDUSTRIAL TRAINING					

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

III Semester	Course Code: D2531502	L	T	P	C
		0	0	0	2
COMPREHENSIVE VIVA					

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

III Semester	Course Code: D2531503	L	T	P	C
		0	0	20	10
DESSERTATION PART -A					

Course Objectives:

1. To enable students to identify a research problem in advanced areas of machine design.
2. To develop the ability to carry out an extensive literature review and identify research gaps.
3. To formulate clear objectives and define the scope of the research work.
4. To develop appropriate research methodology using experimental and/or computational approaches.
5. To prepare students for systematic execution of research work in Dissertation Phase B.

Course Outcomes: At the end of the course, the student will be able to

CO1: Identify a relevant research problem in advanced areas of machine design.
CO2: Critically review literature to identify gaps, research trends, and problem statements.
CO3: Formulate research objectives, scope, and methodology based on literature review.
CO4: Design an experimental setup and/or computational model to address the research objectives.
CO5: Present the research proposal effectively through technical reports and presentations.

Description:

Students are expected to choose real world contemporary problem and apply the engineering principles learned, to solve the probem through building prototypes or simulations or writing codes or establishing processes/synthesis/correlations etc. The department constituted panel will decide the suitability and worthyness of the project.
Dissertation Evaluation:

i. **The dissertation shall be submitted as per the schedule given in the academic calendar.**

ii. **The dissertation supervisor will periodically review the progress of the student and finally give his/her assessment of the work done by the student.**

iii. **The dissertation part –A will be evaluated for 100, marks with the following weightages.**

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

Sub-component	Weightage
a)Periodic evaluation by guide	40 marks
b)Mid-term review	20 marks
C)End sem viva –voce examination	40 marks

Evaluation criteria:

The student will be evaluated by the panel based on the below criteria. Weightage for each criterion will be determined by the panel and will be informed to the students.

Criteria	Description	Weightage
I	Selection of Topic	
II	Literature Survey	
III	Defining the Objectives and Solution Methodology	
IV	Performance of the Task	

D.N.R. COLLEGE OF ENGINEERING & TECHNOLOGY
(Autonomous)
DEPARTMENT OF MECHANICAL ENGINEERING
DR25 M.TECH MACHINE DESIGN COURSES TRUCTURE AND SYLLABUS

IV Semester	Course Code: D2541500	L	T	P	C
		0	0	32	16
DESSERTATION PART -B					