ACADEMIC REGULATIONS, COURSE STRUCTURE AND DETAILED SYLLABUS

Effective from the Academic Year 2020-21 onwards

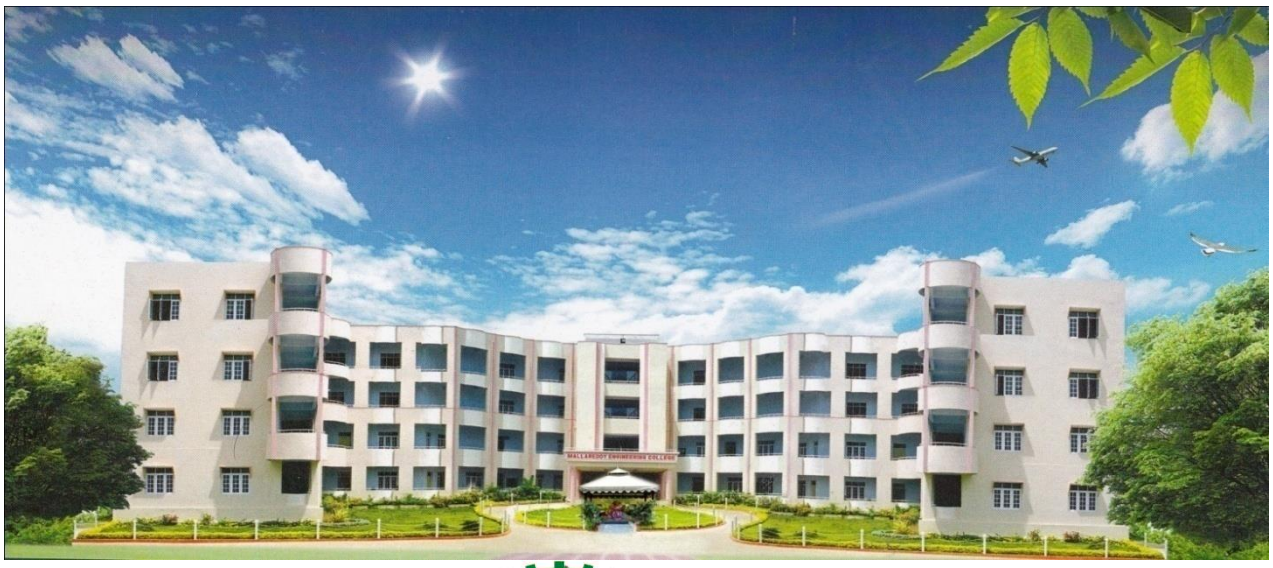
M. Tech. Two Year Degree Course

(MR20 Regulations)

in

Machine Design (MD)

Department of Mechanical Engineering



MALLA REDDY ENGINEERING COLLEGE (Autonomous)

(An UGC Autonomous Institution, Approved by AICTE and Affiliated to JNTUH Hyderabad, Recognized under 2(f) &12 (B) of UGC Act 1956, Accredited by NAAC with 'A' Grade (II Cycle)
Maisammaguda, Dhulapally (Post Via Kompally), Secunderabad-500 100
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MALLA REDDY ENGINEERING COLLEGE (AUTONOMOUS)

MR18 ACADEMIC REGULATIONS (CBCS)
For M. Tech. (REGULAR) DEGREE PROGRAMME

Applicable for the students of M. Tech. (Regular) programme admitted from the Academic Year ***2018-19*** and onwards.

The M. Tech. Degree of Jawaharlal Nehru Technological University Hyderabad shall be conferred on candidates who are admitted to the programme and who fulfill all the requirements for the award of the Degree.

INSTITUTION VISION

A Culture of excellence , the hallmark of MREC as world class education center to impart Technical Knowledge in an ambience of humanity, wisdom, intellect, creativity with ground breaking discovery, in order to nurture the students to become Globally competent committed professionals with high discipline, compassion and ethical values.

INSTITUTION MISSION

Commitment to progress in mining new knowledge by adopting cutting edge technology to promote academic growth by offering state of art Under graduate and Post graduate programmes based on well-versed perceptions of Global areas of specialization to serve the Nation with Advanced Technical knowledge.

DEPARTMENT VISION

To provide world class platform for education, research and knowledge creation in Mechanical Engineering and create global leaders in technical areas for ensuring environment friendly development needed for the society.

DEPARTMENT MISSION

Create innovative learning for the students and faculty with superior and environment friendly infrastructure, best faculty and enable them for better interaction with advanced Mechanical Engineering knowledge and learning under practical situations so as to make them effective leaders.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Graduates are capable to meet the industrial expectations, have a better career and pursue higher studies in the area of machine design.

PEO 2: Graduates are encouraged to predict the technical challenges and provide optimal ways to solve through research methodologies for societal benefits.

PEO 3: Graduates are able to explore their skills to invent, design and realize new technology through lateral thinking.

PEO 4: Graduates are proficient to express their ability to work as team and lead to accomplish the professional and organizational goals with ethical and moral values.

PEO 5: Graduates keep themselves abreast of emerging technologies, continually learn new skills to nourish ever-developing careers.

PROGRAMMEOUTCOMES(POs)

PO 1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO 2: An ability to write and present a substantial technical report/document.

PO 3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO 4: Ability to develop innovative thinking in solving Engineering problems.

PO 5: Engage in Life-long learning independently with a high level of passion and profession.

PO 6: Apply contextual Knowledge to axis societal, safety legal issues, relevant to professional Engineering.

1.0 **Post-Graduate Degree Programmes in Engineering & Technology (PGP in E&T) Malla Reddy Engineering College (Autonomous) (MREC-A)** offers **Two** Year (**Four** Semesters) full-time **Master of Technology (M. Tech.)** Post Graduate programmes, under Choice Based Credit System (CBCS) in different branches of Engineering and Technology with different specializations.

2.0 Eligibility for Admissions:

2.1 Admission to the above programme shall be made subject to eligibility, qualification and specialization as prescribed by the Affiliating University from time to time. Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the Government of Telangana or on the basis of any other order of merit as approved by the University, subject to reservations as laid down by the Govt. from time to time.

2.2 The medium of instructions for all PG Programmes will be **ENGLISH** only.

3.0 M.Tech. Programme (PGP in E&T) Structure and Award of Degree:

3.1 The M.Tech. Programmes in E & T are of Semester pattern, with **Four** Semesters consisting of **Two** academic years, each academic year having **Two** Semesters (First/ Odd and Second/ Even Semesters). Each Semester shall be of 22 weeks duration (inclusive of Examinations), with a minimum of 90 instructional days per Semester.

3.2 A student shall be declared eligible for the award of the M.Tech. Degree, if the student pursues a course of study in not less than two and not more than four academic years. However, the student is permitted to write the examinations for two more years after four academic years of course work, failing which the student shall forfeit the seat in M. Tech. programme.

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

3.4 **UGC/ AICTE** specified definitions/ descriptions are adopted appropriately for various terms and Abbreviations used in these PG academic regulations, as listed below:

3.4.1 Semester Scheme

Each Semester shall have 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) are taken as 'references' for the present set of Regulations. The terms 'SUBJECT' and 'COURSE' imply the same meaning here and refer to 'Theory Subject', or 'Lab Course', or 'Design/ Drawing Subject', or 'Seminar', or 'Project', or "Technical Paper Writing" as the case may be.

3.4.2 Credit Courses

All subjects/courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject/course in an L: T: P: C (Lecture Periods: Tutorial Periods: Practical Periods: Credits) structure based on the following general pattern:

- One credit for one hour/week/semester for theory/lecture (L) / tutorials (T) courses
- One credit for two hours/ week/semester for laboratory/ practical (P) courses

Other student activities like study tour, guest lecture, conference/workshop participations, technical paper presentations, and identified mandatory/audit courses, if any, will not carry credits.

3.4.3 Subject / Course Classification

All subjects / courses offered for the Post-Graduate Programme in E & T (M.Tech Degree Programme) are broadly classified as follows. The Institution has followed in general, the guidelines issued by AICTE/UGC.

S.No	Broad Course Classification	Course Group/ Category	Course Description
1	Core Courses (CC)	PC- Professional Core	Includes subjects related to the parent discipline/ department/ branch of Engineering
		Project Work	M.Tech Project / Dissertation
		Seminar	Seminar/ Colloquium based on core contents related to parent discipline/ department/ branch of Engineering
2	Elective Courses (EC)	PE - Professional Electives	Includes elective subjects related to the parent discipline/ department/ branch of Engineering
		OE - Open Electives	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering
3	Audit Courses (AC)	Audit Courses	These courses are non-credit courses without evaluation.
Total Number of Credits – 68 credits			

3.4.4 Courses of Study:

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

S.No.	Dept.	Specialization Code	Specialization	Intake
1	CE	11	Structural Engineering (SE)	24
2	EEE	24	Electrical Power Systems (EPS)	24
3	ME	31	Thermal Engineering (TE)	18
4		33	Machine Design (MD)	24
5	CSE	51	Computer Science and Engineering (CSE)	18

Any other programme as approved by the University from time to time.

4 Course Registration:

4.1 A 'Faculty Advisor or Counselor' shall be assigned to each student, who will advise him on the Post Graduate Programme (PGP), its Course Structure and Curriculum, Choice/ Option for Subjects/ Courses, based on his competence, progress, pre-requisites and interest.

4.2 The Academic Section of the College invites 'Registration Forms' from students within 15 days from the commencement of class work for the first semester through 'ON-LINE SUBMISSIONS', ensuring 'DATE and TIME Stamping'. The ON-LINE Registration Requests for any 'SUBSEQUENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'CURRENT SEMESTER'.

4.3 A Student can apply for ON-LINE Registration, ONLY AFTER obtaining the 'WRITTEN APPROVAL' from the Faculty Advisor, which should be submitted to the College Academic Section through the Head of Department (a copy of it being retained with Head of Department, Faculty Advisor and the Student).

4.4 If the Student submits ambiguous choices or multiple options or erroneous entries during ON-LINE Registration for the Subject(s) / Course(s) under a given/ specified Course Group/ Category as listed in the Course Structure, only the first mentioned Subject/ Course in that Category will be taken into consideration.

4.5 Subject/ Course Options exercised through ON-LINE Registration are final and CANNOT be changed, nor can they be inter-changed; further, alternate choices will also not be considered. However, if the Subject/ Course that has already been listed for Registration (by the Head of Department) in a Semester could not be offered due to any unforeseen or unexpected reasons, then the Student shall be allowed to have alternate choice - either for a new Subject (subject to offering of such a Subject), or for another existing Subject (subject to availability of seats), which may be considered. Such alternate arrangements will be made by the Head of Department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of Class-work for that Semester.

5 Attendance Requirements:

The programmes are offered on a module basis with each subject/course being considered as a module.

5.1 Attendance in all classes (Theory/Laboratories/Seminar/Project Work) is compulsory. The minimum required attendance in each theory / Laboratory etc. is 75% including the attendance of mid-term examination / Laboratory and the days

of attendance in sports, games, NCC and NSS activities for appearing for the Semester End Examination (SEE). A student shall not be permitted to appear for the Semester End Examinations (SEE) if his attendance is less than 75%.

5.2 Condonation of shortage of attendance in each subject up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee (CAC).

5.3 Shortage of Attendance below 65% in each subject shall not be condoned.

5.4 Students whose shortage of attendance is not condoned in any subject are not eligible to write their Semester End Examination of that subject and their registration shall stand cancelled.

5.5 A stipulated fee prescribed by the CAC, shall be payable towards Condonation for shortage of attendance.

5.6 A candidate shall put in a minimum required attendance in at least three (3) theory subjects in I Year I semester for promoting to I Year II Semester. In order to qualify for the award of the M.Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.

5.7 A student shall not be promoted to the next semester unless the student satisfies the attendance requirement of the present Semester, as applicable. The student may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, the student shall not be eligible for readmission into the same class.

6 Academic Requirements:

The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in item 5.

6.1 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the Semester End Examination and a minimum of 50% of the total marks in the Semester End Examination and Continuous Internal Evaluation taken together. In case the candidate does not secure the minimum academic requirement in any subject he has to reappear for the Semester End Examination in that subject. A candidate shall be given one chance to re-register for the subject if the internal marks secured by the candidate are less than 50% and failed in that subject. This is allowed for a maximum of three subjects and should register within two weeks of commencement of that semester class work. In such a case, the candidate must re-register for the subjects and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon the eligibility for writing the Semester End Examination in those subjects. In the event of the student taking another chance, the student's Continuous Internal Evaluation (CIE) marks and Semester End Examination (SEE) marks obtained in the previous attempt stands cancelled.

6.2 If the student secured 'F' grade in any subject he/she can apply for recounting / revaluation by paying prescribed fee. If the student is not satisfied after the results declaration of recounting / revaluation he/she can apply for challenge valuation with the prescribed fee. College appoints a faculty member; student can bring another faculty member who taught the respective subject at least once (proof should be provided). The faculty member should be from any autonomous college affiliated to JNTUH or JNTUH constituent colleges.

7 Evaluation - Distribution and Weightage of Marks:

The performance of a student in each semester shall be evaluated subject - wise (irrespective of credits assigned) for 100 marks for Theory, Practicals, Seminar, Drawing / Design, Project, and Minor Courses etc.,. The Theory / Practical courses are evaluated with two components. 1. Continuous Internal Evaluation (CIE), 2. Semester End Examination (SEE). The distribution shall be 30 marks for CIE and 70 marks for SEE decided in the Academic Council.

7.1 Theory Courses :

7.1.1 Continuous Internal Evaluation (CIE):

CIE shall be conducted for all courses of PG Programmes twice in a semester (2 Midterm examinations) with the help of objective, subjective evaluation and regular assignments. Each midterm examination consists of objective, subjective paper and one assignment. The objective and subjective test shall be evaluated to 40 % and 50 % for duration of 120 mins and the assignment evaluated for 10 % of the allocated internal marks.

The division of marks for CIE is as given below:

Mid – Term Examination				
Part	**Type of Questions**	**No. of questions**	**Marks per question**	**Total**
Part A	Multiple-choice questions	10	1	10
	Fill-in the blanks	10	1	10
	Sub-Total			20
Part B	Compulsory questions [With Module-wise internal choice]	5	5	25
			Mid-Term Exam Total	45
			Assignment	05
			Grand Total	50

*The CIE will be conducted for 50 marks and scaled to 30 marks.

