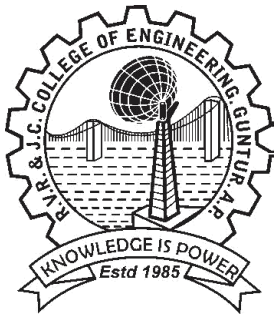

R.V.R. & J. C. COLLEGE OF ENGINEERING

(Autonomous)

Chowdavaram, GUNTUR – 522019.

Regulations (R-17),
Scheme of Instructions, Examinations and Syllabi

For Two Year M.Tech. Degree, Programme
in
MACHINE DESIGN
[w.e.f. 2017-18 AY]

MECHANICAL ENGINEERING

THE INSTITUTION

Established in 1985, Rayapati Venkata Ranga Rao & Jagarlamudi Chandramouli College of Engineering, Guntur is the 'Jewel in the Crown' of Nagarjuna Education Society, which took upon itself the responsibility of enriching the society through promotion of education, literature and culture. As it always happens, the genuine intentions of the promoters of the society received the support of the Almighty. Today eight educational institutions are functioning under the banner and patronage of Nagarjuna Education Society, with R.V.R. & J.C. College of Engineering, being the flag-ship of them, of course.

The Mission

An integrated development of manpower possessing technological and managerial knowledge and skills, values and ethics needed to make an honorable living and contribute to the socio-economic development and welfare of the society.

The Genesis and Growth

Like all great institutions, the College too had a humble beginning with just 180 intake and a barely adequate infrastructure in1985, it is the determination and commitment of the Management that made the College one of the largest among Engineering Institutions in South India with excellent infrastructure, facilities and competent human resources. Today, it offers eight B.Tech., Degree Courses with an intake of 1080 plus 216 through lateral entry into the II Year for Diploma Holders. Further, the College offers MBA, MCA and M.Tech. in six specializations with an intake of 355. The total intake is
1435.

In 1998 it has become the youngest College to have been accredited and as on date all the seven eligible B.Tech. Degree Courses have been accredited in 2002, 2007, 2012 and again in 2017. It has become the first Engineering College in the state to have been accredited fifth time by N.B.A., New Delhi. In 2014, the Institution was accredited by NAAC with 'A' Grade for FIVE Years by getting 3.19 CGPA on 4 point Scale. Further in the Academic Audit and Grading done by Andhra Pradesh State Council for Higher Education, Govt. of A.P., the institute is rated as the SECOND best among Private Engineering Colleges of A.P. and FOURTH best amongst all Engineering Colleges of A.P. including University Engineering Colleges. It has also figured among the "Top-100"Engg. Colleges in independent surveys conducted in 2006 & 2007 by the popular magazine the "OUTLOOK". The College received Best Laboratory Award, Eco Friendly Campus and First Prize for Best Performing Professional UG College in University Examination Results for the last FIVE consecutive years from Acharya Nagarjuna University. The College is a typical example of meticulous planning, resource scheduling, human endeavor and institutional management.

COURSES OFFERED	
1) Under-Graduate: B.Tech	
i) Civil Engineering (1985)	180
ii) Mechanical Engineering (1985)	180
iii) Electronics & Communication Engg. (1985)	180
iv) Electrical & Electronics Engg. (1994)	180
v) Computer Science & Engineering (1994)	180

vi) Chemical Engineering (1996)	60
vii) Information Technology (1998)	120
2) Post-Graduate:	
i) Management Sciences (MBA) (1995)	120
ii) Computer Applications (MCA) (1995)	120
iii) M.Tech in Computer Science & Engineering (2003)	25
iv) M.Tech in Power Systems Engineering (2004)	18
v) M.Tech. Structural Engineering (2004)	18
vi) M.Tech in Communication Engineering and Signal vi) Processing	18
vii) M.Tech in Machine Design	18
viii) M.Tech in Computer Science & Technology	18

The Campus

A built up area of 65,985 sq.m. on a 37.41 acres plot houses 61 Laboratories and 18 Computer Centres besides amenities like Canteen, Seminar Halls, Auditorium, Open Air Theatre, Gymnasium, e-classrooms and Conference Halls etc. to make life in the classroom and outside easy and comfortable. Continuous power supply is provided from 200 KVA, 250 KVA and 500 KVA modern Generator sets. Andhra Bank Branch is located in the campus. A fleet of 24 buses save the staff and students from the vagaries of public transport. The aesthetically designed structures, the hill slopes on the West, a well laid out campus dotted with roads, trees and gardens merge into a stunning landscape that inspires the minds to "Think Better, Work Better".

The Work Culture

The Management and Staff are a group of uncompromising people who stretch beyond reasonable limits to attain their objective - Excellence in everything they do. The people of RVR & JC have learnt that meeting of the minds and joining hands is the easier way to success. They do meet and interact frequently to set new starting lines than to celebrate the finishing lines reached.

The People

The College is possessive of its intellectual property; 257-strong faculties with diversity in specialization and heterogeneity in abilities have unity in their objective of enriching the students with up-to-date technical information, data and skills. The teachers adopt a very professional attitude and commitment in imparting instruction, counseling and personality development in which the student has the final say. The emphasis is more on learning of the student than on teaching. All our teachers are rated 90% good by the students. The 165-odd administrative and supporting people provide the logistics to run academic and administrative operations, with silent efficiency.

Discipline

Insulating the students from the vulnerable influence due to the society's contemporary aberrations is our endeavor. The institution had become the choice of the parents for its track-record of campus discipline. The ambience and the exemplary orderliness of behaviour

of the staff induces a self-imposed discipline in the students. The temporary abnormalities if any, are disciplined, of course.

Computer Centers

The computer facilities are vast. About 1500 terminals with latest configuration are located in fourteen Central and Department Computer Centers, all air conditioned. Software necessary for effective training and instruction as well as for consultancy are in place. All the computers in the campus have been interconnected through campus-wide intranet using Fiber Optic cables and switches. The City Computer Centre is an off-time facility for students & staff. Examination & administrative services are computerised. Currently, 16 MBPS Wireless Internet connectivity is provided by installing a Micro Tower.

Library

The four-storied library of 87,468 volumes of 25,910 titles, 3,267 CDs and educational films is the biggest learning resource in the campus. 257 National and International Journals provide up-to-date information on any topic the students and staff look for. Orderly stacking, computerized information and the seven qualified library staff facilitate easy location of any information needed. The Digital Library is providing internet facility to all the students with 17 systems. Comfortable seating arrangement and large reading spaces provide a serene atmosphere for spending long hours in the library. The City Centre too has a reference library that is open upto 10.00 p.m.

Hostels

Four storied Girls hostel with a 6,040 sq.m. accommodating 650 girl students with modern facilities available. Four storied boys hostels with a 11,152 sq.m. accommodating 1400 students with modern facilities in the College campus.

The Students

From the day of induction, the staff do everything to naturalize the students to the culture of R.V.R. & J.C. College of Engineering i.e. single minded pursuit of the objective. The part played by the students in making the College, into an ideal seat of learning is significant. The students of this College consistently produce the best of the results in the University.

Extra-curricular Activities

NCC, NSS Units are established in the College. Opportunities are a plenty for those with extracurricular talent. Numerous competitions are held for various levels of students, who have proved their superiority in various inter-collegiate competitions conducted by public organizations and other institutions. The students prove their leadership qualities and co-operative skills by organizing colorful functions at regular intervals.

Campus Recruitment

About 50 renowned Industries / IT Organizations regularly visit the College to recruit the final years for employment. A training and placement Department monitors recruitment, short term training and personality development programmes. During the last four years the Campus recruitment steadily grew up to 600+ in 2015-16.

DEPARTMENT OF MECHANICAL ENGINEERING

The Department was established in 1985. It started an U.G. course in Mechanical Engineering in the same year. This course had been accredited by N.B.A. and awarded 'A' Grade for three years in May, 1999, 'A' Grade for five years in May, 2002, 'A' Grade for three years in September, 2007 and accredited Fourth time in July, 2012& for the Fifth time in June, 2017. The Department was well established and running successfully with an intake of 180 Students.

Mechanical Engineering is a challenging discipline. It encompasses all important aspects of Modern Technology. In Automotive, Paper, Aerospace, Petrochemical, Automation, Robotic, Refrigeration and Air-Conditioning Industries and Nanotechnology, Mechanical Engineers have been playing a leading role. Mechanical and Thermal Design of Computers and other Electronic Equipment is carried out by Mechanical Engineers.

Development of ANSYS, Pro-Engineer, Master CAM, AutoCAD packages, Mechanical Desktop, Edge CAM etc., revolutionized the way Mechanical Engineers tackle the problems. Forecasting of the failure, Diagnostics of Breakdowns, Quality Circles, Optimization of Machine elements, Preparation of New Models have become the order of the day for budding Mechanical Engineers. In the early days of the profession, Most of the work of Mechanical Engineers consisted of Design & Manufacture. Now Mechanical Engineers need to know a lot of Principles from other disciplines of Engineering to stay ahead. Guest Lectures and Industrial visits are arranged for Shop floor experience and inplant Training.

As science and Engineering are rapidly changing and advancing, the courses offered by the Department take care of the needs of Prospective Mechanical Engineers. Mechanical Engineering curriculum covers the following areas:

- Mechanical Design
- Thermal Sciences
- Dynamics, Vibration & Controls
- Materials and its behaviour
- Manufacturing Technologies
- Mechatronics

The department has well established laboratories and students learn the concepts through Experienced and well trained Faculty. Several computing environments are available for their study and use computers is also an added advantage for problem solving in many Mechanical Engineering courses.

The Department has 5 Professors all with Doctorate, 8 Associate Professors all with Doctorate. 35 Assistant Professors with two doctorates. The entire faculty has Post-Graduate Degree in Mechanical Engineering with various specializations to provide in-depth Theoretical and Practical knowledge in all disciplines. All the faculty are research oriented and two of them are going to submit the thesis for Ph.D. Nine staff members are in an advanced stage of research for their Ph.D. The doctorate holders of the department are acting as research supervises under Acharya Nagrajuna University, SV University, JNTUK...Etc. and guiding many scholars. The faculty are also the members of various professional societies at national and international level.

All the staff are passionate and dedicated towards teaching and have the welfare and prospect of the students as their main interest. Many of the staff have produced 100% result in the subjects taught by them for the last few years. The general feedback from the students on the Faculty is very good.

The Department regularly organizes various faculty development programs to update the knowledge of faculty. Most of the faculty development programs got financial support from AICTE, UGC, DST. Our management is also give support to enrich the knowledge and to get familiar with the latest advancements.

Department's highly skilled and motivated Technicians have fabricated a number of Test-Rigs for regular laboratory work. They have done innovative projects for which APCOST and the Management

of the College awarded grants and funds. Our Technicians always lend a helping hand to the final year students of all Branches in fabricating and completing their project works.

The Department has sprawling Workshops, where Carpentry, Tin smithy, Welding and House Wiring are taught to students of all branches of First Year. Thermal Sciences laboratory has equipment and test-rigspertaining to IC Engines, Fuels and Lubricants, Air Compressors, Heat Transfer, Refrigeration and Air Conditioning and Automobiles. Experiments to study fundamentals and vibrations of linkages, constructional features and effect of vibration on the life of machinery are carried out in Kinematics and Vibration laboratory, Machine shop, CAD/CAM Laboratory, Metrology Laboratory and Industrial Engineering Laboratory.

The Department's pride is the CAD/CAM Laboratory in which Rs.27 Lakhs from projects sanctioned by AICTE, New Delhi were invested. The laboratory boasts of 130 computer systems with Pentium IV, a serverand latest and advanced Software like AutoCAD, Mechanical Desktop, CATIA, MSC Nastran, Autodesk Inventor, CAEFEM, ANSYS, Pro E, CadianMech-2002. The Department was awarded a MODROB's project by AICTE with a sanction of an amount of Rs.12 Lakhs to establish Mechatronics Laboratory for B.Tech and M.Tech (CAD/CAM) students. The laboratory consists of 18 P-IV latest systems and Mechatronics equipment, which enable the students to learn principles of equipment and simulation software.

A total of Rs. 80 Lakhs have been received by the department for research activities, upgradation of various laboratories and computer systems from funding agencies like AICTE, UGC, APCOST, NEDCAP etc. It is also not an out of place to mention that the department has a Research Centre approved by Acharya Nagarjuna University.

The Department is even doing good in placements. Almost 90% eligible students got placed into Core as well as Software companies. The major recruiters are TCS, CTS, INFOSYS, CUMMINS, TECH MAHINDRA, HEXAGON, SATVEN, HYUNDAI, Mahindra SATYAM and many more. The department organizes many training programs for the benefit of students to improve the skills and knowledge.

The Department library has 750 Text Books, 20 Video Cassettes, 28 Journals, NPTEL video Lectures and 500 Project Work Reports in its stock. It caters to the needs of students for good text books and referencebooks in various subjects.

Every student of Mechanical Engineering will become a member of RVR & JC Mechanical Engineering Association (RAJMEA). It conducts Technical Seminars, Quizzes and Group Discussions by various students and arranges Guest Lectures by eminent persons from Industry and Academic Institutions. Short and Long Industrial Study Tours are arranged frequently to improve the knowledge base of the students. Mech Mantra is an annual feature organized by RAJMEA as a National Level Technical Students Meet in Mechanical Engineering.

A SAE (Society of Automotive Engineers) India Collegiate Club with the name FALCON RACERS is functioning with student and faculty members. The students voluntarily collect sponsorships from various industries and also from our management to design Vehicles. To mention a few , they have participated in National level reputed events and won prizes. Dr. A.P.J. Abdul Kalam patted our students and appreciated for their efforts in fabricating an off road Electric Vehicle.

The department has been appreciated and adored by all the stakeholders for the successful implementation of policies. The feedback was taken at regular intervals and necessary actions were implemented for the benefit of the Department. Regular counselling and advice is given to the students of Mechanical Engineering by all the Faculty of the Department to improve their learning, ability and overall performance apart from guiding in their career.

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R.V.R. & J.C. COLLEGE OF ENGINEERING :: GUNTUR
(Autonomous)

CHOICE BASED CREDIT SYSTEM REGULATIONS (R-17) for 2-YEAR MASTER OF TECHNOLOGY (M.Tech.) Degree Program

(w.e.f. the batch of students admitted into First Year M.Tech. from the academic year 2017-18)

1. MINIMUM QUALIFICATIONS FOR ADMISSION

The eligibility criteria for admission into M.Tech.programmeis as per the guidelines of Andhra Pradesh State Council of Higher Education(APSCHE), Amaravathi.

1.1 Category – A Seats:
The seats under this category shall be filled by the Convener, PGCET Admissions.

1.2 Category – B Seats:
The seats under this category shall be filled by the College as per the guidelines of APSCHE

2. COURSES OF STUDY

M.Tech. Courses are offered in the following branches of study:

1	Civil Engineering	-	Structural Engineering
2	Computer Science & Engineering	-	Computer Science and Engineering.
3	Electrical & Electronics Engineering	-	Power Systems Engineering.
4	Electronics & Communication Engineering	-	Communication Engineering & Signal Processing
5	Information Technology	-	Computer Science & Technology
6	Mechanical Engineering	-	Machine Design

3. DURATION OF THE COURSE AND MEDIUM OF INSTRUCTION

3.1 The duration of the course is two academic years consisting of two semesters in each academic year.

3.2 The medium of instruction and examination is English.

4. MINIMUM INSTRUCTION DAYS

Each semester shall consist of a minimum number of 90 days of instruction excluding the days allotted for tests, examinations and preparation holidays.

5. REGISTERING THE COURSES OFFERED

5.1 A student has to register and secure 74 credits out of which 24 credits from laboratory courses including Dissertation.