The first mid-term examination shall be conducted for the first 50% of the syllabus, and the second mid-term examination shall be conducted for the remaining 50% of the syllabus. First Assignment should be submitted before the conduct of the first mid-term examinations, and the Second Assignment should be submitted before the conduct of the second midterm examinations. The weightage for the midterm examination shall be given as 70% of the best performing midterm examination and 30% of the other performing midterm examination. The student shall appear for both midterm examinations. In case for any specific reason the student appears only for one midterm examination, only 70% weightage of that examination shall be considered.

7.1.2 Semester End Examination (SEE):

Semester End Examination (SEE) shall be conducted for all courses of PG Programmes at the end of the Semester. Duration of the examination is 3 hours. The paper setting and evaluation of all courses carried out by external examiners. The examiners will be selected by the chief controller of examination/ Principal.

Type of Questions	No. of Questions	Marks per Question	Total
Essay Type Answer Questions [For each question there will be an 'either or choice', which means that there will be two questions from each module and the student should answer either of the two questions.]	5	14	70

7.2 Practical Courses:

7.2.1 Continuous Internal Evaluation (CIE):

CIE marks shall be awarded with a distribution of 40% for day - to-day performance and timely submission of lab records, 40% for internal lab exam (best out of two exams) and 20% for viva-voce. The CIE will be conducted for 50 marks and scaled to 30 marks.

7.2.2 Semester End Examination (SEE):

SEE marks shall be awarded with a distribution of 20% for design/procedure/schematic diagram of the given experiment, 40% for conduction of experiment, 20% for results and 20% for viva - voce. For conducting SEE (with duration of 3 hours), one internal examiner and one external examiner will be appointed by the Chief Controller of Examinations/Principal of the college. The external examiner should be selected from outside the college among the autonomous / reputed institutions from a panel of three examiners submitted by the concerned Head of the Department.

7.3 Seminar:

There shall be a seminar presentation during III semester. 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 Departmental Academic Committee consisting of Department PG Coordinator, Supervisor and two other senior faculty members of the department. For Seminar there will be only internal evaluation. Out of the total allocated marks distribution of marks shall be 30% for the report, 50% for presentation and 20% for the queries. A candidate has to secure a minimum of 50% of marks to be declared successful. If the student fails to fulfill minimum marks, the student has to reappear during the supplementary examinations. There shall be no semester end examinations for the seminar.

7.4 Evaluation of Project/ Dissertation Work :

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

7.4.1 A Project Review Committee (PRC) shall be constituted with Head of the Department as Chairperson/Department PG Coordinator, Project Supervisor and one senior faculty member of the Departments offering the M. Tech. programme.

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

7.4.3 After satisfying 7.4.2, a candidate has to submit, in consultation with his Project Supervisor, the title, objective and action plan of his project work to the PRC for approval. Only after obtaining the approval of the PRC the student can initiate the Project work.

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

7.4.5 A candidate shall submit his project status report in two stages at least with a gap of 2 months between them.

7.4.6 The work on the project shall be initiated at the beginning of the III Semester and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of all theory and practical courses with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Head of the Department and make an oral presentation before the PRC.

Note: *The project supervisor/guide has to ensure that the student has to publish a minimum of one paper based on his/her thesis in an International Journal of*

repute preferably in UGC CARE-Group I list.

7.4.7 For the final approval by the PRC, the soft copy of the thesis should be submitted for ANTI-PLAGIARISM check for the quality and the plagiarism report should be included in the final thesis. If the similarity information is less than 24%, then only thesis will be accepted for submission.

7.4.8 Three copies of the Project Thesis certified by the supervisor, HOD shall be submitted to the Chief Controller of Examinations /Principal for project evaluation (Viva Voce).

7.4.9 For Project/Dissertation phase-I in III Semester is internal evaluation only. The evaluation marks shall be carried out with a distribution of 70% evaluated by the PRC and 30% by Supervisor. The Supervisor and PRC will examine the Problem Definition, Objectives, Scope of Work and Literature Survey in the same domain. A candidate has to secure a minimum of 50% of the allocated marks to be declared successful for Project work Part-I. If the student fails to fulfill minimum marks, the student has to reappear during the supplementary examination.

7.4.10 For Project/Dissertation phase-II in IV Semester is an external evaluation. The evaluation shall be carried out by the External examiner appointed by the Chief Controller of Examinations/Principal. For this, the Head of the Department shall submit a panel of 3 examiners, eminent in that field, with the help of the supervisor/guide concerned. The distribution of marks followed by Quality of the work (Plagiarism), Paper publication, nature of the work (Tools & software used and Innovative ideas), presentation and Viva-Voce - each for 20% of allocated marks. The candidate has to secure minimum of 50% marks in Project Evaluation (Viva-Voce) examination.

7.4.11 If the student fails to fulfill as specified in 7.4.10, based on the recommendation of the external examiner, the student will reappear for the Viva-Voce examination with the revised thesis only after three months. In the reappeared examination also, fails to fulfill, the student will not be eligible for the award of the degree.

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

7.5 Non-Credit Courses:

7.5.1 Audit Courses:

Audit Courses offered in any Semester, a '**Satisfactory Participation Certificate**' shall be issued to the student from the concerned authorities, only after securing ≥ 65% attendance in such a course. No marks or Letter Grade shall be allotted for these activities.

8 Examinations and Assessment - The Grading System:

8.1 Grades will be awarded to indicate the performance of each student in each Theory Subject, or Lab / Practicals, or Seminar, or Project, etc., based on the % marks obtained in CIE + SEE (Continuous Internal Evaluation + Semester End Examination, both taken together) as specified in Item 6 above, and a corresponding Letter Grade shall be given.

8.2 As a measure of the student's performance, a 10-point Absolute Grading System using the following Letter Grades (UGC Guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured (Class Intervals)	**Grade Points**	**Letter Grade (UGC Guidelines)**
≥ 90%,	10	O (Outstanding)
(≥ 80%, <90%)	9	A+ (Excellent)
(≥ 70%, < 80%)	8	A (Very Good)
(≥ 60%, < 70%)	7	B+ (Good)
(≥ 55%, < 60%)	6	B (Average)
(≥ 50%, < 55%)	5	C (Pass)
(< 50%)	0	F(Fail)
Absent	0	Ab

8.3 A student obtaining F Grade in any Subject shall be considered 'failed' and is be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when conducted. In such cases, his Internal Marks (CIE Marks) in those Subjects will remain the same as those he obtained earlier.

8.4 A student not appeared for examination then 'Ab' Grade will be allocated in any Subject shall be considered 'failed' and will be required to reappear as 'Supplementary Candidate' in the Semester End Examination (SEE), as and when conducted.

8.5 A Letter Grade does not imply any specific Marks percentage and it will be the range of marks percentage.

8.6 In general, a student shall not be permitted to repeat any Subject/ Course (s) only for the sake of 'Grade Improvement' or 'SGPA/ CGPA Improvement'.

8.7 A student earns Grade Point (GP) in each Subject/ Course, on the basis of the Letter Grade obtained by him in that Subject/ Course. The corresponding 'Credit Points' (CP) is computed by multiplying the Grade Point with Credits for that

particular Subject/ Course.

Credit Points (CP) = Grade Point (GP) x Credits …. For a Course

8.8 The Student passes the Subject/ Course only when he gets GP ≥ 5(C Grade or above).

8.9 The Semester Grade Point Average (SGPA) is calculated by dividing the Sum of Credit Points (∑CP) secured from ALL Subjects/ Courses registered in a Semester, by the Total Number of Credits registered during that Semester. SGPA is rounded off to TWO Decimal Places. SGPA is thus computed as:

$$\mathbf{SGPA} = \left\{\sum_{i=1}^{N} C_i G_i\right\} / \left\{\sum_{i=1}^{N} C_i\right\} \ldots \textbf{For each Semester}$$

where 'i' is the Subject indicator index (takes into account all Subjects in a Semester), 'N'is the no. of Subjects 'REGISTERED' for the Semester (as specifically required and listed under the Course Structure of the parent Department), C_i is the no. of Credits allotted to the i^{th} Subject, and G_i represents the Grade Points (GP) corresponding to the Letter Grade awarded for that i^{th} Subject.

8.10 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student over all Semesters considered for registration. The CGPA is the ratio of the Total Credit Points secured by a student in ALL registered Courses in ALL Semesters, and the Total Number of Credits registered in ALL the Semesters. CGPA is rounded off to TWO Decimal Places. CGPA is thus computed from the II Semester onwards, at the end of each Semester, as per the formula:

$$\mathbf{CGPA} = \left\{\sum_{j=1}^{M} C_j G_j\right\} / \left\{\sum_{j=1}^{M} C_j\right\} \ldots \textbf{for all S semesters registered}$$

(i.e., upto and inclusive of S semesters, S ≥ 2)

where 'M' is the TOTAL no. of Subjects (as specifically required and listed under the Course Structure of the parent Department) the Student has 'REGISTERED' from the 1stSemester onwards upto and inclusive of the Semester S (obviously M > N), 'j' is the Subject indicator index (takes into account all Subjects from 1 to S Semesters), C_j is the no. of Credits allotted to the j^{th} Subject, and G_j represents the Grade Points (GP)corresponding to the Letter Grade awarded for that j^{th} Subject. After registration and completion of I Semester however, the SGPA of that Semester itself may be taken as the CGPA, as there are no cumulative effects.

Illustration of calculation of SGPA

Course/Subject	Credits	Letter Grade	Grade Points	Credit Points
Course 1	3	A	8	3X8=24
Course 2	3	O	10	3X10=30
Course 3	3	B	6	3X6=18
Course 4	3	A+	9	3X9=27
Course 5	2	B+	7	2X7=14
Course 6	2	A	8	2X8=16
Course 7	2	B	6	2X6=12
	18			141
SGPA = 141/18 = 7.83				

Illustration of calculation of CGPA

Semester	Credits	SGPA	Credits X SGPA
Semester I	18	7	18 X 7 = 126
Semester II	18	6	18 X 6 = 108
Semester III	16	6.5	16 X 6.5 = 104
Semester IV	16	7.25	16 X 7.25 = 116
	68		454
CGPA = 454/68 = 6.67			

8.11 For Calculations listed in Item 8.6 – 8.10, performance in failed Subjects/ Courses (securing 'F' Grade) will also be taken into account, and the Credits of such Subjects/Courses will also be included in the multiplications and summations.

9. Award of Degree and Class:

9.1 A Student who registers for all the specified Subjects/ Courses as listed in the Course Structure, satisfies all the Course Requirements, and passes the examinations prescribed in the entire PG Programme (PGP), and secures the

required number of **68** Credits (with CGPA ≥ 5.0), shall be declared to have 'QUALIFIED' for the award of the M.Tech. degree in the chosen Branch of Engineering and Technology with specialization as he admitted.

9.2 Award of Class

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

Class Awarded	CGPA
First Class with Distinction	≥ 8.00
First Class	≥ 6.50 and < 8.00
Second Class	≥ 5.00 and < 6.50

9.3 A student with final CGPA (at the end of the PGP) < 5.00 will not be eligible for the Award of Degree.

9.4 Students will be eligible for the award of **'Gold Medal'** , if he/she passes all the subjects / courses in first appearance within the first academic years (or four sequential semesters) from the date of commencement of first year first semester and should have secure CGPA ≥ 8.00 at the end of four sequential semesters.

10 Withholding of Results:

If the student has not paid the dues, if any, to the Institution/University or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases.

11 Transitory Regulations:

11.1 If any candidate is detained due to shortage of attendance in one or more subjects, they are eligible for re-registration to maximum of two earlier or equivalent subjects at a time as and when offered.

11.2 The candidate who fails in any subject will be given two chances to pass the same subject;

otherwise, he has to identify an equivalent subject as per MR18 Academic Regulations.

12. Student Transfers:

12.1 There shall be no Branch/Specialization transfers after the completion of Admission Process.

12.2 The students seeking transfer to MALLA REDDY ENGINEERING COLLEGE (Autonomous)- MREC(A) from various other Universities/ institutions have to pass the failed subjects which are equivalent to the subjects of MREC(A), and also pass the subjects of MREC(A) which the students have not studied at the earlier institution. Further, though the students have passed some of the subjects at the earlier institutions, if the same subjects are prescribed in different semesters of MREC (A), the students have to study those subjects in MREC (A) in spite of the fact that those subjects are repeated.

12.3 The transfer students from other Universities / Institutions to MREC (A) who are on rolls will be provided one chance to write internal examinations in the failed subjects and/or subjects not studied as per the clearance letter issued by the JNTUH.

13. General:

13.1 **Credit**: A module by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.

13.2 **Credit Point:** It is the product of grade point and number of credits for a course.

13.3 Wherever the words “he”, “him”, “his”, occur in the regulations, they shall include “she”, “her” also.

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

13.5 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the College Academic Committee headed by the Principal is final.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR IMPROPER CONDUCT IN EXAMINATIONS

Sl.No.	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 SEE)	Expulsion from the examination hall and cancellation of the performance in that course 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 course 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 that course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester. The Hall Ticket of the candidate shall be cancelled.
3	Impersonates any other candidate in connection with the	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the

	examination.	seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the courses of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all SEE. The continuation of the programme by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all SEE. The continuation of the programme 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 course.
6	Refuses to obey the orders of the Chief Controller of Examinations (CCE) / Controller of Examinations (CE)/ Assistant Controller of Examinations (ACE) / any officer on duty or misbehaves or creates disturbance	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that

	of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination	semester. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police cases registered against them.
7	Leaves the exam hall taking away answer scriptor 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 course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all SEE. The continuation of the programme 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 course and all other courses the candidate

		has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. 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.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that course and all other courses the candidate has appeared including practical examinations and project work of that SEE.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the CCE for further action toward suitable punishment.	

Note: ***The student(s) found indulging in malpractices during the CIE also will be punished based on the recommendations of the College Academic Committee.***

Malpractices identified by squad or special invigilators

1. Punishments to the students as per the above guidelines.

MALLA REDDY ENGINEERING COLLEGE (AUTONOMOUS)

Course Structure for M.Tech. Machine Design

MR18 Regulations - Effective from the Academic Year 2018 – 19 On wards

SEMESTER-I							
Sl. No.	**Category**	**Course Code**	**Name of the Subject**	**L**	**T**	**P**	**Credits**
1.	PCC	A3201	Advanced Mechanics of Solids	3	1	-	4
2.	PCC	A3202	Mechanical Vibrations	3	-	-	3
3.	PEC- I	A3213	Fundamentals of Tribology	3	-	-	3
		A3214	Computer Aided Design				
		A3215	Rotor Dynamics				
4.	PEC- II	A3216	Mechanics of Composite Materials	3	-	-	3
		A3217	Vehicle Dynamics				
		A3218	Design for Manufacturing & Assembly				
5.	HSMC	A0H18	Research Methodology and IPR	2	-	-	2
6.	PCC	A3203	Dynamics and Vibrations Lab	-	-	3	1.5
7.	PCC	A3204	Advanced Material Testing lab	-	-	3	1.5
8.	AC	A0A04	English for Research Paper Writing	2	-	-	-
			Total	**16**	**1**	**6**	**18**
			Total Contact Hours	**23**			

SEMESTER-II							
Sl. No.	**Category**	**Course Code**	**Name of the Subject**	**L**	**T**	**P**	**Credits**
1.	PCC	A3205	Design of Mechanical Systems	3	-	-	3
2.	PCC	A3206	Advanced Finite Element Methods	3	-	-	3
3.	PCC	A3207	Robotics and Controls	3	-	-	3
4.	PEC- III	A3219	Analysis and Synthesis of Mechanisms	3	-	-	3
		A3220	Design of Hydraulic and Pneumatic Components				
		A3221	Advanced Tool Design				
5.	PEC- IV	A3222	Experimental Stress Analysis	3	-	-	3
		A3223	Fracture Mechanics				
		A3224	Tribology in Design				
6.	PCC	A3208	Advanced Computer Aided Modelling Lab	-	-	3	1.5
7.	PCC	A3209	Advanced Computer Aided Analysis Lab	-	-	3	1.5
8.	AC	A0A05	Value Education	2	-	-	-
Total				**17**	**-**	**6**	**18**
Total Contact Hours				**23**			

SEMESTER-III							
Sl. No.	**Category**	**Course Code**	**Name of the Subject**	**L**	**T**	**P**	**Credits**
1.	PEC- V	A3225	Geometric Modelling	3	-	-	3
		A3226	Condition Monitoring				
		A3227	Design for Process and Product Development				
2.	OE-I	A3228	Industrial Safety	3	-	-	3
		A0B20	Advanced Optimization Techniques				
		A1128	Waste to Energy				
3.	PROJ	A3210	Seminar	-	-	4	2
4.	PROJ	A3211	Project / Dissertation Phase - I	-	-	16	8
Total				**6**	**-**	**20**	**16**
Total Contact Hours				**26**			

SEMESTER-IV							
Sl. No.	**Category**	**Course Code**	**Name of the Subject**	**L**	**T**	**P**	**Credits**
1.	PROJ	A3212	Project / Dissertation Phase – II	-	-	32	16
Total				**-**	**-**	**32**	**16**
Total Contact Hours				**32**			

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) I Semester		
Code: A3201	**ADVANCED MECHANICS OF SOLIDS**	**L**	**T**	**P**
Credits: 4		3	1	-

Prerequisites: Mechanics of solids

Course Objectives: To impart knowledge on the behavior of unsymmetrical bending, torsional member, axis symmetry elements, plates and shell elements, their places of utility and of course the design procedure of such elements in practical applications.

MODULE I: Shear Centre & Unsymmetrical Bending: [13 Periods]
Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections.
Unsymmetrical bending: Bending stresses in Beams subjected to Non symmetrical bending, Deflection of straight beams due to non-symmetrical bending.

MODULE II: Curved Beam Theory [13 Periods]
Winkler Bach formula for circumferential stress – Limitations –Correction factors – Radial stress in curved beams – closed ring subjected to concentrated and uniform lads- stresses in chain links.

MODULE III: Torsion & Axis-Symmetric Problems: [13 Periods]
A:Torsion of a cylindrical bar of Circular cross Section; Saint -Venant's semi-inverse methods; Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section; Hallow thin wall torsion members, Multiply connected Cross section, Thin wall torsion members with restrained ends
B: Axis-Symmetric Problems - Rotating Discs – Flat discs, Discs of uniform thickness, Discs of Uniform Strength, Rotating Cylinders.

MODULE IV: Theory of Plates & Axis-Symmetric Problems: [13 Periods]
Introduction: Stress resultants in a flat plate, Kinematics: Strain-Displacement relations for plates; Equilibrium equations for small displacement theory of flat plates; Stress – Strain – Temperature relation for Isotropic plates: Strain energy of a plate; Boundary conditions for plate; Solution of rectangular plate problem; Solution of circular plate problem. Beams on Elastic Foundation: General theory; Infinite Beam subjected to Concentrated load; boundary conditions; Infinite beam subjected to a distributed load segment; Semi-infinite beam with concentrated load near its end; Short Beams.

MODULE V: Contact Stresses [12 Periods]
Introduction, problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Methods 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. SrinathL.S. "**Advanced Mechanics of Solids**" McGraw Hill,2009.
2.Timoshenko "**Theory of Plates & Shells",** McGraw Hill, 2nd Edition,1964.

REFERENCES

1. Seely and Smith "**Advanced Mechanics of materials"** John Wiley, 2nd Edition,1961.
2. Boresi& Sidebottom "**Advanced Mechanics of materials"** wielyInternational,4thEdition,1986.
3. Cook R D and Young, "Advanced Mechanics of Materials", John Wiley Co., New Delhi 1987.
4. Sadhu singh "**Strength of materials**" KhannaPublishers ,2004.
5. Beer &Jhonson "**Mechanics of Materials" ,** McGraw Hill,3Edition,2004.

E - RESOURCES:

1. www.springer.com/in/book/9783540437970
2. solidmechanics.org/
3. pleiades.online/en/journal/mechsol
4. am.iitd.ac.in/journals_list.pdf
5. nptel.ac.in/courses/105106049
6. nptel.ac.in/courses/112101095

Course Outcomes

At the end of the course, students should be able to:

1. Apply various types of stresses for different loading conditions behind Unsymmetrical bending.
2. Solve analytical solutions for the design of curved beams.
3. Evaluate elasticity for modeling torsion of machine members and rotary discs.
4. Analyze stresses and strain for flat plates and axis-symmetry problems.
5. Determine contact stresses for multi body components.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**2**				
CO2	**1**	**1**				**2**
CO3	**1**	**1**	**3**	**3**	**1**	**1**
CO4	**1**	**2**		**3**	**2**	**3**
CO5	**1**		**3**			

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) I Semester		
Code: A3202	MECHANICAL VIBRATIONS	L	T	P
Credits: 3		3	-	-

Prerequisites: Nil

Course Objectives: The objectives of this course is to impart knowledge on the sources of vibration and noises in automobiles and make modifications to reduce the vibration and noise and improve the life of the components. To create expertise in vibration measurement and control.

MODULE I: Fundamentals of Vibration [10 Periods]

Introduction -Sources Of Vibration-Mathematical Models- Displacement, velocity and Acceleration- Review Of Single Degree Freedom Systems -Vibration isolation Vibrometers and accelerometers - . Response To Arbitrary and non- harmonic Excitations – Transient Vibration –Impulse loads- Critical Speed Of Shaft-Rotor systems.

MODULE II: Two Degree Freedom System [10 Periods]

Introduction - Principal modes- undamped and damped free and forced vibrations; undamped vibration absorbers, lag range's equation.

MODULE III: Multi-Degree Freedom System [10 Periods]

A: Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and Eigen vectors – orthogonal properties – Forced Vibration by matrix inversion – Modal damping in forced vibration

B: Numerical Methods -Raleigh's stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

MODULE IV: Continuous System [09 Periods]

Systems governed by wave equations – Vibration of strings – Vibration of rods – Euler Equation for Beams – Effect of Rotary inertia and shear deformation - Dynamics of rotating machinery

MODULE V: Vibration Measurement [09 Periods]

Measurement of vibration, free and forced tests, FFT analyzer, methods of vibration control, excitation reduction at source, balancing of rigid, flexible and variable mass rotors. Dynamic properties and selection of structural materials, viscoelastic polymers.

TEXT BOOKS

1. SS Rao, "**Mechanical Vibrations",** Pearson, 2009, 4thEdition, 2015.
2. V.P.Singh, "Mechanical Vibrations" Dhanpat Rai Publications, 2016.
3. Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000.

REFERENCES

1. Groover,**"Mechanical Vibrations",** Nem Chand and Bros, 8th Edition, 2009.
2. Meirovitch, "**Elements of Vibration Analysis",** TMH, 2001.
3. SchaumSeries,"**Mechanical Vibrations",** McGraw Hill, 1996.
4. Debabrata Nag, "**Mechanical Vibrations",**Wiley
5. A. G. Ambekar, "**Mechanical Vibrations and sound engineering",** PHI
6. JSRao& K. Gupta,"**Theory and Practice of Mechanical Vibrations",** New Age Intl. Publishers, Revised 2nd Edition, 2014.

E - RESOURCES:

1. link.springer.com/article/10.1007/BF02744480
2. www.vibetech.com/techpaper.htm
3. journals.sagepub.com/doi/abs/10.1177/1687814016655778
4. https://www.journals.elsevier.com/journal-of...vibration/most-downloaded-articles
5. jvejournals.com/journal-vibroengineering
6. nptel.ac.in/courses/112105048/
7. nptel.ac.in/courses/112103111/29

Course Outcomes:

At the end of the course, students should be able to:

1. Summarize fundamentals of vibration and analyze the mathematical model of a linear vibratory system to determine its response.
2. Calculate free and forced vibration response of an undamped or damped system.
3. Evaluate Multi-degree of freedom of various systems and numerical integration methods in vibration analysis for resolving the problems.
4. Determine continuous system problems of real life engineering systems.
5. Discuss about the various working operations of various vibration measuring instruments, vibration control and analysis techniques.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			**1**			
CO2				**1**		
CO3	**1**	**2**	**3**	**1**		**1**
CO4	**2**	**1**	**1**	**2**		
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) I Semester		
Code: A3213	FUNDAMENTALS OF TRIBOLOGY (Professional Elective - I)	L	T	P
Credits: 3		3	-	-

Prerequisites: Nil

Course Objectives: The main objective of this course is to describe surface topography, physio-chemical aspects of solid surfaces, laws of friction, various types of wear and lubricants and surface interactions.

MODULE I: Introduction to Tribo Design [09 Periods]

Specific principles, Tribological problems in machine design, Surface topography, Tribological processes: Contact process-contact mechanics, friction process-sliding and rolling friction, wear process-wear mechanisms, Stick-slip effects, Friction and wear test methods, Tribological materials.

MODULE II: Lubrication [09 Periods]

Purpose of lubrication, Basic modes of lubrication-Stribeck curve, hydrodynamic lubrication, Elastodynamic lubrication, Mixed lubrication, Boundary lubrication; Hydrostatic lubrication, Properties of lubricant, Additives, Choice of lubricant, oil, grease and solid lubricants, lubrication systems and their selection, oil conservation.

Selection of Rolling Element Bearings - Nominal life, static and dynamic capacity, equivalent load, probabilities of survival - cubic mean load, Selection of ball and roller bearings, bearing mounting details, preloading of bearings.

MODULE III: Hydrostatic Bearings [10 Periods]

A: Arrangement, advantages and limitations, Hydrostatic step bearing analysis-energy losses, optimum design, temperature rise; Hydrostatic conical thrust bearing, pad coefficients; Hydrostatic journal bearings - design procedures; Hydrostatic squeeze film bearings-analysis, thrust bearings and journal bearings - design procedure.

B: Fundamentals of fluid film formation, Mechanisms of pressure development in oil film, Reynold's equation, Hydrodynamic journal bearing-Sommerfeld number, bearing performance, temperature rise; Hydrodynamic thrust bearings - Raimondi and Boyd Method, fixed and tilting pads, single and multiple pad bearings.

MODULE IV: Computational Hydrodynamics [09 Periods]

Finite difference equivalent of the Reynolds equation, Numerical analysis of hydrodynamic lubrication in idealized journal and partial arc bearings, Vibrational stability in journal bearings-determination of stiffness and damping coefficients. Elasto-

Hydrodynamic Lubrication-Pressure-viscosity term in Reynold's Equation - Hertz theory - Ertel-Grubin Equation, lubrication of spheres, introduction to thermo-hydrodynamic lubrication.

MODULE V: Surface Engineering [10 Periods]

Surface modifications - transformation hardening, surface fusion - thermo chemical processes - surface coatings - plating and anodizing - fusion processes - vapour phase processes.

TEXT BOOKS

1. Majumdar, B.C, "**Introduction to Tribology of Bearings",** S.Chand, 2nd Edition, 2008.
2. Kenneth C Ludema, "**Friction. Wear, Lubrication: A Text book in Tribology",** CRC Press, 1st Edition, 1996.
3. John Williams, "**Engineering Tribology"**, Cambridge University Press, 2006.

REFERENCES

1. Neale M J,**"Tribology Handbook"**, Neumann Butterworths, 1975.
2. Connor J J O and Boyd, **"Standard Handboook of Lubrication Engineers",** ASLE, McGraw Hill Book Co., 1966.
3. Basu S K, Sengupatha S N and Ahuja D B, "Fundamentals of Tribology", Prentice Hall of India Pvt. Ltd., 2005.

E Resources:

1. itmmec.iitd.ac.in/
2. www.emeraldinsight.com/loi/ilt
3. www.tribology.fink.rs/guide.html
4. tribology.asmedigitalcollection.asme.org/journal.aspx
5. nptel.ac.in/courses/112102015/
6. nptel.ac.in/courses/112102014/

Course Outcomes:

At the end of the course, students should be able to:

1. Understand the concepts of tribological contacts and systems, the interrelation of parameters.
2. Methodology for deciding lubricants and lubrication regimes for different operating conditions.
3. Analyze hydrostatic and hydrodynamic journal bearings for given load / speed conditions.
4. Evaluate the performance of computational hydrodynamics and Elasto-hydrodynamic bearing lubrications.

5. Ability to work as an expert engineer and researcher in multicultural and interdisciplinary teams in the broad field of tribology, surfaces, interfaces and maintenance.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**					
CO2	**1**			**1**		
CO3						
CO4	**1**		**1**	**3**	**3**	
CO5			**2**	**2**	**2**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) I Semester		
Code: A3214	COMPUTER AIDED DESIGN (Professional Elective - I)	L	T	P
Credits: 3		3	-	-

Prerequsites: Engineering Drawing, Machine Drawing, Basics of Computer

Course objectives: The main objective of this course is to introduce the basic tools of computer-aided design (CAD), to expose the contemporary computer design tools for mechanical engineers and to prepare the student to be an effective user of a CAD/CAM system.