5.2 The structure of the M.Tech.Programme comprises of two semesters of course work consisting of 6 Core subjects + 6 Elective subjects +4 Labs or 3 Labs + 1 Seminar (or) 2 Labs + 2 Seminars, followed by two semesters of Dissertation.

5.3 MOOCS (Massive Open Online Courses) Requirements.

- Enrolment of MOOCS Course will be initiated from the date of commencement of class work for I Year I Semester.
- MOOCS course completion certificate of duration not less than 8 weeks, must be submitted on or before the last instruction day of II Year I Semester, for which 2 Credits will be awarded, otherwise his / her Semester End Examination results will not be declared.
- List of organizations offering MOOCS course(s) will be announced by the respective Board of Studies at the time of commencement of class work for I Year I Semester.

5.4 Internship / Industrial Training / Professional Certification:

- Internship / Industrial Training / Professional Certification should be taken up during the summer holidays for a period of 4 – 8 weeks.
- Internship / Industrial Training / Professional Certification completion certificate must be submitted along with a report and presentation during the II Year I Semester Internal evaluation, otherwise his / her Semester End Examination results will not be declared.

5.5 Dissertation shall be carried out under the Supervision of a Faculty Member in the concerned department. A student may, however, in certain cases, be permitted to work on his Dissertation at the place of employment, any recognized Institution/R&D Organization/Industry with the approval of the Head of the Department concerned and Head of the Organization. In such cases, the Dissertation shall be jointly supervised by a member of the faculty and a person from the Organization.

5.6 The student hasto publish (or) get acknowledgement for acceptance of publication in at least one paper in a Conference / peer reviewed Journal related to his / her work to get eligibility to submit the Dissertation.

6. EVALUATION

6.1 The performance of the student in each semester is evaluated subject wise. In each Semester, there shall be two Internal Examinations consists of a Sessional Test for 30 Marks and an Assignment for 10 Marks. The semester end examination is conducted for 60 marks. The Internal Evaluation for Theory subjects is based on the 80% (24 out of 30 marks) weightage given to the best of the performances and the remaining 20% (6 out of 30 marks) for the least performance, in the two midterm examinations one held in the middle of thesemester and the other held immediately after the completion of the instruction. Theinternal evaluation for practical subjects is based on the day to day performance andsemester end internal practical Examination.

6.2 The marks for Seminar will be awarded by internal evaluation by a panel of the department.

6.3 For taking the Semester end examination in any theory or practical subject, studentsshall be required to obtain a minimum of 50% marks in Internal evaluation in thatsubject failing which he/she is required to repeat the subjectwhen next offered.

6.4 For each theory subject, there is a comprehensive Semester End Examination at the end of each Semester.

6.5 For each Practical course the Semester End Examination is conducted by one internal and one external examiner appointed by the Principal of the College.The duration of the examination is specifiedin the detailed Schemes of Instruction & Examination.

6.6 Examination in Dissertationis conducted by one internal examiner and one external examiner appointed by the Principal.

6.7 The performance of the students in each semester is evaluated subject wise The distribution of marks between internal assessment and Semester End Examination is as follows:

Nature of the subject	Sessional Marks	Semester End Exam. Marks
Theory	40	60
Laboratory	40	60
Seminar / Internship / Professional Certification / Dissertation Review	100	--
Dissertation	40	60

7. LABORATORY / PRACTICAL COURSES

In any semester, a minimum of 10 experiments / exercises specified in the syllabus for laboratory course shall be completed by the student and get the record certified by the concerned Head of the Department, to be eligible to appear for the Semester End Examination in that Practical course.

8. ATTENDANCE

8.1 The student shall put up a minimum of 75% attendance in each subject.

8.2 Condonation of shortage in attendance up to 10% in any subject may be condoned by the Principal of the College for reasons of ill health and the application is submitted through proper channel at the time of actual illness and is supported by a certificate from the authorized Medical Officer approved by the Principal.

8.3 If the student does not satisfy the attendance requirement in any subject he or she shall not be permitted to appear for the Semester End examination in that subject and has to repeat that subject when next offered.

9. CONDITION(S) FOR PROMOTION:

A studentis eligible for promotion to next semester, if he/she satisfies the minimum requirements of attendance and sessional marks in 50% of the Theory Subjects, as stipulated in *Clauses 6 and 8*.

10. CONDITIONS FOR PASS

A studentis declared to have passed in individual subject if he / she secures a minimum of 40% marks in theory and 50% marks in Laboratory / Dissertation inSemester End Examination and a minimum of 50% marks in both Sessional & Semester EndExamination put together.

11. AWARD OF CREDITS

Credits are awarded for each Theory/Practical/Seminar/Dissertation Subject. Each theory subject is awarded 4 credits and each practical/Seminar subjects is awarded 2 credits. Dissertation seminar in II Year I Semester is awarded 4 credits and Dissertation at the end of II Year II Semester is awarded 10 credits.

11.1 AWARD OF GRADES

S.No.	Range of Marks	Grade	Grade Points
1.	≥90%	O	10.0
2.	80%-89%	A^+	9.0
3.	70%-79%	A	8.0
4.	60%-69%	B^+	7.0
5.	55%-59%	B	6.0
6.	50%-54%	C	5.0
7.	≤49%	F	0.0
8.	The grade 'W' represents withdrawal / absent (subsequently changed into pass or C to O or F grade in the same semester)	W	0.0

11.2 A student securing 'F' grade in any subject there by securing zero grade points has to reappear and secure at least 'C' grade in the subsequent examinations for that subject.

11.3 After each semester, Grade sheet will be issued which will contain the following details:

- The list of subjects for each semester and corresponding credits and grades obtained
- The Semester Grade Point Average (SGPA) for each semester and
- The Cumulative Grade Point Average (CGPA) of all subjects put together up to that semester.

SGPA is calculated based on the following formula:

$$\frac{\sum[No.of\ credits \times Grade\ points]}{\sum No.of\ Credits}$$

CGPA will be calculated in a similar manner, considering all the subjects up to that semester.

11.4 A consolidated Grade Sheet shall be issued to the student, after completing all, indicating the CGPA of all the Four years put together.

11.5 Conversion of CGPA into equivalent Percentageof marks:

Percentage of Marks = 9.25 x CGPA.

12. ELIGIBILITY FOR AWARD OF M.TECH. DEGREE

The M.Tech. Degree shall be conferred on a student who satisfies the following requirements:

12.1 The student who satisfies the conditions for pass in all the subjects including labs of all the years as stipulated in ***Clauses 11***.

12.2 ***Maximum Time Limit for completion of M.Tech Degree***

A student, who fails to fulfil all the academic requirements for the award of the degree within four academic years from the year of admission, shall forfeit his/her seat in M.Tech. Degree.

13. AWARD OF CLASS

A student who becomes eligible for the award of M.Tech. Degree as stipulated in ***Clause 12*** shall be placed in one of the following Classes.

S.No.	Class	CGPA
1	First Class With Distinction	8.0 or more
2	First Class	6.5 or more but less than 8.0
3	Second Class	5.0 or more but less than 6.5

14. AWARD OF RANK

The rank shall be awarded based on the following:

14.1 Ranks shall be awarded in each branch of study for the top ten percent of the students appearing for the Regular Semester End Examinations or the top two students whichever is minimum.

14.2 The Rank shall be awarded only to those studentss who completes their degree within two academic years.

14.3 For the purpose of awarding rank in each branch, only such students who passed all subjects in the first attempt shall be considered.

15. TRANSITORY REGULATIONS

A student, who is discontinued in any semester, on readmission shall be required todo all the subjects in the curriculum prescribed for such batch of students in which the studentsjoins subsequently.

15.1 A student, studied under Acharya Nagarjuna University (ANU) regulations,discontinued at the end of the I Year I Semester, shall joinin I Year I Semester of Autonomous batch of R-17 regulations.