MODULE I: CAD Hardware and Software **[09 Periods]**

Types of systems and system considerations, input and output devices, hardware integration and networking, hardware trends, Software modules,

MODULE II: **Computer Communications** **[09 Periods]**

Computer Communications, Principle of networking, classification networks, network wring, methods, transmission media and interfaces, network operating systems,

MODULE III : **Computer Graphics** **[10 Periods]**

A: Introduction, transformation of geometric models: translation, scaling, reflection, rotation, homogeneous representation, concatenated transformations.

B: mappings of geometric models, translational mapping rotational mapping, general mapping, mappings as changes of coordinate system; inverse transformations and mapping;

MODULE IV : **Generation of models** **[10 Periods]**

Projections of geometric models, orthographic projections, Geometric Modeling, curve representation: Parametric representation of analytic curves, parametric representation of synthetic curves, curve manipulations. Surface representation,

MODULE V: **Fundamentals of solid modeling** **[10 Periods]**

Solid modeling, boundary representation (B-rep), Constructive Solid Geometry (CSF), sweep representation, Analytic Solid Modeling (ASM), other representations; solid manipulations, solid modeling based applications: mass properties calculations, mechanical tolerancing, etc.

REFERENCES:

1. Ibrahbim Zeid, “CAD / CAM Theory and Practice”.
2. Jim Browne, “Computer Aided Engineering and Design”.
3. P. Radhakrishnan / V. Raju / S. Subramanyam, “CAD / CAM / CIM”.
4. P.N. Rao, “CAD / CAM principles and applications”, Tata Mcraw-Hill, 02.
5. Rogers / Adams, “Mathematical Elements for Computer Graphics”.
6. Rooney and Steadman, “Principles of Computer Aided Design”, Aug. 1993.

E-Resources:

1. https://en.wikipedia.org/wiki/Computer-aided_design
2. https://www.techopedia.com/definition/2063/computer-aided-design-cad
3. https://www.inc.com/encyclopedia/computer-aided-design-cad-and-computer-aided-cam.html
4. https://www.youtube.com/watch?v=ZDeLwFwnFKg

Course Outcomes:

At the end of the course students able to:

1. Understanding of the principles of CAD systems
2. Implementing these principles, and its connections to CAM and CAE systems.
3. Understand 2D, 3D transformations and projection transformations
4. Use knowledge of various approaches of geometric modeling
5. Understand mathematical representation of 2D and 3D entities

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			**3**			
CO2	**2**			**1**		
CO3			**3**			
CO4	**3**			**2**		**1**
CO5			**2**			

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) I Semester		
Code: A3215	ROTOR DYNAMICS (Professional Elective - I)	L	T	P
Credits: 3		3		-

Prerequisites: Kinematics of Machinery, Dynamics of Machinery

Course Objectives: The main objective of this course is to understand the rotor and gear system motions, gyroscopic effects, critical speeds and balancing of rotors.

MODULE I: Introduction to Vibration and the Laval-Jeffcott Rotor Model [10 Periods]
Co-ordinate systems, Steady state rotor motion, Elliptical motion, Single degree of freedom systems, Free and forced vibrations. The two degrees of freedom rotor system, Geared systems, Translational motion, Natural frequencies and Natural modes, Steady state response to unbalance, the effect of flexible support.

MODULE II: Torsional Vibrations of Rotating Machinery [10 Periods]
Modeling of rotating machinery shafting, Multi degree of freedom systems, Determination of natural frequencies and mode shapes, Branched systems, Numerical methods for fundamental frequency.

MODULE III: Rigid Rotor Dynamics and Critical Speed [10 Periods]
A: Rigid disk equation - Rigid rotor dynamics, Rigid rotor and flexible rotor, The gyroscopic effect on rotor dynamics, Whirling of an unbalanced simple elastic rotor, Unbalance response.
B: Orbital Analysis and Cascade Plots, Simple shafts with several disks, Effect of axial stiffness, Determination of bending critical speeds, Campbell diagram.

MODULE IV: Influence of Bearings on Rotor Vibrations [09 Periods]
Support stiffness on critical speeds- Stiffness and damping coefficients of journal bearings, Computation and measurements of journal bearing coefficients, Mechanics of Hydro dynamic Instability, Half frequency whirl and Resonance whip, Design configurations of stable journal bearings.

MODULE V: Balancing of Rotors [09 Periods]
Single plane balancing, Multi-plane balancing, Balancing of rigid rotors, Balancing of flexible rotors, Influence coefficient and modal balancing techniques for flexible rotors.

REFERENCES

1. J. S. Rao, “Rotor Dynamics”, New Age International Publishers, New Delhi.
2. S. Timoshenko, D H. Young and W. Weaver, “Vibration Problems in Engineering”, John Wiley.
3. W J Chen and J E Gunter, “Introduction to Dynamics of Rotor – Bearing Systems”, Trafford Publishing Ltd.
4. T. Yamamoto and Y. Ishida, “Linear and Nonlinear Rotor Dynamics: A Modern Treatment with Applications”, John Wiley.
5. V J. S. Rao, “Vibratory Condition Monitoring of Machines”, Narosa Publishing House.

E-Resources:

1. https://nptel.ac.in/courses/112103024/4
2. https://nptel.ac.in/courses/112103024/
3. https://en.wikipedia.org/wiki/Rotordynamics
4. http://www.oros.com/3902-orbigate.htm?gclid=CjwKCAjw 8nbBRBnEiwAqWt1zStey0Pahdw3PLq7pJBZbuaB1x0pxtFfks2005ozj7UgKhnl8q5Y WhoCwAUQAvD_BwE

Course Outcomes:

At the end of the course, students should be able to:

1. Determine the natural frequencies and mode shapes.
2. Design the rotating machineries by considering torsional vibrations.
3. Analyze whirling of shafts and unbalanced responses.
4. Understand the influence of bearings on rotor dynamics.
5. Balancing of multi-plane rotors..

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**		**2**			
CO2			**1**	**1**		
CO3	**3**	**1**			**1**	
CO4			**2**	**1**		**1**
CO5	**3**					

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) I Semester		
Code: A3216	MECHANICS OF COMPOSITE MATERIALS (Professional Elective - II)	L	T	P
Credits: 3		3	-	-

Prerequisites: Nil

Course objectives: The main objective of this subject is to understand the fundamentals of composite material strength and its mechanical behavior and analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.

MODULE I: Basic Concepts, Characteristics and Reinforcements [10 Periods]
Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.
Reinforcements - Fibres – Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

MODULE II: Micro mechanics& Manufacturing methods [10 Periods]
Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties. Manufacturing methods -Auto clave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

MODULE III: Coordinate Transformation [10 Periods]
A: Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off – axis, stiffness modulus, off – axis compliance.
B: Elastic behavior of unidirectional composites -Elastic constants of lamina, relationship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

MODULE IV: Strength of Unidirectional Lamina [09 Periods]
Micro mechanics of failure, Failure mechanisms, strength of an orthotropic lamina, strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micros mechanical predictions of elastic constants.

MODULE V: Analysis of Laminated Composite Plates [09 Periods]
Introduction thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

TEXT BOOKS:

1. Autar K. Kaw, "**Mechanics of Composite Materials",** Second Edition (Mechanical Engineering), Publisher: CRC, 2nd Edition, 2006.
2. Mallick, P.K., Fiber –"Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
3. R. M. Jones, "**Mechanics of Composite Materials",** B S Publications, 2nd Edition,1998.

REFERENCES:

1. Isaac and M Daniel, "**Engineering Mechanics of Composite Materials",** Oxford University Press, 2nd Edition, 2006.
2. B. D. Agarwal and L. J. Broutman, "**Analysis and performance of fibre Composites",** Wiley-Interscience, New York,3rd Edition,2012.
3. L. R. Calcote, "**Analysis of Laminated Composite Structures",** Van Nostrand Rainfold, New York, 1969.
4. Vasiliev & Morozov, "**Advanced Mechanics of Composite Materials",** Elsevier, Second Edition, 2007.

E Resources:

1. www.sciencedirect.com/science/book/9780080453729
2. https://www.elsevier.com › ... › Mechanics of Materials › Materials Mechanics
3. link.springer.com/journal/11029
4. https://books.google.com › Technology & Engineering › Materials Science › General
5. nptel.ac.in/courses/112104161/
6. nptel.ac.in/courses/101104010/

Course Outcomes

At the end of the course, students should be able to:

1. Explain basic concepts of different types of Composites with its applications and different reinforcement.
2. Course would be helpful to understand the basic principle behind the various fabrication techniques in Composites.
3. Students would be trained to model the mechanical behaviour of Composites in unidirectional laminates.
4. Determine strength of the composite materials using unidirectional laminates and able to make use of Classical Lamination Theory for the design of Composite Structures.
5. Analyze of composite plates in different load conditions and testing methods.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**			**3**		
CO2		**1**				
CO3			**2**			
CO4	**3**			**3**		
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) I Semester		
Code:A3217	VEHICLE DYNAMICS (Professional Elective - II)	L	T	P
Credits: 3		3	-	-

Prerequisites: Engineering Mechanics, Dynamics of Machinery

Course objectives: The main aim of this subject is to understand the fundamentals of dynamics of vehicles, suspension, steering mechanism and stability of the vehicle.

MODULE I: Introduction [10 Periods]

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

MODULE II: Vehicle Frame [10 Periods]

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

MODULE III: Steering Mechanisms [10 Periods]

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

B: Rear Axle Mechanism -Determination of Optimum Dimension and properties for Steering Linkages ensuring minimum error in Steering, Design of Final Drive Gearing, Rear Axle Shafts and Rear Axle Housings.

MODULE IV: Suspension Design [09 Periods]

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

MODULE V: Wheeled Vehicle Handling [09 Periods]

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

TEXT BOOKS:

1. RaoJ.S and Gupta.K ,"**Theory and Practice of Mechanical Vibrations**",Wiley Eastern Ltd., New Delhi -2, 2002.
2. GiriN.K,"**Automotive Mechanics**" ,Khanna Publishers, 2002.
3. Gillespie T.D, "**Fundamentals of Vehicle Dynamics**", SAE USA 1992.

REFERENCES:

1. Heldt.P.M , "**Automotive Chassis**",Chilton Co., New York- 1992
2. Ellis.J.R , "**Vehicle Dynamics**",Business Books Ltd., London- 1991.
3. Giles.J.G.Steering,"**Suspension and Tyres**",Illiffe Books Ltd., London- 1998
4. Ham B, Pacejka, "**Tyre and Vehicle Dynamics" ,**SAE Publication - 2002.

E Resources:

1. jstem.org/index.php?journal=JSTEM&page=article&op=download...1511…
2. www.natrip.in
3. www.tandfonline.com/toc/nvsd20/current
4. topics.sae.org/vehicle-dynamics/magazines
5. nptel.ac.in/courses/107106080/

Course Outcomes:

At the end of the course, students should be able to:

1. Understand about the fundamentals of vehicle dynamics, vehicle terrain and kinematics.
2. To analyze the influence of vehicle configuration, chassis of the vehicle.
3. Design parameters on vehicle performance, front and rear axle mechanism.
4. Evaluate the design paradigm for suspension of the vehicles using CAE.
5. Analyze the stability of the heavy vehicles and its controlling effects.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1				**3**		
CO2		**3**				
CO3			**2**		**1**	
CO4	**2**					**1**
CO5				**3**		

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) I Semester		
Code: A3218	**DESIGN FOR MANUFACTURING AND ASSEMBLY (Professional Elective - II)**	**L**	**T**	**P**
Credits: 3		3		**-**

Prerequisites: Machine Drawing, Metal Casting, Manufacturing Technology

Course Objectives: The main objective of this subject is to know the concept of design philosophy, material selection, manufacturing and assembly for various products.

MODULE I: Introduction [10 Periods]

Design philosophy – Steps in Design process – General Design rules for Manufacturability – Basic principles of designing for economical production – Creativity in design. Materials: Selection of Materials for design – Developments in Material Technology – Criteria for material selection – Material selection interrelationship with process selection – process selection charts.

MODULE II: Machining Process & Metal Casting [10 Periods]

Overview of various machining processes – general design rules for machining - Dimensional tolerance and surface roughness – Design for Machining ease – Redesigning of components for machining ease with suitable examples, General design recommendations for machined parts.

Metal Casting - Appraisal of various casting processes, Selection of casting process, General design considerations for casting – casting tolerances – Use of Solidification Simulation in casting design – Product design rules for sand casting.

MODULE III: Metal Joining & forging [10 Periods]

A: Appraisal of various welding processes, Factors in design of weldment – General design guidelines – pre and post treatment of welds – Effects of thermal stresses in weld joints.

B: Design of brazed joints. Forging- Design factors for forging – Closed die forging design – parting lines of dies – Drop forging die design – General design recommendations

MODULE IV: Extrusion, Sheet Metal Work [09 Periods]

Design guidelines for Extruded sections - Design principles for Punching, Blanking, Bending, and Deep Drawing – Keeler Goodman Forming Limit Diagram – Component Design for Blanking.

MODULE V: Design of Manual Assembly [09 Periods]

General design guidelines for Manual Assembly - Development of Systematic DFA Methodology - Classification System for Manual handling- Classification System for Manual Insertion and Fastening - Effect of part symmetry on handling time - Effect of part thickness and size on handling time - Effect of weight on handling time - Applications of the DFA methods , Further general design guidelines.

TEXT BOOKS

1. Bralla, Design for Manufacture handbook, McGraw hill, 1999.
2. Geoffrey Boothroyd, "Assembly Automation and Product Design", Marcel Dekker Inc., NY, 1992.

REFERENCES

1. George E. Deiter, "**Engineering Design - Material & Processing Approach",** McGraw Hill Intl. 2nd Ed, 2000.
2. Geoffrey Boothroyd, Peter Dewhurst & Winston Ansthony Knight,**"Product Design for Manufacturing and Assembly",** CRC Press,3rd Edition, 2010.
3. Surender Kumar & Goutham Sutradhar, "**Design and Manufacturing"**, Oxford & IBH Publishing Co. Pvt .Ltd., New Delhi, 1998.
4. Harry Peck , Designing for manufacture, Pitman– 1973

E Resources:

1. www.engineersedge.com/training.../design-for-manufacturing-training.htm
2. https://www.dfma.com/
3. infoguides.rit.edu › InfoGuides
4. https://books.google.co.in/books?isbn=1860583725
5. nptel.ac.in/courses/107103012/

Course Outcomes:

At the end of the course, students should be able to:

1. Demonstrate design philosophy, creativity and material selection for manufacture the end product.
2. Analyze various machining process and metal casting techniques using general design principles.
3. Understand the different welding processes, forging operations and complex interrelationships between design and manufacturing.
4. Explore and understand the extrusion and sheet metal operations using design concepts for various engineering applications.
5. Formulate various assembly concepts and methodology for improving the assembly operation using minimal time period.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**					
CO2		**2**		**3**		
CO3	**1**		**1**	**3**		
CO4		**2**				
CO5	**1**					

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code:A0H18	RESEARCH METHODOLOGY AND IPR	L	T	P
Credits: 2		2	-	-

Prerequisites: NIL

Course Objectives: The objective of the course is to make students familiar with the basics of research methodology and various types of Intellectual Properties, IPR legislations and policies.

MODULE-1 Research Problem [06 Periods]

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.

MODULE – II Technical Writing & Research Proposal [07 Periods]

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.

MODULE – III Intellectual Property Rights [06 Periods]

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

MODULE – IV Patent Rights [06 Periods]

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

MODULE – V Case Studies [07 Periods]

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

REFERENCES:

1. Prabhuddha Ganguli: ‘ Intellectual Property Rights” Tata Mc-Graw –Hill, New Delhi
2. M.Ashok Kumar and Mohd.Iqbal Ali: “Intellectual Property Right” Serials Pub.
3. Carlos M.Correa- **‘‘Intellectual property rights , The WTO and Developing countries”**-Zed books

4. Law relating to patents, trademarks, copyright designs, Wadehra, B.L. & 2 ed. Universal Law Publishing 2000.
5. C.R.Kothari, **"Research Methodology"** New Age International Publishers, Fourth edition, 2018.
6. Donald Cooper & Pamela Schindler, **"Business Research Methods",** TMGH, 9th edition.
7. Alan Bryman & Emma Bell, **"Business Research Methods"**, Oxford University Press.

E Resources:

1. https://www.wto.org/english/tratop_e/trips_e/trips_e.htm
2. https://www.wto.org/english/thewto_e/whatis_e/tif_e/agrm7_e.htm
3. http://nptel.ac.in/courses/110999906/
4. http://nptel.ac.in/courses/109105112/

Course outcomes:

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

1. Comprehend the concepts of research methodology and its concepts.
2. Realize the concepts of literature review and developing a research proposal.
3. Understand the basic concepts of Intellectual property rights.
4. Understand the types of patents and their procedures.
5. Recognize the recent developments in IPR administration.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**3**			**3**	**3**
CO2	**3**	**3**			**3**	**3**
CO3	**3**	**3**			**3**	**3**
CO4	**3**	**3**			**3**	**3**
CO5	**3**	**3**			**3**	**3**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) I Semester		
Code: A3203	**DYNAMICS AND VIBRATIONS LAB**	**L**	**T**	**P**
Credits: 1.5				**3**

Prerequisites: Dynamics lab.

Course Objectives:

The objective of this lab is to provide students with an environment to model and analyze complex engineering systems for vibration analysis. This lab space is being utilized for experimental research and course related projects and demonstrations. The lab also provides tools for design projects, which involve concepts and applications in terms of dynamics, vibrations and controls.

List of Experiments

1. Determination of steady state amplitude of a forced vibratory system.
2. To determine the radius of gyration of given bar by using Bi-Filer suspension
3. Static balancing using steel balls.
4. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
5. Field balancing of the thin rotors using vibration pickups.
6. Determination of the magnitude of gyroscopic couple, angular velocity of precession and representation of vectors.
7. Determination of natural frequency of given structure using FFT analyzer.
8. Diagnosis of a machine using FFT analyzer.
9. Direct Kinematic analysis of a robot.
10. Inverse Kinematic analysis of a robot.
11. Trajectory planning of a robot in joint space scheme.
12. Palletizing operation using Robot programming.

Course outcomes

At the end of the course, students should be able to:

1. Understand the free and forced response of 1DOF systems
2. Learn how to use graphical methods to solve the equation of motion in damped forced vibrations
3. Understand the response of 2DOF systems.
4. Understand how to determine the natural frequencies of continuous systems starting from the general equation of displacement.
5. Understand how to apply the boundary conditions to continuous systems.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			**2**			
CO2	**2**					
CO3			**2**			**1**
CO4	**1**			**3**		
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) I Semester		
Code: **A3204**	**ADVANCED MATERIAL TESTING LAB**	**L**	**T**	**P**
Credits: 1.5		**-**	**-**	**3**

Prerequisites: Material Science, Mechanics of solids.

Course Objectives: The main objective of this laboratory is to determine the microstructure and properties of various materials and to determine the properties of materials using various measurement techniques.

List of Experiments

1. Preparation and study of the Micro Structure of ferrous metals and alloys.
2. Preparation and study of the Microstructure of nonferrous metals and alloys.
3. Effect of tempering time on the hardness of quenched carbon steels.
4. Effect of tempering temperature on the hardness of a hardened carbon steels.
5. Preparation of metallic specimens by electro polishing.
6. Study of work hardening characteristics of a pure metal.
7. Determination of carbon percentage in the given ferrous specimen.
8. Determination of Tensile strength of steel specimen using UTM.
9. Determination of impact strength using Charpy and Izod test.
10. Hoop stress and strain relationship for thin cylinder.
11. Analysis of Fatigue behaviour of the given specimen.
12. Analysis of torsional rigidity of steel specimen.

Course Outcomes:

At the end of the course, students should be able to:

1. Understand the basic structure of metals and alloys.
2. Understand the microstructure of ferrous and non-ferrous materials.
3. Understand the heat treatment and the work hardening of the materials.
4. Understand the design principles in the product design.
5. Analyze the properties of materials for various engineering applications.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1				**2**		
CO2	**2**					
CO3			**2**			
CO4	**2**				**1**	
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code: A0A04	**ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**
Credits: Nil		**2**	**-**	**-**

Prerequisites: Nil

Course objective: The objective of the course is to provide the knowledge on structuring paragraphs, paraphrasing and preparation of research documents related to abstract, literature review, methods and results.

Module I: **[06 Periods]**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Module II: **[07 Periods]**

Clarifying Who Did What, Highlighting Your Findings, Hedging and criticising, paraphrasing and plagiarism, sections of a paper, abstracts. Introduction.

Module III: **[06 Periods]**

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

Module IV: **[06 Periods]**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Module V: **[07 Periods]**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

REFERENCES:

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

Course outcomes

At the end of the course, students should be able to

1. Structure the sentences and paragraphs.
2. Elaborate the various sections of research papers.
3. Explore the check list in research documents.
4. Apply the key skills to coin the title, abstract, introduction and literature review.
5. Inspect the skills required for preparing experimental results and discussions.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		**2**			**2**	**1**
CO2		**2**			**2**	**1**
CO3		**2**			**2**	**1**
CO4		**2**			**2**	**1**
CO5		**2**			**2**	**1**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code: A3205	DESIGN OF MECHANICAL SYSTEMS	L	T	P
Credits: 3		3		--

Prerequisites: Nil

Course Objectives: The objective of the course is to understand the basic design concepts, problem formulation, identifying solutions and concept optimization.

MODULE I: Introduction [10 Periods]

Introduction of Design of Systems-Introduction-Concept of Systems -General Model of A System -Application of A System-Elements/Components of a System -Classification of a System in Mechanical Systems Design --A Case Study of a Mechanical System Design.

MODULE II: Engineering Processes and the System Approach [10 Periods]

Introduction (System Approach) -Application of Systems Concepts in Engineering -Identification of Engineering Functions of Systems-The Characteristics of a System in "MSD" --Engineering Activities Matrix -Defining the Proposed Effort -Role of Engineer in "Mechanical System Design" -Engineering Problem Solving -Concurrent Engineering (CE)- A. Case Study: Viscous Lubrication System in Wire Drawing.

MODULE III: Design and Problem Formulation [10 Periods]

A: Introduction -Nature of Engineering Problem -Needs Statement -Identification and Analysis of Need -Hierarchical Nature of System and Hierarchical Nature of Problem.
B: Environment -Problem Scope and Constraints -A Case Study: Heating Duct Insulation System -A Case Study: High-Speed Belt Drive System -Chain Drives.

MODULE IV: System Theories [09 Periods]

Introduction -System Analysis View Point -Black Box or Decision Process Approach -State Theory Approach --Component Integration Approach -A Case Study: Automobiles Instrumentation Panel System.

MODULE V: Optimization Concepts [09 Periods]

Introduction -The Optimization Process -Motivations and Freedom of Choice -Goals and Objectives-Criteria -Methods of Optimization -A Case Study: Aluminium Extrusion System.

TEXT BOOKS

1. Siddiqui, K.U.; Manoj Kumar Singh "Mechanical System Design" New Age International 2007.
2. Simant, R. C. Mishra **"**Mechanical System Design**"** PHI Learning Pvt. Ltd., 2009**.**

E Resources

1. https://www.en.aau.dk/education/master/design-mechanical-systems
2. https://catalog.byu.edu/engineering-and-technology/mechanical-engineering/mechanical-system-design-fundamentals
3. https://www.springer.com/in/book/9783211994603

Course outcome:

At the end of the course, students should be able to:

1. Students will understand how to prepare a needs-assessment for a given project
2. Students will learn how to define a deliverable and make a budget for a project
3. Students will learn successful group interaction for a project
4. Students will produce an intermediate and final design report as part of their deliverable for a project
5. Students will deliver a final oral presentation for their project, including intermediate oral updates of their project as required by the project sponsor

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**			**3**		
CO2			**2**			**1**
CO3	**2**			**3**		
CO4			**2**		**2**	
CO5	**1**					

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code: A3206	ADVANCED FINITE ELEMENT METHODS	L	T	P
Credits: 3		3	-	-

Prerequisites: Finite Element Methods

Course Objectives: The objective of the course is to understand principles of finite element modeling and analysis of 1D, 2D, 3D and Scalar Field variable Problems.

MODULE I: Introduction **[10 Periods]**

Introduction to FEM - comparison of FEM with other methods – H and P methods – Variational and weighted residual methods- Rayleigh – Ritz and Galerkin methods – Coordinate system-Element types, shape function. Element equation, stiffness matrix, boundary conditions. Global stiffness matrix- solution methods –Gauss elimination – Determination of nodal solutions.

MODULE II: 1D Problems **[10 Periods]**

Finite Element modelling of bar element – Stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems.

Plane Truss and Space Truss –Problems Beams - Shape functions – Stiffness matrix – Load vector – Problems.

MODULE III: 2D and 3D Problems **[10 Periods]**

A: CST, LST and QST Elements - Stiffness matrix and Load vectors, boundary conditions, Isoparametric elements – Quadrilateral element, shape functions – Numerical Integration.

B:Axi-symmetric elements - solids subjected to Axi-symmetric loading. 3D elements-Tetrahedran element – Jacobian matrix– Stiffness matrix

MODULE IV: Dynamic Analysis **[09 Periods]**

Equations of motion for dynamic problems. Consistent and lumped mass matrices. Formulation of element mass matrices. Free vibration problem formulation, Solution of Eigen value problems using 1D elements, Time dependent one- dimensional bar analysis

MODULE V: Heat Transfer Analysis **[09 Periods]**

Basic differential equations of heat transfer, one dimensional steady state heat transfer problems involving conduction and convection. Analysis of tapered fin, Formulation of thermal stress problems and examples, transient thermal analysis.

TEXT BOOKS

1. SS Rao, "**The Finite Element Methods in Engineering"** Elsevier publisher,5thEdition, 2010.

2. Chandrupatla, Ashok and Belegundu**"Introduction to Finite Elements in Engineering"** Prentice – Hall,3rd Edition,2002.

EFERENCES BOOKS:

1. J. N. Reddy **"An Introduction to Finite Element Method",** McGrawhill, 3rd Edition, 2006.
2. O.C. Zienkiewicz **"The Finite element method in engineering science",** McGrawhill, 2nd Edition, 2007
3. Robert Cook "Concepts and applications of finite element analysis", Wiley, 3rd Edition, 1989.
4. S.Md. Jalaludeen"Introduction to Finite element analysis", Anuradha Publications, 2012.

E Resources:

1. http://www.colorado.edu/engineering/CAS/courses.d/AFEM.d/
2. https://cosmolearning.org/courses/advanced-finite-elements-analysis/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-094-finite-element-analysis-of-solids-and-fluids-ii-spring-2011/lecture-notes/
4. https://link.springer.com/book/10.1007%2F978-3-642-30316-6
5. http://ieeexplore.ieee.org/document/649424/

Course Outcomes:

At the end of the course, students should be able to:

1. This course would make familiar of basic approximate methods in Structural applications.
2. This Course would be helpful to understand the basic principle of Finite Element Analysis in 1D, 2D and 3D.
3. Students would be trained to solve structural and non-structural problem using FEM.
4. One would be able to make use of Finite Element technique for a analyzing a manufacturing process.
5. This Course would equip the students to effectively employ finite element method in order to simulate and launch a new engineering component to the market.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		**2**				
CO2	**2**		**2**			
CO3		**1**				**1**
CO4	**1**			**2**		
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code: A3207	**ROBOTICS & CONTROLS**	**L**	**T**	**P**
Credits: 3		3	-	-

Prerequisites: Kinematics and Dynamics

Course Objectives: The primary goal of this course is to provide students with an understanding of how industrial engineering tools and techniques can be used in design, evaluation, and improvement of service systems. It introduces the major classes of industrial automation. Issues associated with the successful deployment of automation are presented.

MODULE I: Introduction & Control System and Components 10 Periods]

Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement. Control System and Components - Basic concept and modal of controllers control system analysis, robot activation and feedback components. Sensors: Desirable features, tactile, proximity and range sensors, uses sensors in robotics, Positions sensors, velocity sensors, actuators sensors, power transmission system.

MODULE II: Motion Analysis and Control [10 Periods]

Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.

MODULE III: End Effectors & Machine Vision: [10 Periods]

A: Grippers-types, operation, mechanism, force analysis, tools as end effect or consideration in gripper selection and design.

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

MODULE IV: Robot Programming & Robot Languages: **[09 Periods]**

Lead through programming, Robot programming as a path in space, Motion interpolation, wait, sinonal and delay commands, Branching capabilities and Limitations. Robot Languages -Textual robot Languages, Generation, Robot language structures, Elements in function.

MODULE V: Robot Cell Design and Control & Robot Application: **[09 Periods]**

Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work wheel controller. Robot Application-

Material transfer, Machine loading/unloading, Processing operation, Assembly and Inspection, Feature Application.