15.2 A student, studied under ANU Regulations and discontinued at the end of the I year II Semester and also at the subsequent semesters will follow the same regulations of ANU and he/she has to complete the subject by appearing the examinations conducted by Acharya Nagarjuna University. The class will be awarded based on the academic performance of a student in ANU Regulations.

16. CONDUCT AND DISCIPLINE

16.1 Students shall conduct themselves within and outside the premises of the institute in a manner befitting the students of our institution.

16.2 As per the order of Hon'ble Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.

16.3 The following acts of omission and / or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures with regard to ragging.

a) Lack of courtesy and decorum, indecent behavior anywhere within or outside the campus.
b) Willful damage of college / individual property.
c) Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.
d) Mutilation or unauthorized possession of library books.
e) Noisy and unseemly behavior, disturbing studies of fellow students.
f) Hacking of computer systems (such as entering into other person'sareas without prior permission, manipulation and / or damage of computer hardware and software or any other cyber-crime etc.)
g) Usage of camera / cell phone in the campus
h) Plagiarism of any nature
i) Any other acts of gross indiscipline as decided by the academic council from time to time.

16.4 Commensurate with the gravity of offense, the punishment may be reprimand, fine, expulsion from the institute / hostel, debar from examination, disallowing the use of certain facilities of the institute, rustication for a specified period or even outright expulsion from the institute or even handing over the case to appropriate law enforcement or the judiciary, as required by the circumstances.

16.5 For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the chief warden, the head of the department and the principal respectively, shall have the authority to reprimand or impose fine.

16.6 Cases of adoption of unfair means and / or any malpractice in an examination shall be reported to the principal for taking appropriate action.

16.7 All cases of serious offence, possibly requiring punishment other than reprimand, shall be reported to the academic council.

16.8 The institute level standing disciplinary action committee constituted by the academic council shall be the authority to investigate the details of the offence, and recommend disciplinary action based on the nature and extent of the offence committed.

16.9 The principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the department in an appropriate manner, and subsequently such actions shall be placed before the academic council for ratification. Any emergency modification of regulation, approved by the appropriate authority, shall be reported to the academic council for ratification.

16.10 "Grievanceand Redressal Committee"(General) constituted by the Principal shall deal with all grievances pertaining to the academic / administrative / disciplinary matters.

17. MALPRACTICES

17.1 The Principal shall refer the cases of malpractices in internal assessment tests and semester-end examinations to a malpractice enquiry committee constituted by him / her for the purpose. Such committee shall follow the approved scales of punishment. The principal shall take necessary action, against the erring students basing on the recommendations of the committee.

17.2 Any action on the part of a student during an examination trying to get undue advantage or trying to help another, or drive the same through unfair means is punishable according to the provisions contained hereunder. The involvement of the staff, who are in-charge of conducting examinations, valuing examination papers and preparing / keeping records of documents relating to the examinations in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned in the examination shall be viewed seriously and recommended for award of appropriate punishment after thorough enquiry.

18. AMENDMENTS

The College may from time to time, revise, amend, or change the Regulations, Schemes of Examinations, and / or Syllabus.

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Department of Mechanical Engineering
R.V.R. &J.C COLLEGE OF ENGINEERING (A) :: GUNTUR – 522019.

SCHEME OF EXAMINATION AND INSTRUCTION FOR I / II M.TECH. w.e.f 2017-18

I/II M.TECH (MACHINE DESIGN) :: FIRST SEMESTER

Sl. No	Code No & Subject		Hours/Week		Credits	Evaluation of Marks			
			Lecture	Practical		Internal	External		Total
							Theory	Practical	
1	MD511	Core Subject-1	4	--	4	40	60	--	100
2	MD512	Core Subject-2	4	--	4	40	60	--	100
3	MD513	Core Subject-3	4	--	4	40	60	--	100
4	Elective Subject-1		4	--	4	40	60	--	100
5	Elective Subject-2		4	--	4	40	60	--	100
6	Elective Subject-3		4	--	4	40	60	--	100
7	MD551	LAB-I	--	6	2	40	--	60	100
8	MD552	LAB-II	--	6	2	40	--	60	100
TOTAL			24	12	28	320	360	120	800

I/II M.TECH (MACHINE DESIGN) :: SECOND SEMESTER

Sl. No	Code No & Subject		Hours/Week		Credits	Evaluation of Marks			
			Lecture	Practical		Internal	External		Total
							Theory	Practical	
1	MD521	Core Subject-4	4	--	4	40	60	--	100
2	MD522	Core Subject-5	4	--	4	40	60	--	100
3	MD523	Core Subject-6	4	--	4	40	60	--	100
4	Elective Subject-4		4	--	4	40	60	--	100
5	Elective Subject-5		4	--	4	40	60	--	100
6	Elective Subject-6		4	--	4	40	60	--	100
7	MD561	LAB-III	--	6	2	40	--	60	100
8	MD562	Seminar	--	6	2	100	--	--	100
TOTAL			24	12	28	380	360	60	800

II/II M.TECH (MACHINE DESIGN) :: FIRST SEMESTER

Sl. No	Code No & Subject		Hours/Week		Credits	Evaluation of Marks		
			Lecture	Practical		Internal	External	Total
1	MD611	MOOCS	--	--	2	--	--	--
2	MD651	Dissertation Review	--	24	4	100	--	100
3	MD652	Internship	--	--	2	100	--	100
TOTAL			--	24	8	200	--	200

M.TECH. II/II M.TECH (MACHINE DESIGN) :: SECOND SEMESTER

Sl. No	Code No & Subject		Hours/Week		Credits	Evaluation of Marks		
			Lecture	Practical		Internal	External	Total
1	MD661	Project Viva Voce Examination	--	24	10	40	60	100

TOTAL MARKS : 1900 **TOTAL :74 Credits**

R.V.R. & J.C. College of Engineering (A):: GUNTUR.

Subjects List- M.Tech (Machine Design) w.e.f 2017-18

Core:

S.No	Subject codes	Subject Name
	I SEM	
1.	MD 511	Theory of Elasticity and Plasticity
2.	MD512	Machinery Vibration And Control
3.	MD513	Mechanisms and Robot Kinematics
	II SEM	
4.	MD 521	Finite Element Methods
5.	MD 522	Optimization Techniques
6.	MD 523	Advanced Materials for Design

Electives:

S.NO	Elective Subject Codes	Subject Name
1.	MD571	Design of Experiments
2.	MD572	Fluidics and Control Systems
3.	MD573	Mechatronics System Design
4.	MD574	Computational Fluid Dynamics
5.	MD575	Reliability Engineering
6.	MD576	Mechanics of Composite Materials
7.	MD577	Tribology
8.	MD578	Product Design and development
9.	MD579	Rapid Prototyping
10.	MD580	Fracture Mechanics
11.	MD581	Robotic Engineering
12.	MD582	Signal Analysis And Condition Monitoring
13.	MD583	Design for Manufacturing and Assembly
14.	MD584	Vehicle Dynamics
15.	MD585	Theory of Plates and Shells
16.	MD586	Mechanics of Sheet Metal Forming
17.	MD587	Research Methodology
18.	MD588	Geometric Modelling

LABs:

S.NO	LABS	LAB NAME
1.	MD551	Computer aided Design LAB
2.	MD552	Machine Dynamics and Vibrations LAB
3.	MD561	Analysis LAB

I - YEAR
I SEMESTER

MD 511 – THEORYOF ELASTICITY & PLASTICITY

I Year M.Tech. (Machine Design) :: First Semester

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

The objectives of this course are to make the students:

1. Comprehend various concepts such as state of stress at a point, various stress components, invariants, principal stresses and general equations of equilibrium for a state of stress in three dimensions.
2. Understand and apply various concepts like strain at a point, strain invariants, principal strains and deformations for solving problems.
3. Understand, analyze and apply concept of plane stress and strain, equations of equilibrium and compatibility conditions in two dimensional rectangular coordinates, Airy's stress function approach to solve beam problems.
4. Understand, analyze and apply equations of equilibrium and compatibility conditions in two dimensional polar coordinates for axi-symmetric problems, apply general equilibrium equation of torsion for solving problems on prismatic circular and non-circular members.
5. Absorb various concepts such as plastic deformation, yield criterion, plastic-flow rules, stress-strain behavior during deformation and creep behavior of various metals.