TEXT BOOKS

1. Groover M P, "**Industrial Robotics**", Pearson Edu, 2nd Edition, 2012.
2. J.J.Craig "**Introduction to Robotic Mechanics & Control"** Pearson, 3rd edition, 2008.

REFERENCES:

1. Fu K S, "Robotics" McGraw Hill, 2nd Edition, 2008.
2. Richard D. Klafter, "**Robotic Engineering"** Prentice Hall,1989.
3. Asada and Slotine, "**Robot Analysis and Intelligence",** Wiley Inter-Science, 1986.
4. Mark W. Spong and M. Vidyasagar, **"Robot Dynamics & Control",** John Wiley & Sons (ASIA) Pte Ltd, 2008.
5. Mittal R K &Nagrath I J, "**Robotics and Control"** TMH, 6th Edition, 2007.

E Resources:

1. www.emeraldinsight.com/journal/ir.
2. https://www.omicsonline.org/scholarly/industrial-robotics-journals-articles-ppts-list.php
3. www.geku.co.uk/
4. robotics.kawasaki.com/en1/
5. nptel.ac.in/courses/112103174/39
6. nptel.ac.in/courses/112101099/

Course Outcomes:

At the end of the course, students should be able to:

1. Understand about robot kinematics and dynamics systems, ability to write basic program to control robot.
2. Discuss the various types of Industrial Controls and explain which control method or technology is better suited for a given environment or application.
3. Understand the context and importance of robotics, machine vision in the different Industrial applications.
4. Design and develop the programming languages for robotics.
5. Design robot cell and interpretation methods for the control of robots.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1				**2**		
CO2		**2**			**1**	
CO3				**1**		
CO4	**2**		**3**			
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code: A3219	ANALYSIS AND SYNTHESIS OF MECHANISMS (Professional Elective - III)	L	T	P
Credits: 3		3	-	-

Prerequisites: Dynamics of Machinery

Course objectives:

The main objective of this course is to understand the theoretical background for basic and advanced kinematics and synthesis of mechanisms to achieve desired motion and an opportunity to use theory and application tools through a major mechanism design applications.

MODULE I: Basic Concepts [10 Periods]

Definitions and assumptions; planar and spatial mechanisms; kinematic pairs; degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Review of graphical and analytical methods of velocity and acceleration analysis of kinematically simple mechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods.

MODULE II **:Curvature Theory [10 Periods]**

Fixed and moving centrodes, inflection circle, Euler-Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell mechanisms.

MODULE III: Synthesis of mechanisms [10 Periods]

Kinematic Synthesis of planar mechanisms, accuracy (precision) points, Chebesychev spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, centre and circle point curves, Analytical synthesis of four-bar and slider-crank mechanisms.

MODULE IV: Synthesis of angular velocities and accelerations [09 Periods]

Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers, three accuracy point synthesis using complex numbers.

MODULE V: Coupler Curves [09 Periods]

Equation of coupler curve, Robert-Chebychev theorem, double points and symmetry. Kinematic Analysis of Spatial Mechanisms, Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms

TEXT BOOKS:

1. R.S. Hartenberg and J. Denavit, “Kinematic Synthesis of Linkages”, McGraw-Hill, New York, 1980.
2. Robert L.Nortan ,"Design of Machinery',Tata McGraw Hill Edition
3. Hamilton H.Mabie,"Mechanisms and Dynamics of Machinery",John Wiley and sons New York
4. S.B.Tuttle,"Mechanisms for Engineering Design" John Wiley and sons New York.

REFERENCES:

1. A.G. Erdman and G.N. Sandor, “Mechanism Design – Analysis and Synthesis”, (Vol. 1 and 2), Prentice Hall India, 1988
2. A.S. Hall, “Kinematics and Linkage Design”, Prentice Hall of India.
3. J.E. Shigley and J.J. Uicker, “Theory of Machines and Mechanisms”, 2nd Edition, McGraw-Hill, 1995.
4. Ghosh and A.K. Mallik, “Theory of Machines and Mechanisms”, Affiliated East-West Press, New Delhi, 1988.

E Resources:

1. http://courses.me.metu.edu.tr/courses/me431/download/Introduction.pdf
2. https://books.google.co.in/books/about/Kinematic_Analysis_and_Synthesis_of_Mech.html?id=GbSDz8Sge8kC
3. http://ocw.upm.es/ingenieria-mecanica/mechanical-devices-for-industry/contenidos/learning-guide
4. https://www.scribd.com/document/103469079/Computer-Aided-Analysis-and-Synthesis-of-Mechanisms
5. https://www.researchgate.net/publication/283343729_Kinematic_Analysis_and_Synthesis_of_Mechanisms

Course Outcomes:

At the end of the course, students should be able to:

1. Develop analytical equations describing the relative position, velocity and acceleration of all moving links.
2. Select, configure, and synthesize mechanical components into complete systems.
3. Use kinematic geometry to formulate and solve constraint equations to design linkages for specified tasks.
4. Formulate and solve four position synthesis problems for planar and spherical four-bar linkages by graphical and analytical methods.
5. Analyze and animate the movement of planar and spherical four-bar linkages.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1				**3**		
CO2		**1**				**1**
CO3	**2**		**3**	**3**		
CO4						
CO5			**3**			

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code: A3220	DESIGN OF HYDRAULIC AND PNEUMATIC COMPONENTS (Professional Elective - III)	L	T	P
Credits: 3		3	-	-

Prerequisites: Fluid Mechanics

Course Objectives:

To know the advantages and applications of Fluid Power Engineering and Power Transmission System and to learn the Applications of Fluid Power System in automation of Machine Tools and others Equipments.

MODULE I: Fluid Power Systems and Fundamentals [10 Periods]

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics-Applications of Pascals Law- Laminar andTurbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves and fittings.

MODULE II: Hydraulic System & Components [10 Periods]

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators – Types ofhydraulic cylinders – Single acting, Double acting special cylinders like tanden, Rodless,Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

MODULE III: Design of Hydraulic Circuits [10 Periods]

A: Construction of Control Components : Directional control valve – 3/2 way valve – 4/2 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram.

B: Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit.

MODULE IV: Pneumatic Systems and Components [09 Periods]

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Penumo hydraulic circuit,Sequential circuit design for simple applications using cascade method.

MODULE V: Design of Pneumatic Circuits [09 Periods]

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

TEXT BOOKS

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill,2001.

REFERENCES

1. Srinivasan.R, "Hydraulic and Pneumatic controls", Vijay Nicole, 2006.
2. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.
3. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995
4. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
5. Harry L. Stevart D.B, "Practical guide to fluid power", Taraoeala sons and Port Ltd.
   Broadey, 1976.
6. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
7. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

E-Resources:

1. https://www.scribd.com/doc/71748995/Applied-Hydraulics-Pneumatics-Jayakumar
2. https://ourmechanicalengg.wordpress.com/2016/04/11/applied-hydraulics-and-pneumatic-ahp/
3. https://slideplayer.com/slide/5675986/
4. http://www.vidyarthiplus.in/2014/09/applied-hydraulics-and-pneumatics-two.html

Course Outcomes:

At the end of the course, students should be able to:

1. explain the similarities and differences of the electrical, pneumatic and hydraulic systems
2. decide which system is better for a specific application,
3. understand the basic parts of the industrial hydraulic and pneumatic systems and their functions,
4. design a hydraulic or pneumatic system circuit by using related software and make simulations,
5. design a hydraulic or pneumatic system and outline PLC control algorithm for a predefined automation process.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1				**3**		
CO2			**3**	**3**		
CO3	**1**				**2**	
CO4			**3**	**2**		
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code: A3221	ADVANCED TOOL DESIGN (Professional Elective - III)	L	T	P
Credits: 3		3	-	-

Prerequisites: Machine Drawing, Manufacturing Technology

Course Objectives: To understand the concepts of tool design and allied fixture design for machining and forming systems.

MODULE I: Basic principles of tool design [10 Periods]

Tool design – An overview, Introduction to Jigs and fixtures.

Work holding devices: Basic principle of six point location, Locating methods and devices, Principle of clamping and Types of clamps.

MODULE II: Design of Jigs and fixtures [10 Periods]

Design of jigs: Type of Drill bushes, Classification of drill jigs, Design of drill jigs. Design of fixtures: Design of milling fixtures, Design of turning fixtures

MODULE III: Introduction of press tool design [10 Periods]

A: Introduction to Die cutting operations, Introduction to press and classifications, Die set assembly with components.

B: Introduction to Centre of pressure, Examples of centre of pressure, Design of piercing die, Design of blanking die, Progressive, Compound and Combination dies .

MODULE IV: Design of cutting tools [09 Periods]

Introduction to cutting tools, Design of single point tool, Design of drill bit, Design of milling cutter

MODULE V: NC Machine Cutting Tools [09 Periods]

Brief introduction of NC machines work holding devices: Tool design for NC machines-Anintroduction, Fixture design for NC Machine, Cutting tools for NC Machine, Tool holding methods for NC Machine, ATC and APC for NC Machine, Tool presetting for NC Machine.

TEXT BOOKS:

1. F.W.Wilson.F.W. "Fundamentals of Tool Design", ASME, PHI, New Delhi, 2010.
2. Donaldson.C, G.H.Lecain and V.C.Goold "Tool Design", TMH, New Delhi, 2010.

REFERENCES:

1. K.Venkataraman, "**Design of Jigs, Fixtures & Press tools**", Tata McGraw-Hill Publishing Company Limited, New Delhi 2005.
2. Edward G Hoffman, "**Jigs and Fixture Design**", Thomson – Delmar Learning, Singapore, 2004.
3. Hiram E Grant, "**Jigs and Fixture**" Tata McGraw Hill, New Delhi, 2003.
4. "**Fundamentals of Tool Design**", CEEE Edition, ASTME, 1983.

E-Resources

1. https://slideplayer.com/slide/5766891/
2. https://slideplayer.com/slide/7774043/
3. https://www.slideshare.net/mrgtimoq/tooling-design-presentation
4. https://uni.edu/~rao/Mfg%20Tooling%20-04%20Cutting%20tool%20design.pdf

Course Outcomes:

At the end of this course students will be able to

1. Interpret the geometrical and dimensional details of a production drawing.
2. Understand principles of locating and clamping systems.
3. Design jigs and fixtures for conventional and NC machining.
4. Select and design progressive, compound or combination dies for press working operations.
5. Design single point and multipoint cutting tools.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**				**3**	
CO2			**1**			
CO3				**2**		**1**
CO4	**2**					
CO5			**1**			

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code: A3222	EXPERIMENTAL STRESS ANALYSIS (Professional Elective - IV)	L	T	P
Credits: 3		3	-	-

Prerequisites: Metrology and Measurements

Course Objectives: The main objective of this course is to understand the relation between the mechanics of materials and experimental stress analysis, measurement methods, recording instruments, coating methods and photo elasticity.

MODULE I: Introduction & Strain measurement methods [10 Periods]

Theory of Elasticity, Plane stress and plane strain conditions, compatibility conditions, problem using plane stress and plane strain conditions, three-dimensional stress strain relations.

Strain measurement methods - various types of strain gauges, electrical resistance strain gauges, semiconductor strain gauge circuits.

MODULE II: Recording Instruments [10 Periods]

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.

MODULE III: Brittle Coatings & Moire Methods [10 Periods]

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

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

MODULE IV: Photo Elasticity [09 Periods]

Photo elasticity, polariscope, plane and circularly polarized light, bright and dark filed setup, photo elasticity materials, Isochromatic fringes – Isoclinic's.

MODULE V: 3D Photo Elasticity & Birefringent coating [09 Periods]

Introduction, locking in model deformation, materials for three dimensional photo elasticity, machining cementing and slicing three dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions, applications of the Frozen-stress method, the scattered-light

method. Birefringent coating - Introduction, coating stress and stains, coating sensitivity, coating materials, application of coatings, effective of coating thickness, fringe-order determinations in coatings, stress separation methods.

TEXT BOOKS:

1. Timoshenko and GoodierJr , "**Theory of elasticity" ,**3rd Edition,2010.
2. Sadhu singh, "**Experimental Stress Analysis" ,**KhannaPublications,2009.

REFERENCES:

1. Dally and Riley, "**Experimental Stress analysis" ,**McGraw-Hill, 3rd Edition,1991.
2. LOVE A.H., "**A treatise on Mathematical theory of elasticity",** Dover Publications,2007.
3. Frocht, "**Photo Elasticity**" J. Wiley , 3rd Edition, 2006

E Resources:

1. www.springer.com/in/book/9783319060859
2. https://mechanical.illinois.edu/courses/tam-456-experimental-stress-analysis
3. www.worldcat.org/title/proceedings-of-the...experimental-stress-analysis/.../6469098
4. journals.sagepub.com/home/sd
5. nptel.ac.in/courses/112106068/
6. nptel.ac.in/downloads/112106068/

Course Outcomes:

At the end of this course students will be able to

1. Understand about the theory of plasticity, different strain gauges, strain measurements in different engineering applications.
2. Utilize collection of data from the output device from various recording instruments.
3. Interpret different types of coatings methods in brittle and ductile materials for experimental conditions.
4. Inspection of stressed materials using photo elasticity method.
5. Determine the strain value of the stressed material using 3D photo elasticity and birefringent coatings.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1						
CO2	**3**			**3**		
CO3		**2**			**2**	
CO4	**1**		**1**			
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code: A3223	**FRACUTRE MECHANICS (Professional Elective - IV)**	**L**	**T**	**P**
Credits: 3		**3**		**-**

Prerequisites: Mechanics of Solids

Course objectives: The main aim of this course is to study the fundamental principles and assumptions of fracture mechanics, mode of fractures, fatigue life, crack arrest mechanism and different case studies of the failures.

MODULE I: Introduction to Fracture Mechanics 10 Periods]

The Crack Tip Plastic Zone, Methods for Measuring Fracture Toughness, The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation - limit analysis – field equation for stress intensity factor.

MODULE II: Stationary Crack Under Static Loading [10 Periods]

Strength of cracked bodies, potential energy and surface energy, Griffith's theory , Irwin – Orwin extension of Griffith's theory to ductile materials, Stress analysis of cracked bodies, Effect of thickness on fracture toughness, Stress intensity factors for typical geometries, plastic zone size – Dugdaale model, determination of J integral and its relation to crack opening displacement.

MODULE III: Energy Balance and Crack Growth [10 Periods]

A: Phase in fatigue life - Crack initiation – Crack growth - Final fracture - Dislocation – Fatigue fracture surfaces.

B: Assessment of Failures: Safe Life and Fail safe design philosophies - Importance of Fracture Mechanics in Aerospace structure – Applications to composite materials and structures - crack arrest mechanism –K1c test methods - R curves - determination of collapse load.

MODULE IV: Fatigue Crack Growth Curve [09 Periods]

Low cycle and high cycle fatigue - Coffin- Manson's Relation –Transition Life – Cyclic strain hardening and softening – Analysis of load histories – Cycle counting techniques – Cumulative damage – Miner's theory, other theories-external factors affecting the K1c values.- leak before break analysis.

MODULE V: Fatigue Failures [09 Periods]

Dynamic Fracture, Stress Corrosion Cracking, Corrosion Fatigue, Fatigue - Crack Propagation under Variable - Amplitude Load Fluctuation, Fatigue - Crack Initiation, Fatigue - Crack Propagation under Constant - Amplitude Load Fluctuation.

TEXT BOOKS:

1. Anderson T.L & Boca Raton, "**Fracture Mechanics: Fundamental and Applications**" CRC Press, Florida, 3rd Edition,2005.
2. Richard W Hertz ,"**Deformation and Fracture mechanics of Engineering Materials"**Wiley, 5th Edition,2012.

REFERENCES:

1. Preshant Kumar, "Elements of Fracture Mechanics", Wheeler Publishing, 1999.
2. John M.Barson and StanelyT.Rolfe Fatigue and fracture control in structures Prentice hall Inc. Englewood cliffs. 1977
3. D.R.J. Owen and A.J. Fawkes, "**Engineering Fracture Mechanics"** Pincridge press, Swansea, U.K.
4. B.R. Lawn and T.R. Wilshaw, "**Fracture of brittle solids"**,Cambridge university press,2ndEdition,1993.

E Resources:

1. www.fracturemechanics.org/
2. www.continuummechanics.org/
3. https://www.journals.elsevier.com/engineering-fracture-mechanics/
4. link.springer.com/journal/10704
5. nptel.ac.in/courses/112106065/
6. nptel.ac.in/courses/112106065/5

Course Outcomes:

At the end of the course, students should be able to:

1. Understand the introduction to fracture mechanics, mode of failures and different combination of applied stresses.
2. Analyze the material failures in different failure theories and estimate failure conditions of a structures.
3. Assessment of failures, safe and fail load conditions and various curve fitting standards.
4. Determine the fatigue failures in different conditions.
5. Predict the dynamic fracture analysis of brittle and ductile materials.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**		**3**	**2**		
CO2						
CO3		**1**		**2**		
CO4			**3**			
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code:A3224	TRIBOLOGY IN DESIGN (Professional Elective - IV)	L	T	P
Credits: 3		3	-	-

Prerequisites: Design of Machine Members

Course Objectives: The main objective of this course is to describe surface topography, physio-chemical aspects of solid surfaces, laws of friction, various types of wear and lubricants and surface interactions.

MODULE I: Introduction to Tribo Design [10 Periods]

Specific principles, Tribological problems in machine design, Surface topography, Tribological processes: Contact process-contact mechanics, friction process-sliding and rolling friction, wear process-wear mechanisms, Stick-slip effects, Friction and wear test methods, Tribological materials.

MODULE II: Lubrication [10 Periods]

Purpose of lubrication, Basic modes of lubrication-Stribeck curve, hydrodynamic lubrication, Elastodynamic lubrication, Mixed lubrication, Boundary lubrication; Hydrostatic lubrication, Properties of lubricant, Additives, Choice of lubricant, oil, grease and solid lubricants, lubrication systems and their selection, oil conservation.

Selection of Rolling Element Bearings - Nominal life, static and dynamic capacity, equivalent load, probabilities of survival - cubic mean load, Selection of ball and roller bearings, bearing mounting details, preloading of bearings.

MODULE III: Hydrostatic Bearings [10 Periods]

A: Arrangement, advantages and limitations, Hydrostatic step bearing analysis-energy losses, optimum design, temperature rise; Hydrostatic conical thrust bearing, pad coefficients; Hydrostatic journal bearings - design procedures; Hydrostatic squeeze film bearings-analysis, thrust bearings and journal bearings - design procedure.

B: Fundamentals of fluid film formation, Mechanisms of pressure development in oil film, Reynold's equation, Hydrodynamic journal bearing-Sommerfeld number, bearing performance, temperature rise; Hydrodynamic thrust bearings - Raimondi and Boyd Method, fixed and tilting pads, single and multiple pad bearings.

MODULE IV: Computational Hydrodynamics [09 Periods]

Finite difference equivalent of the Reynolds equation, Numerical analysis of hydrodynamic lubrication in idealized journal and partial arc bearings, Vibrational stability in journal bearings-determination of stiffness and damping coefficients. Elasto-

Hydrodynamic Lubrication-Pressure-viscosity term in Reynold's Equation - Hertz theory - Ertel-Grubin Equation, lubrication of spheres, introduction to thermo-hydrodynamic lubrication.

MODULE V: Surface Engineering [09 Periods]

Surface modifications - transformation hardening, surface fusion - thermo chemical processes - surface coatings - plating and anodizing - fusion processes - vapour phase processes.

TEXT BOOKS

1. Majumdar, B.C, "**Introduction to Tribology of Bearings",** S.Chand, 2nd Edition, 2008.
2. Kenneth C Ludema, "**Friction. Wear, Lubrication: A Text book in Tribology",** CRC Press, 1st Edition, 1996.
3. John Williams, "**Engineering Tribology"**, Cambridge University Press, 2006.

REFERENCES

1. Neale M J,**"Tribology Handbook"**, Neumann Butterworths, 1975.
2. Connor J J O and Boyd, **"Standard Handboook of Lubrication Engineers",** ASLE, McGraw Hill Book Co., 1966.
3. Basu S K, Sengupatha S N and Ahuja D B, "Fundamentals of Tribology", Prentice Hall of India Pvt. Ltd., 2005.

E Resources:

1. itmmec.iitd.ac.in/
2. www.emeraldinsight.com/loi/ilt
3. www.tribology.fink.rs/guide.html
4. tribology.asmedigitalcollection.asme.org/journal.aspx
5. nptel.ac.in/courses/112102015/
6. nptel.ac.in/courses/112102014/

Course Outcomes:

At the end of the course, students should be able to:

1. Understand the concepts of tribological contacts and systems, the interrelation of parameters.
2. Methodology for deciding lubricants and lubrication regimes for different operating conditions.
3. Analyze hydrostatic and hydrodynamic journal bearings for given load / speed conditions.
4. Evaluate the performance of computational hydrodynamics and Elasto-hydrodynamic bearing lubrications.

5. Ability to work as an expert engineer and researcher in multicultural and interdisciplinary teams in the broad field of tribology, surfaces, interfaces and maintenance.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1		**1**		**3**		
CO2	**1**		**2**			
CO3				**1**		
CO4	**2**		**1**			
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code: A3208	ADVANCED COMPUTER AIDED MODELLING LAB	L	T	P
Credits: 1.5		-	-	3

Prerequisite: Introduction to Computer Aided Drafting and Design

Course objectives: The objective of this course is to understand the concepts and applications of three dimensional graphic design using various visualization, sketching modelling and assembly.

List of Experiments

1. Study of limits, tolerances and fits.
2. Study of fundamental calculations of shaft deviations.
3. Sketching the necessary views of fast and loose pulleys.
4. Sketching the necessary views of V-belt pulleys.
5. Sketching the necessary views of bevel gears.
6. Sketching the necessary views of worm gearing.
7. Part modelling and assembly of steam engine connecting rod end.
8. Part modelling and assembly of rotary gear pump.
9. Part modelling and assembly of using fuel injector.
10. Part modelling and assembly of tail stock.
11. Part modelling and assembly of non-return valve(light duty).
12. Part modelling and assembly of Rams bottom safety valve.

Course Outcomes:

At the end of the course, students should be able to:

1. Create technically correct surface and solid models that are common to and useful for visualization and problem solving in mechanical engineering using various design software programs.
2. Create technical documentation/presentations of models from mechanical engineering in both technically correct and visually pleasing solid, orthographic, and section view formats
3. Produce project design documentation using modeling skills in project-based assignments
4. Coordinate civil and mechanical engineering models into the design development process.
5. Understand 2D drawings and convert it into part modeling and assembly drawings.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1					**1**	
CO2	**2**		**3**			
CO3			**1**	**2**		
CO4		**1**				
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code: A3209	ADVANCED COMPUTER AIDED ANALYSIS LAB	L	T	P
Credits: 1.5		-	-	3

Prerequisite: Introduction to Finite Element Analysis.

Course Objectives: The objective of this course is to recognize the limitations of CAD, and CAE software, the ability to demonstrate sound, rational approaches to the solution of engineering problems, the ability to use engineering software to support design and identify research and development opportunities in CAD/CAE.

List of Experiments

1. Analysis Simply Supported Beam with Uniformly distributed load
2. Analysis Simply Supported Beam with Uniformly varying load
3. Analysis of Trusses
4. Analysis Stress analysis of a rectangular plate with a circular hole
5. Analysis Corner angle bracket
6. Analysis Spanner under plane stress
7. Thermal Analysis 1
8. Thermal Analysis 2
9. Modal Analysis of Cantilever beam for natural Frequency determination
10. Harmonic Analysis of Cantilever beam
11. Dynamic analysis of bar subjected to forcing function
12. Laminar Flow Analyses in a 2-D Duct.

Course outcome:

At the end of the course, students should be able to:

1. Identify how product life cycle management (PLM) approaches and software are used in design-manufacturing enterprises.
2. Understand the mathematical representations of lines, surfaces, and solid models.
3. Develop knowledge of Finite Element Analysis and developing computational models.
4. Carryout static, dynamic and harmonic analysis using FEA software.
5. Demonstrate knowledge in optimization and how it is used in engineering design applications

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1					**1**	
CO2		**1**		**3**		
CO3					**3**	
CO4	**3**		**2**			
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) II Semester		
Code:A0A05	**VALUE EDUCATION**	**L**	**T**	**P**
Credits: Nil		**2**	**-**	**-**

Pre-requisites: Nil

Course Objectives: The course deals about value of education and self- development, Imbibe good values in students and know about the importance of character.

Module -I **[06 Periods]**

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

Module -II **[07 Periods]**

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

Module -III **[06 Periods]**

A: Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality.

B: Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.

Module -IV **[07 Periods]**

Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

Module -V **[06 Periods]**

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

TEXT BOOKS:

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

Course Outcomes:

At the end of the course, students should be able to:

1. Understand the self-development and moral values
2. Explore the importance of character, cultivation of values
3. Apply the personality development methods
4. Analyze the association and cooperation principles
5. Elaborate the principles of religions, good health science.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Program Outcomes (POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1					**2**	**2**
CO2					**2**	**2**
CO3					**2**	**2**
CO4					**2**	**2**
CO5					**2**	**2**

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) III Semester		
Code: A3225	GEOMETRIC MODELING (Professional Elective - V)	L	T	P
Credits: 3		3	-	-

Prerequisites: Engineering Drawing

Course Objectives: The main objective of this subject is to impart knowledge on computer graphics which are used routinely in diverse areas as science, engineering, medicine, etc.

MODULE I: Introduction & Cubic Splines [10 Periods]

Definition, Explicit and implicit equations, parametric equations. Wireframe modeling, Geometric Entities, Analytical curves, Synthetic curves, Splines.

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

MODULE II: Bezier Curves & B-Spline Curves [10 Periods]

Bernstein basis, equations of Bezier curves, properties, derivatives. Problems

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

MODULE III: Transformations & Solids [10 Periods]

A: Homogenous Transformations, 2D transformation of Translation, Scaling,Rotation.

B: Rotation about arbitrary axis, concatenation, Introduction to 3D Transformations, reflection. Solids - Tri-cubic solid, Algebraic and geometric form.

MODULE IV: Surfaces [09 Periods]

Bicubic surfaces, Coon's surfaces, Bezier surfaces, B-Spline surfaces, surfaces of revolutions, Sweep surfaces, ruled surfaces, tabulated cylinder, bilinear surfaces, Gaussian curvature.Surface manipulations

MODULE V: Solid Modeling Concepts [09 Periods]

Boundary representation, Half space Modeling, spatial cell, cell decomposition, Part Modeling, Assembly modeling, Mass Properties, mechanical tolerancing.

TEXT BOOKS

1. Ibrahim Zeid,"**CAD/CAM",** Tata McGraw Hill, 2nd Edition2014.
2. Alavala,"**CAD/CAM concepts and Applications",** PHI,5th Edition,2013.
3. William M Neumann and Robert F.Sproull "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.

REFERENCES

1. Micheal E. Mortenson,"**Geometric Modeling",** McGraw Hill Publishers
2. K.Lalit Narayan, K.MallikarjunaRao& MMM Sarcar, "**Computer Aided Design and Manufacturing",** PHI Publishers.
3. Roger & Adams,"**Elements of Computer Graphics",** Tata McGraw Hill

E Resources:

1. graphics.utdallas.edu/gmp2016/
2. www.cs.ucdavis.edu/~joy/GeometricModelingLectures
3. https://www.journals.elsevier.com/graphical-models/
4. geomalgorithms.com/journals.html
5. nptel.ac.in/courses/112102101/44
6. www.nptelvideos.in/2012/12/computer-aided-design.html

Course Outcomes:

At the end of the course, students should be able to:

1. Possess in-depth knowledge of wireframe modeling, geometric entities and various curves and splines of 3D computer graphics applications.
2. Understand various types of Bazier curves and B-Spline curves in computer graphics.
3. Differentiate the most common modeling surfaces which are necessary to solve CAE problems that arise in engineering.
4. Analyze and interpretation of various transformation techniques and solids in 2D and 3D computer graphics applications.
5. Familiarized with the computer graphics applications in design

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			**1**		**1**	
CO2		**2**				
CO3	**1**			**1**		
CO4						
CO5			**1**			

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) III Semester		
Code: A3226	CONDITION MONITORING (Professional Elective - V)	L	T	P
Credits: 3		3	-	-

Pre-Requisites: Metrology and Measurements, Mechanical Vibrations

Course Objectives: The objective of this course is to idealize various maintenance operations, various sensors used for measuring vibrations and non-destructive testing methods for quality measurements.