COURSE OUTCOMES:

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

CO1 Apply various stress components, invariants, principal stresses and general equations of equilibrium for solving problems in Cartesian coordinates.

CO2 Apply various concepts of strain, strain invariants, principal strains and deformations for solving problems.

CO3 Apply plane stress, plane strain concepts and Airy's stress function approach to solve beam problems in Cartesian coordinates.

CO4 Apply equations of equilibrium and compatibility conditions to solve two dimensional polar coordinates axi-symmetric problems, apply general equilibrium equation of torsion to solve problems on members with circular and non-circular sections.

CO5 Understand various concepts associated to plastic deformation like true strain, strain hardening, yield criterion, plastic-flow rules, stress-strain behavior during deformation and creep behavior of various metals.

UNIT I

Introduction, state of stress at a point,stress components on an arbitrary plane, principal stresses, principal planes, stress invariants, deviatoric and hydrostatic components of stress, theories of failure, stress components in rectangular coordinates, differential equations of equilibrium. (12)

UNIT II

State of strain at a point, strain in rectangular components, interpretation of γ_{xy}, γ_{yz} and γ_{zx} as shear strain components, deformations, deformations in the neighborhood of a point, principal strains, strain invariants, strain deviator. St Venant's principle. (12)

UNIT III

Plane stress, plane strain, equations of equilibrium in 2D rectangular coordinates. Compatibility equations in rectangular coordinates. Polynomial solution (Airy's stress function) approach for simple beam problems in two dimensional rectangular coordinates. (12)

UNIT IV

Equations of equilibrium in 2D polar coordinates. Compatibility equations in polar coordinates. Axisymmetric problems using stress function approach. (6)

Torsion of prismatic bars-Introduction, general solution of the torsion problem, stress function, torsion of solid and hollow circular sections and non circular sections. (6)

UNIT V

Plasticity: Introduction and fundamentals, Structure of metals - Plastic deformation of metals - deformation stress-strain behavior,Engineering and natural strains,Mathematical relationships between true stress and true strains, yield criteria-Von Mises, Trescaflow rules, strain hardening postulates, creep, total strain theory. (12)

TEXT BOOKS:

1. Advanced Mechanics of solids – L.S.Srinath, McGrawhill publishers.
2. Theory of Elasticity by Timoshenko, S.P. and Goodier, J.N., Tata McGrawhill.
3. Theory of plasticity by J. Chakraborthy, Butter worth publishers.

REFERENCES:

1.Theory of Elasticity Sadhu Singh, Khanna publishers.
2. Elasticity theory, applications and numerics, Martin Sadd, Elsevier publishers.
3. An Engineering Theory of Plasticity by E.P. Unksov, Butter worths publishers.
4. Theory of Plasticity by Hoffman and Sacks, McGrawhill publishers.

WEB RESOURCES:

1.nptel.ac.in/courses/105108070/
2. Micro.stanford.edu/~caiwei/me340/
3. www.me.ust.hk/~meqpsun/Notes/303-chapter1-2.doc
4. Textofvideo.nptel.iitm.ac.in/112106065/lec37.pdf
5.home.iitk.ac.in/~anandh/AML120/Elasticity.ppt

MD 512–MACHINERY VIBRATION AND CONTROL

I Year M.Tech. (Machine Design) :: First Semester

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

At the end of this course, the students will

1. Fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions,
2. Be able to obtain linear vibratory models of dynamic systems with changing complexities (SDOF),
3. Be able to write the differential equations of motion of vibratory systems of 2 DOF,
4. Be able to make free and forced vibration analysis of single and multi-degree of freedom linear systems including shafts.
5. To study various techniques of vibration control and measurement.

COURSE OUTCOMES:

At the end of the course the students

CO1 know the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions.

CO2 Able to analyze the mathematical model of a linear vibratory system to determine its response.

CO3 capable to obtain linear mathematical models of real life engineering systems.

CO4 Able to determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation.

CO5 Able to apply sensors , other vibration control and measuring instruments for the necessity of industrial applications.

UNIT I

Fundamentals of Vibration:- Introduction, Definitions, Vector method of representing Harmonic Motions, Addition of two simple Harmonic motion of the same frequency.

Undamped Free Vibrations of Single Degree of Freedom Systems: Introduction, Derivations of differential equations, solution of differential equation, Torsional vibrations, Equivalent stiffness of spring combinations, Energy method. (12)

UNIT II

Damped Free Vibrations of Single Degree of Freedom Systems:-Introduction, Different types of damping, Free vibrations with viscous damping, Logarithmic Decrement, Viscous dampers, Coulomb damping.

Forced Vibrations of Single Degree of Freedom Systems:-Introduction, Forced vibrations with constant Harmonic excitation, Forced vibration with rotating and reciprocating unbalance, forced vibrations due to excitation of the support, Vibration, isolation and transmissibility.(12)

UNIT III

Two Degrees of Freedom Systems: Introduction, Principal modes of vibration, Natural Frequencies of a tightly stretched string, having two masses, Double pendulum, Torsional System, Systems with damping, undamped forced vibration with harmonic excitation

Multi-degree of Freedom Systems – Exact Analysis: Introduction, free vibrations, Equation of motion, Influence Co efficient, Natural frequencies and mode shapes (Eigen values and Eigen vectors) (12)

UNIT IV

Multi-degree of Freedom Systems – Numerical Methods: Introduction, Rayleigh's Method, Stodala's method, Rayleigh – Ritz Method (problems limited to maximum of 3 DOF).

Speeds of shafts: Introduction, Critical speed of a light shaft having a single disc without damping, critical speed of a light shaft having a single disc with damping, critical speeds of a shaft having multiple discs – Dunkley's Method, Secondary critical speeds. (12)

UNIT-V

Vibration Control: Introduction, Vibration Nomograph and Vibration Criteria, Reduction of Vibration at the Source, Balancing of Rotating Machines, Balancing of Reciprocating Engines, Control of Vibration, Control of Natural Frequencies, Introduction of Damping, Vibration Isolation, Vibration Absorbers.

Vibration Measurement and Applications: Introduction, Transducers, Vibration Pickups, Frequency-Measuring Instruments, Vibration Exciters, Signal Analysis, Machine Condition Monitoring and Diagnosis. (12)

TEXT BOOKS:

1. G K Grover , Mechanical Vibrations 8th Ed. ,Nem Chand & Bros , 2009 **[For Units I – IV]**
2. S.S. Rao, Mechanical Vibrations, Pearson Education India; 4 edition 2003 **[For UNIT V]**

REFERENCE BOOKS:

1. William T. Thomson, Theory of Vibrations with Applications, Pearson Education; 5th edition, 2008.
2. V P Singh, Mechanical Vibrations, Dhanpat Rai & Co. Pvt. Ltd.
3. S Graham Kelly ,Mechanical Vibrations , Schaum's Outline series.

WEBRESOURCES:

1. http://nptel.ac.in/courses/112103111/
2. https://engfac.cooper.edu/pages/tzavelis/uploads/Vibration%20Theory.pdf
3. http://sv.20file.org/up1/541_0.pdf

MD 513–MECHANISMS AND ROBOT KINEMATICS

I Year M.Tech. (Machine Design) :: First Semester

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES

1. To understand various mobilities of advanced mechanisms
2. To synthesize the various mechanisms
3. To understand the various methods and techniques for design analysis of mechanisms
4. To understand the various robot manipulators and their drive and transmission systems
5. To know about the forward and inverse kinematics of robot configuration

COURSE OUTCOMES

CO1 To analyse the given mechanism based on dof.
CO2 To design mechanism by using various types of synthesis.
CO3 To learn about various techniques and optimization methods for design and analysis of various mechanisms.
CO4 To acquire the knowledge on various types of robots and their working.
CO5 To apply the principles of robot kinematics.

Course Content

UNIT – I

Mobility analysis – Degree of freedom (DOF), mixed mobility, total, partial and fractionalDOF. Closed and open chain systems, structural analysis and synthesis of mechanisms. (12)

UNIT – II

Alternative design solutions, coding, evaluation and selection of optimum mechanism, typesynthesis, number synthesis and design of mechanisms. (12)

UNIT – III

Indexes of merit, graphical, algebraic and optimization techniques, matrix methods ofdesign and analysis, design of function, path and motion generators, structural andmechanical error. (12)

UNIT – IV

Manipulators – Classification, actuation and transmission systems, Robot drive SystemsCoordinate transformation– DH notations (12)

UNIT – V

Forward Kinematics: Forward solution Simple problems involving 2 and 3 DOF manipulators.
Inverse Kinematics: Inverse or backward solution - Closed form solution, problems involved 2 and 3 DOF manipulators. (12)

TEXT BOOKS:

1. George N Sandor and Arthur G Erdman, Mechanism Design, VOL – 1, PHI, 1988.
2. George N Sandor and Arthur G Erdman, Mechanism Design, VOL – 2, PHI, 1988.
3. *ARTHUR G. ERDMAN, GEORGE N. SANDOR, SRIDHAR KOTA,* Mechanism Design, *Fourth Edition, Pearson Education.*
4. Robotic Engineering by Richard D.Klafter, Prentice-Hall of India Pvt Ltd, 2010.
5. Robotics and Control, R.K. Mittal and I.J. Nagarath, TMH, 2005.

REFERENCE BOOKS:

1. Introduction To Robotics: Mechanics And Control, John J. Craig 3rd edition, Pearson, 2008.
2. Introduction to Robotics: Analysis, Systems, Applications, Saeed B. Niku,Prentice Hall, NJ, 2010.

Web Resources:

1. http://web.mit.edu/2.75/fundamentals/FUNdaMENTALs%20Book%20pdf/FUNdaMENTALs%20Topic%204.PDF
2. http://www.isid.ac.in/~dmishra/gmdoc/mdnotes.pdf

MD 551–COMPUTER AIDED DESIGN LAB

I Year M.Tech. (Machine Design) :: First Semester

Practical	:	*6 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

The objectives of this course are to make the students:

1. To Understand the basic commands and its usage in construction of various parts.
2. To get familiarize with variuous Design and Drafting features of Modelling Softwares.

COURSE OUTCOMES:

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

CO1 To apply the necessary commands to model the component.
CO2 To Apply various concepts of modelling, Assembly and Drafting for projects.

Exercises will be given on Modeling of mechanical Components using packages like PRO/ENGINEER, Uni-Graphics, CATIA, Autodesk INVENTOR, Solid works etc.

1. Fundamental on Sketcher and Part Drawings

2. Creation of working drawings of components and preparation of assembly models of screw jack, leaf jig, plumber block, lathe chuck, machine-vice, box type drilling jig assembly etc. by using the following techniques:
   - Generation of surfaces of revolution
   - Generation of surfaces of extrusion
   - Generation of surfaces by skinning operation
   - Generation of solid models using constructive solid geometry, method shading and rendering.

3. Generation of Ferguson's cubic surface patches, Generation of Bezier UNISURF surface patches, Generation of Coon's patches.

4. Practice on Design Calculations using Software

MD 552–MACHINE DYNAMICS & SIMULATION LAB

I Year M.Tech. (Machine Design) :: First Semester

Practical	:	*6 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

This subject provides students with:

1. To supplement the principles learnt in kinematics and Dynamics of Machinery.
2. To understand how certain measuring devices are used for dynamic testing.
3. Techniques to model and to simulate various systems;
4. The ability to analyze a system and to make use of the information to improve the performance.

COURSE OUTCOMES:

Upon completion of the subject, students will be able to

CO1 Study the effect of dynamics on vibrations in single and multi-degree of freedom system.

CO2 Understand the working principle of governor /gyroscope and demonstrate the effect of forces and moments on their motion.

CO3 Simulate the operation of a system and make improvement according to the simulation results.

ANY TEN EXPERIMENTS SHOULD BE PERFORMED:

1. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils
2. Determination of steady state amplitude of a forced vibratory system
3. Static balancing using steel balls
4. Determine the MI of connecting rod by bi-filar suspension pendulum method
5. Determination of natural frequency of given structure using FFT analyzer
6. Diagnosis of machine using FFT analyzer.
7. Determination of the magnitude of gyroscopic couple, angular velocity of precession, and representation of vectors.

Experiments through virtual Lab: http://mdmv-nitk.vlabs.ac.in/index.html#

1. Free Vibration of cantilever beam
2. 2DOF Forced vibration
3. Dynamic Vibration Absorber

SIMULATION:

1. Solving problems involving numerical differentiation and integrations.
2. Solving Truss and Beam Problems using MATLAB.
3. Position Analysis of Slider-Crank (R-RRT) Mechanism and determination of point on a link.
4. Simulation of spring mass damper System using MATLAB.
5. Frequency Response Analysis (Draw the Phase Margin and Gain Margin, Bode Plots) of given system using MATLAB.

I - YEAR
II SEMESTER

MD 521–FINITE ELEMENT METHODS

I Year M.Tech. (Machine Design) :: Second Semester

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To present the Finite element method (FEM) as a numerical method for engineering analysis of continua and structures.
2. To present 1-D Finite elements for the analysis of bars.
3. To present Finite elements for the analysis of trusses, beams.
4. To present 2-D and 3-D Finite elements for the analysis axisymmetric problems.
5. To present the knowledge of FEM for heat transfer analysis and Dynamic analysis.

COURSE OUTCOMES:

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

CO1 Understand the concept of finite element method for solving machine design problems.
CO2 Formulate and solve manually problems in 1-D structural systems involving bars.
CO3 Formulate and solve manually problems in 1-D structural systems involving trusses and beams.
CO4 Develop 2-D and 3-D FE formulations involving triangular, quadrilateral elements and higher order elements.
CO5 Apply the knowledge of FEM heat transfer analysis and Dynamic analysis.

UNIT – I

Introduction to finite element Method: Introduction to FEM, basic concepts, historical back ground, Advantages , disadvantages and applications of FEM, general description, and comparison of FEM with other methods

Formulation Techniques: Methodology, Engineering problems and governing differential equations, potential energy method, Raleigh Ritz method, Galerkin and weighted residual methods, Essential and natural boundary conditions.

Discretization of the domain: Basic element shapes, discretization process, node numbering scheme. Interpolation function, FEM procedure. (12)

UNIT-II

One-dimensional finite element methods: Coordinate system: Global, local, natural coordinate system. Shape functions: Polynomial shape functions, Derivation of shape functions, Natural co-ordinate and coordinate transformation, Linear and quadratic elements. Convergence and compatibility requirement of shape functions.

Structural analysis of Bar: Element matrices, assembling of global stiffness matrix, Application of boundary conditions, Elimination and penalty approaches, solution for displacements, reaction, stresses, temperature effects. (12)

UNIT-III

Trusses: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, and stresses (Limited to three members only).

Beams: Element matrices, assembling of global stiffness matrix, solution for displacements, reaction, stresses. (12)

UNIT – IV

Two dimensional problems: CST, LST, Quadrilateral element and Shape functions for six and eight nodded elements, axisymmetric formulations, Element matrices, boundary conditions. Finite element modelling of axisymmetric solids subjected to Axisymmetric loading with triangular elements.

Finite Element Formulations for triangular and quadrilateral Plate elements.