MODULE I: Introduction [10 Periods]

Maintenance – objectives – types – concepts and economic benefits, Preventive maintenance – time based & condition based, Condition Monitoring & Performance monitoring, Vibration Monitoring – causes and effects of vibration, Review of Fundamentals of Vibrations, Vibration Measuring Equipment -Sensors, Signal conditioners, recording elements,

MODULE II: Sensors [10 Periods]

Factors affecting the choice of sensors, Contact type sensors – Non contact type sensors, Signal conditioning – Display/Recording elements, Vibration meters and analyser, Overall Level Measurement, Vibration limits & Standards, Signal Analysis - Frequency Analysis,

MODULE III: Vibration Measuring Techniques 10 Periods]

A: Measurement of overall vibrations levels, Vibration limits and standards, Case studies, Special Vibration Measuring Techniques, Shock Pulse Method, Kurtosis, Cepstrum.
B: Analysis, Critical speed analysis, Orbit, vibration control, Wear behavior monitoring and Contaminants Monitoring Technique, Filters, chip detectors, Ferrography,

MODULE IV: Measuring of Various Parameters [09 Periods]

Oil Analysis – oil degradation analysis, Abrasive Particle in oil, counters, Particle classification and counter, spectrometric oil analysis, Performance trend monitoring – Primary and secondary parameters, Performance trend analysis, Performance trend monitoring systems, Case studies, Temperature Monitoring – Various techniques – thermometer, thermocouple, Thermography, infrared pyrometers etc, Corrosion Monitoring – different techniques, Selection of condition motoring techniques,

MODULE V: Non-destructive techniques [10 Periods]

Important features, Types of defects detected by NDT – Visual, Dye Penetration, Acoustic Emission and its applications, Xray, Radiographic, Magnetic Flux test etc, Application of NDT Techniques, Application of computer in experimental analysis, Data acquisition and recording and storage device, Flow chart of a case study.

REFERANCES:

1. Isermann R., Fault Diagnosis Applications, Springer-Verlag, Berlin, 2011.
2. Rao, J S., Vibration Condition Monitoring, Narosa Publishing House, 2nd Edition, 2000.
3. Allan Davies, Handbook of Condition Monitoring, Chapman and Hall, 2000.

E-Resources:

1. https://www.slideshare.net/hareeshang/unit-5-vibration-measuring-instruments
2. https://www.slideshare.net/Anupamthecooldude/vibration-measurement-60712025
3. info.bannerengineering.com/cs/groups/public/.../powerpoint/b_4183845~8.pptx
4. https://www.kamk.fi/loader.aspx?id=0a8111c4-ddae-41cf-9e42-9504f7b24056
5. https://www.nde-ed.org/GeneralResources/IntroToNDT/Intro_to_NDT.ppt

Course outcomes:

At the end of the course, the student shall be able to:

1. Understand the maintenance scheme, their scope and limitations – apply the maintenance strategies to various problems in the industrial sectors.
2. Analyze for machinery condition monitoring and explain how this compliments monitoring the condition.
3. Develop an appreciation for the need of modern technological approach for plant maintenance to reduce the maintenance expenditure.
4. Emphasizes on case studies that require gathering information using the modern testing equipment and processing it to identify the malfunction in that system.
5. Identify vibration measurement, lubrication oil analysis.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**		**1**			
CO2				**2**		
CO3		**1**			**1**	
CO4	**1**		**2**			
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) III Semester		
Code:A3227	DESIGN FOR PROCESS AND PRODUCT DEVELOPMENT (Professional Elective - V)	L	T	P
Credits: 3		3	-	-

Pre-Requisites: Nil

Course Objectives : The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

MODULE I: Introduction [10 Periods]

Need for IPPD-Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer – behaviour analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement.

MODULE II: Concept Generation, Selection & Testing [10 Periods]

Plan and establish product specifications. Task - Structured approaches - clarification search-externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology - benefits. Implications - Product change variety - component standardization - product performance - manufacturability – Concept Testing Methodologies.

MODULE III: Product Architecture [10 Periods]

A: Product development management - establishing the architecture - creation - clustering geometric layout development - Fundamental and incidental interactions – related system level design issues.

B: Secondary systems -architecture of the chunks – creating detailed interface specifications-Portfolio Architecture.

MODULE IV: Industrial Design [09 Periods]

Integrate process design - Managing costs - Robust design - Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design-impact – design process - investigation of customer needs conceptualization - refinement - management of the industrial design process - technologydriven products - user - driven products - assessing the quality of industrial design.

MODULE V: Design for Manufacturing and Product Development [09 Periods]

Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping - Planningfor prototypes - Economic Analysis - Understanding and representing tasks-baseline projectplanning - accelerating the project-project execution.

TEXT BOOKS:

1. Product Design and Development, Karl T.Ulrich and Steven D.Eppinger, McGraw –Hill International Edns.1999

REFERANCES:

1. Kemnneth Crow, Concurrent Engg./Integrated Product Development, DRM Associates, DRM Associates, ,Workshop Book
2. Stephen Rosenthal, Effective Product Design and Development, Business One Orwin, Homewood, 1992,ISBN, 1 -55623-603-4
3. Stuart Pugh, Tool Design – Integrated Methods for successful Product Engineering, Addison Wesley Publishing,Neyourk,NY,1991, ISBN 0-202-41639-5

E- RESOURCES:

1. www.wright.edu/~george.polak/ch03.ppt
2. https://www.csus.edu/indiv/b/blakeh/mgmt/documents/OPM101Chapter3_000.ppt
3. https://www.slideshare.net/QRCE/product-design-development-1-presentation

Course Outcomes:

At the end of the course, the student shall be able to:

1. Understand the integration of customer requirements in product design.
2. Apply structural approach to concept generation, selection and testing.
3. Create geometric layout and architecture.
4. Use CAD/CAM/CAE software for various product and process design.
5. Understand various aspects of design such as industrial design, design for manufacturing, economic analysis and product architecture.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			**2**			
CO2		**1**		**2**		
CO3	**2**		**2**		**1**	
CO4				**1**		
CO5		**1**				

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) III Semester		
Code:A3228	INDUSTRIAL SAFETY (Open Elective)	L	T	P
Credits: 3		3	-	-

Prerequisites: Nil

Course objectives: The objective of this course is to understand and maintain health and safety from various hazards and understand the different types of maintenance in industry.

Module-I: Industrial Safety [10 Periods]

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

Module -II: Fundamentals of Maintenance Engineering [10 Periods]

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

Module -III: Wear and Corrosion and Their Prevention [10 Periods]

A: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, Screw down grease cup, Pressure grease gun,. Splash lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication and Ring lubrication.

B: Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Module-IV: Fault Tracing [09 Periods]

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

Module -V: Periodic and Preventive Maintenance: [09 Periods]

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

REFERENCES:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

E-Resources

1. https://www.safeopedia.com/definition/1052/industrial-safety
2. https://en.wikipedia.org/wiki/Industrial_safety_system

Course Outcomes

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

1. Understand the basic concepts of industrial safety needs
2. Understand and identify various hazards in industry
3. Understand and avoid wear and tear during manufacturing process
4. Identify suitable fault finding activities
5. Use periodic and preventive maintenance in industry

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1				**1**		
CO2	**1**		**3**			
CO3		**2**		**2**		
CO4					**1**	
CO5			**1**			

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) III Semester		
Code:A0B20	ADVANCED OPTIMIZATION TECHNIQUES (Open Elective)	L	T	P
Credits: 3		3	-	-

Pre-requisites: Nil

Course Objectives: To understand extremely important topics under the broad umbrella of optimization, this is synonymous with efficiency which is the underlying prime rationale for all scientific and technological advances and progress.

Module - I: Linear Programming [10 Periods]

Introduction and formulation of models; convexity; graphical &simplex method; Big-M Method, Two phase method; degeneracy, non-existent and unbounded solutions; duality in L.P. Dual simplex method, sensitivity analysis for cost and requirement vector; Revised simplex method; Transportation and Assignment problems.

Module - II: Integer Linear Programming [10 Periods]

Gomory's cutting plane method; branch and bound algorithm; traveling salesman problem; knapsack problem; linear C-1 problem.

Module - III: Dynamic Programming , CPM & PERT [09 Periods]

A: Belman's Principle of optimality; recursive relations; Solution of L.P. Problem; simple examples.
B: CPM & PERT

Module -IV: Non-Linear Programming [09 Periods]

Classical optimization methods; equality and inequality constraints; Lagrange multipliers; Kuhn-tucker conditions; quadratic forms; quadratic programming and Beale's methods.

Module -V: Search Methods [10 Period]

One dimensional optimization; Fibonacci search; multi dimensional search methods; uni-variate search; gradient methods; steepest descent/ascent methods; conjugate gradient method; Fletcher- reeves method; penalty function approach.

TEXT BOOKS

1) J.K. Sharma "Operations Resarach Theory & Applications", 4th Edition, Mc.Millan Publications
2) S.S.Rao -"Engineering Optimization theory and Practice", 4th Edition, J Wiley & Sons, Newjersey

REFERENCES

1. K.V.Mital -"Optimization methods in operations research and system analysis", 3rd Edition, Newage International (P) Ltd., publishers.
2. H.A Taha "Operations Research: An Introduction" Prentice Hall Edition, 2016 reprint

3. Raul Poler et.al “Operations Research Problems Statement and solutions” Springer, 2014 reprint.

E Resources:

1. http://www.mhhe.com/engcs/industrial/hillier/etext/PDF/chap03.pdf (LPP)
2. http://ocw.nctu.edu.tw/upload/classbfs121001503719748.pdf (Transportation Problems)
3. http://shodhganga.inflibnet.ac.in/bitstream/10603/19544/12/7_chapter%201.pdf (Replacement Models)
4. https://www.math.ucla.edu/~tom/GameTheory/mat.pdf (Game Theory)
5. http://www.ime.unicamp.br/~andreani/MS515/capitulo12.pdf (Inventory Models)

Course Outcomes

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

1. Find feasible solution to LPP by various methods.
2. Minimize the cost and time by using Travelling salesmen Problem.
3. Understand various methods Dynamic programming.
4. Understand the various concepts on Non-Linear programming.
5. Understand the various concepts of Search methods.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**			**3**		
CO2		**1**		**2**		
CO3	**2**			**3**		
CO4	**3**		**1**			
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) III Semester		
Code:A1128	WASTE TO ENERGY (Open Elective)	L	T	P
Credits: 3		3	-	-

Pre-requisites: Nil

Course objective: The objective of this course is to introduce different Waste to Energy conversions and its innovative practices, explores the role of energy from waste in resource management and clean energy production.

MODULE I: Introduction [08 Periods]
Classification of waste as fuel - Agro based, Forest residue, Industrial waste - MSW - Conversion devices - Incinerators, gasifiers, digestors.

MODULE II: Biomass Pyrolysis [10 Periods]
Pyrolysis - Types, slow fast - Manufacture of charcoal - Methods - Yields and application - Manufacture of pyrolytic oils and gases, yields and applications.

MODULE III: Biomass Gasification [10 Periods]
A: Gasifiers - Fixed bed system - Downdraft and updraft gasifiers - Fluidized bed gasifiers - Design, construction and operation - Gasifier burner arrangement for thermal heating.
B: Gasifier engine arrangement and electrical power - Equilibrium and kinetic consideration in gasifier operation.

MODULE IV: Biomass Combustion [08 Periods]
Biomass stoves - Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

MODULE V: Biogas [12 Periods]
Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants - Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

REFERENCES

1. "**Non Conventional Energy**", Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. "**Biogas Technology - A Practical Hand Book**" - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. "**Food, Feed and Fuel from Biomass**", Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. "**Biomass Conversion and Technology**", C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

E - RESOURCES

1. https://www.eia.gov/energyexplained/?page=biomass_waste_to_energy
2. https://www.r-e-a.net/renewable-technologies/energy-from-waste
3. http://www.volund.dk/Waste_to_Energy/How_it_works

Course Outcomes:

At the end of the course, students should be able to:

1. Understand the different types of wastes generated in an industry
2. Produce energy from various resources
3. Convert urban waste to useful energy
4. Assess the environmental impacts of various wastes.
5. Understand the benefits of waste-to-energy conversion.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**2**			**3**		
CO2			**2**		**1**	
CO3	**3**			**2**		
CO4			**1**	**1**		
CO5						

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) III Semester		
Code: A3210	**SEMINAR (PROJECT)**	**L**	**T**	**P**
Credits: 2				**4**

Course Objectives: To promote deeper understanding the basic concepts, physical mechanism behind the processes, participate in scientific analysis and comprehensive of scientific writing of verbal presentation. This course is to introduce post graduate student to ideas, methods and techniques that can improve the content and presentation of scientific seminars.

Course Outcomes:

At the end of the course, students should be able to

1. Write technical documents to the standards
2. Give oral presentation on technical and general topics
3. Express ideas clearly with examples
4. Identify the research opportunities related to their area.
5. Communicate effectively.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**					**1**
CO2					**2**	
CO3			**2**			
CO4	**2**					**1**
CO5			**1**		**2**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) III Semester		
Code: A3211	**PROJECT / DISSERTATION PHASE - I**	**L**	**T**	**P**
Credits: 8				**16**

Course Objectives: To utilize basic knowledge and advance techniques to make product/process using experimentation and/or simulation and expose to others as document and oral presentation.

Course Outcomes:

At the end of the course, students should be able to

1. Summarize the work completed in the form of technical documents
2. Specify the techniques implemented or to be implemented
3. Explain the results obtained in Project Phase I
4. Summarize the ultimate finding of the project
5. Detailed presentation of work carried out.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**2**	**2**	**3**	**3**	
CO2					**2**	**1**
CO3		**2**	**3**	**3**		
CO4	**2**					**1**
CO5			**2**		**2**	

2020-21 Onwards (MR-20)	MALLA REDDY ENGINEERING COLLEGE (Autonomous)	M.Tech. (Machine Design) IV Semester		
Code: A3212	**PROJECT / DISSERTATION PHASE - II**	**L**	**T**	**P**
Credits: 16				**32**

Course Objectives: To utilize science and engineering to make product/process using innovative techniques, predict the results and prepare technical documents.

Course Outcomes:

At the end of the course, students should be able to

1. Identify project goals, constraints, deliverables, performance criteria, control needs and requirements.
2. Implement concepts, tools and techniques to do quality projects.
3. Adapt projects in response to issues that arise internally and externally.
4. Interact with team and stakeholders in a professional manner, respecting differences, to ensure a collaborative project environment.
5. Utilize technology tools for communication, collaboration, information management, and decision support.

CO- PO Mapping (3/2/1 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak						
COs	**Programme Outcomes(POs)**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**2**	**2**	**3**	**3**	
CO2					**2**	**1**
CO3		**2**	**3**	**3**		
CO4	**2**					**1**
CO5			**2**		**2**	