Three dimensional problems: Tetrahedron element – Jacobian matrix – Stiffness matrix. Concepts of Iso parametric, super parametric and Sub parametric Elements. (12)

UNIT-V

Heat transfer problems: Formulation, and solution procedure, 1D – Straight uniform fin analysis, Tapered fin analysis, Analysis of uniform fin using Quadratic element, 2-D Conduction and convection, examples: - two-dimensional fin. Finite element formulation of flat, curved, cylindrical and conical Shell elements.

Dynamic considerations: Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis. (12)

TEXT BOOK:

1. Finite element methods by Chandrubptla&Belagondu.

REFERENCES:

1. Theory and design of modern Pressure Vessels / John F. Harvey 'Van/ NostrandReihold Company/NY.
2. Pressure Vessel Design and Analysis / Bickell M. B. Ruizes / Macmillan Publishers
3. Process Equipment design / Beowll&YoundEtt.
4. Indian standard code for unfired Pressure vessels IS 2825.
5. Pressure Vessels Design Hand Book Henry H. Bednar PE / CB S Publishers / New Delhi.
6. Theory of plates and shells / Timoshenko&Noinosky / Dover Publications.
7. Stress in Beams, Plates and Shells / Ansel C. Ugural / CRC Press

WEB RESOURCES:

1. http://nptel.ac.in/courses/112104116/
2. https://ocw.mit.edu/courses/mechanical-engineering/2-092-finite-element-analysis-of-solids-and-fluids-i-fall-2009/download-course-materials/

MD 522–OPTIMIZATION TECHNIQUES

I Year M.Tech. (Machine Design) :: Second Semester

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To understand the need and origin of the optimization methods.
2. To identify solve single variable and multivariable optimization problems.
3. To provide basic understanding of simulation.
4. To get a basic picture of the various optimization methods and their applications used in engineering.

COURSE OUTCOMES:

CO1 Explain an overview of optimization problems.
CO2 Know and solve single variable and multivariable optimization problems.
CO3 Solve optimization problems with equality and inequality constrains.
CO4 Formulate and solve integer programming problems and simulation.
CO5 Establish basic concepts of genetic algorithms, simulated algorithms and neural networks.
CO6 Formulate and apply optimization methods to design problems like simple truss members, axial and transverse loaded members.

UNIT I

General Characteristics of mechanical elements, adequate and optimum design, formulation of objective function, design constraints -Classification of optimization problems and applications.
Single variable and multivariable optimization, Techniques of unconstrained minimization Golden Section, Fibonacci and gradient search methods – Quadratic Interpolation method. (12)

UNIT II

Multi – variable optimization with equality and inequality constraints - Direct methods - Indirect methods using penalty functions, Lagrange multipliers,Kuhn-Tucker conditions , merits and demerits of classical optimization techniques. (12)

UNIT III

Simulation:Introduction, Types of Simulation, Random numbers and random number generation: Mixed congruential method, additive congruential method and multiplicative congruential method, Simulation Processes, Monte-Carlo Technique, Application problems. (12)

UNIT IV

Genetic Algorithms: Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators.
Simulated Annealing:Introduction,Procedure, Algorithm, Features of the Method.
Introduction to Neural networks: Basic concept of Neural Networks, Characteristics of Neural Networks, Model of an Artificial Neuron, Neural Network Architectures – Single layer feed forward network, Multi-layer feed forward network. (12)

UNIT V

Review of Linear programming using simplex approach.
Integer programming: Introduction – formulation – Gomory cutting plane algorithm Branch and Bound method.
Design application - Structural applications - Design of simple truss members. Design of simple axial, transverse loaded members for minimum cost and /or weight. (12)

TEXT BOOKS:

1. A.Ravindran, K.M.Ragsdell&G.V.Reklaitis "Engineering Optimization Methods and Applications", 2nd edition, Wiley publications.
2. Singeresu S. Rao, "Engineering Optimization - Theory and Practice" New Age Intl. Ltd., Publishers, 2000.

REFERENCES:

1. Johnson Ray, C., "Optimum design of mechanical elements", Wiley, John & Sons, 1981.
2. Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall of India, 1995.
3. R. Pannerselvam, "Operations Research ", Prentice Hall of India, 2nd Edition, 2006.
4. G. A. Vijayalakshmipai and SanguthevarRajasekaran "Neural networks, Fuzzy logic and Genetic algorithm" Prentice Hall of India, 7th Edition, 2007
5. S.D. Sharma, "Operations Research",Kedarnath Ram nath& Co., 11thEdition, 2002.

WEB RESOURCES:

1. http://nptel.ac.in/courses/111105039/
2. http://freevideolectures.com/Course/3475/Optimization
3. http://www.nptelvideos.in/2012/11/numerical-optimization.html
4. http://optimization.mit.edu/classes.php

MD 523– ADVANCEDMATERIALS FOR DESIGN

I Year M.Tech. (Machine Design) :: Second Semester

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To provide the basics of Advanced/ Smart materials.
2. To provide fundamentals on fabrication of non-metallic materials, metallic materials, Ceramics, Piezoelectric materials.
3. To provide knowledge on shape memory alloys and their functioning.
4. To provide the basics of nano concepts and nanostructures.
5. To introduce to CNTs, MEMs and NEMs, applications.
6. To provide knowledge on characterization of nano materials, associated with modern materials and Nanotechnology. This is a foundation to many novel techniques and design.

LEARNING OUTCOMES:

CO1 Students can learn the basics of Advanced/ Smart materials and Material science.
CO2 Apply methodologies to study the nano structures.
CO3 Students can attain knowledge regarding the piezo electric materials shape memory alloys.
CO4 Students can analyze, design and utilization of smart and nano materials.
CO5 Students become professionally sound with regards to social responsibilities.

UNIT-I

Selection of Engineering Materials: Introduction, The families of engineering materials and material properties. The selection strategy, Attribute limits and material indices, The selection procedure, Computer-aided selection, The structural index.

Materials for Engineering Design: Non Metallic materials- Polymer matrix materials-constituents, Processing & Properties. Present and future applications. Ceramics-processing,Properties and applications. (12)

UNIT-II

Metallic materials: Dual phase steels, micro alloyed steels, high strength low alloy steels, managing steels, Metal matrix composites, processing, properties and applications.

Piezo Electric materials: Introduction, Piezo electric Properties, actuation of structural components by piezo electric crystals, actuator-structure interaction, axial motion of rods, bending of beams. (12)

UNIT-III

Shape Memory Alloys: Introduction, Experimental phenomenology, influence of stress on characteristic temperatures, design considerations, vibration control through shape memory alloys, applications of shape memory alloys. (12)

Unit-IV

Introduction to Nanotechnology, History of Nano Technology,Biomimetics, Definition-Nanotechnology and Nano Science Feynman predictions on NanoTechnology, Moore's law. NanoTechnology applications in various fields.

Nano Structures: Classification of Nanostructures- Zero dimensional-Nanoparticles, One Dimensional-Nanowires, Two dimensional Nano structures-Thin films.

Top-Down Nano fabrication: Definiton, Top-Downfabricationmethology- Deposition (or) Growth-Physical Vapour deposition methods, Chemical Vapour deposition methods. Lithography-Photo Lithography, Soft lithography-Nano imprinting, Etching-Physical and Chemical etching. Material modification –Ion implantation.

Bottom-up Fabrication: Definition,Bottom-up Fabrication methodology:Building block Fabrication- Physical fabrication approaches, Chemical Vapour growth (VLS Mechanism)-Nano wires preparation.Self Assembly and Self Organization-Chemical Self assembly (SAMs), Physical self assembly -examples. (12)

Unit-V

Carbon Nanotubes (CNTs), Study of Structure of CNTs and Various methods of synthesis of CNTs. properties and applications.

MEMS and NEMS: Introduction toMicro electromechanical systems-MEMs and Nano electromechanical systems-NEMs-applications.

Characterization of Nano Structures: Electron microscopy- SEM, TEM Scanning Probe Microscopy--STM, AFM. (12)

TEXT BOOKS:

1. Materials Selection in Mechanical Design "Michael F. Ashby", Third Edition.
2. Mechanical Metallurgy/George E.Dieter/McGraw Hill,1998.
3. Smart Structures: Analysis and Design-AV Srinivasan, D.Michael McFarland,Cambridge University Press NY 2001.
4. Introduction to Nanotechnology by Poole and Owens, Wiley (2003).
5. Nanostructures & Nanomaterials, Synthesis Properties and applications by Guozhong Cao. IPC London.
6. Hand Book of NanoTechnology Bharat Bhushan, Springer.

REFERENCES:

1. Nanoscale Science and Technology by Kelsall, Hamley, and Geoghegan, Wiley (2005).
2. Nano-Chemistry: A Chemical Approach to Nanomaterials, Ozin and Arsenault, RSC Publishing
3. Introduction to Nanoscale Science and Technology by Di Ventra, Evoy, and Heflin, Kluwer Academic Publishers (2004).
4. Material Science and Engineering, WD.Callister, John Wiley.
5. Material Science and Engineering, V.Raghavan, Prentice Hall of India.

WEB REFERENCES

1. https://ocw.mit.edu/courses/materials-science-and-engineering/3-080-economic-environmental-issues-in-materials-selection-fall-2005/lecture-notes/lec_ms1.pdf
2. http://nptel.ac.in/courses/112104122/

MD 561 – ANALYSISLAB

I Year M.Tech. (Machine Design) :: Second Semester

Practicals	:	*6 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

Course Objectives

1. Learn practical application of FEA using the ANSYS software and MATLAB
2. Build computer models or transfer CAD models of structures, products, components or systems.
3. Apply operating loads or other design performance conditions.
4. Study the physical responses, such as stress levels, temperature distribution etc.

Learning Outcomes:

At the end of this course the student will be able to:

CO1 Understand the basics of ANSYS capabilities, terminology and the GUI.
CO2 Acquire the knowledge in building solid models & meshing, apply loads, solving & reviewing results.
CO3 Be in a position to solve the problem by programming.
CO4 Solve various engineering problems in structural, thermal and fluid mechanics.

Exercises will be given on Analysis of mechanical Components using packages like ANSYS / HYPERMESH / NASTRAN, etc

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

1. Static Analysis
2. Modal Analysis
3. Harmonic Analysis
4. Buckling Analysis
5. Analysis of Composites

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

1. Steady state thermal analysis
2. Transient thermal analysis

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

IV. ANSYS FLUENT:

1. Fluid Flow and Heat Transfer in a Mixing Elbow.
2. Laminar and turbulent pipe flow.

V FEM USING MATLAB

1. MATLAB application to Static Analysis of 2d Truss
2. MATLAB Program to solve static beam deflections
3. MATLAB application to Modal Analysis.
4. MATLAB application to Transient Analysis.

REFERENCES:

1. Engineering Analysis with ANSYS Software, Y. Nakasone and S. Yoshimoto, Elsevier Butterworth-Heinemann, 2006
2. The Finite Element Method using MATLAB by Young W Kwon , CRC Press , 1997.

MD 562 - SEMINAR

I Year M.Tech. (Machine Design) :: Second Semester

Practicals	:	*6 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

- Each Student must present a minimum of Three seminars on latest issues on the current domain
- The marks for Seminar will be awarded by internal evaluation committee of the department.

II – YEAR :: I– SEMESTER

MD 611 – MOOCS

- Enrolment of MOOCS Course will be initiated from the date of commencement of class work for I Year 1st Semester.
- MOOCS course completion certificate of duration not less than 8 weeks, must be submitted on or before the last instruction day of II Year I Semester, otherwise his / her Semester End Examination results will not be declared.
- List of organizations offering MOOCS course(s) will be announced by the respective Board of Studies at the time of commencement of class work for I Year I Semester.
- The students must register under SWAYAM domain https://swayam.gov.in/

MD 651 – Dissertation REVIEW

- Identification of a real life problem in thrust areas
- Developing a mathematical model for solving the above problem
- Finalisation of system requirements and specification
- Proposing different solutions for the problem based on literature survey
- Future trends in providing alternate solutions
- Consolidated report preparation of the above

MD 652 – INTERNSHIP

- Internship / Industrial Training / Professional Certification should be taken up during the summer holidays for a period of 4 weeks.
- Internship / Industrial Training / Professional Certification completion certificate must be submitted along with a report and presentation during the II Year I Semester Internal evaluation, otherwise his / her Semester End Examination results will not be declared.

II – YEAR :: II – SEMESTER

MD 661- PROJECT WORK

The project work involves the following:

- **Preparing a project - brief proposal including**
- Problem Identification
- A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
- List of possible solutions including alternatives and constraints
- Cost benefit analysis
- Time Line of activities
- **A report highlighting the design finalization [based on functional requirements & standards (if any)]**
- **A presentation including the following:**
  - Implementation Phase (Hardware / Software / both)
  - Testing & Validation of the developed system
  - Learning in the Project
- **Consolidated report preparation.**

Elective Subjects

MD 571 DESIGN OF EXPERIMENTS

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES: This subject provides students with the knowledge to

1. Use statistics in experimentation and understand the important role of experimentation in new product design, manufacturing process development, and process improvement;
2. Learn the experimental designs most widely used in practice and choose an appropriate experimental design based on the study objectives.
3. Estimate precise model, quantifying the dependence of response variable(s) on process inputs.
4. Reduce variation by locating a region where the process is easier to manage and maximize or minimize a response.
5. Become familiar with various methodologies that can be used in conjunction with experimental designs for robustness and optimization.

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

CO1 Formulate objective(s) and identify key factors in designing experiments for a given problem.
CO2 Develop appropriate experimental design to conduct experiments for a given problem.
CO3 Analyze experimental data to derive valid conclusions.
CO4 Optimize process conditions by developing empirical models using experimental data.
CO5 Design robust products and processes using parameter design approach.

UNIT-I

Introduction: Strategy of experimentation, some typical applications of experimental design, Basic principles, Guidelines for designing experiments, A brief history of statistical design, Using statistical design in experimentation.

Simple comparative experiments : Introduction, Basic statistical concepts, Sampling and sampling Distribution, Inferences about the Differences in means, randomized designs, Inferences about the Differences in means, Paired comparison Designs, Inferences about the Variances of Normal Distributions, ANOVA. (12)

UNIT-II

Randomized Block Designs: Randomized complete block design, Latin square design, Balanced incomplete block design.

Introduction To Factorial Design: Basic definition and principles, Advantages of factorials, The two factor factorial design, General factorial design, Fitting response curves and surfaces, Blocking in a factorial design. (12)

UNIT-III

Fitting Regression Models : Introduction, Linear regression models, Estimate of parameters in linear regression models, Hypothesis testing in multiple regression, Confidence intervals in multiple regression, Prediction of new response observations, Regression model diagnostics, testing for lack of fit. (12)

UNIT-IV

Response surface methods: Introduction, method of steepest ascent, analysis of second-order response surface, experimental designs for fitting response surfaces. (12)

UNIT-V

Taguchi Method Of Design Of Experiments : Concept design, Parameter design, Tolerance design, Quality loss function, Signal-to- Noise ratio, Orthogonal array experiments, Quality characteristics, Selection and testing of noise factors, Selection of control factors, Parameter optimization experiment, Parameter design case study. (12)

TEXT BOOKS:

1. Douglas C Montgomery, "Design and Analysis of Experiments", John Wiley.
2. John P.W.M., "Statistical Design and Analysis of Experiments", Macmillan.

REFERENCE BOOKS:

1. Montgomery D.C., Runger G.C., "Introduction to Linear Regression Analysis",JohnWiley
2. Myres R.H., Montgomery D. C., "Response Surface Methodology: Process and Productoptimization Using Designed Experiments", Wiley, New York
3. Taguchi, "Introduction to Quality Engineering", Asian Productivity Organisation, G. UNIPUB, White Plains, New York.

WEB RESOURCES:

1. http://nptel.ac.in/courses/111104075/
2. http://nptel.ac.in/courses/111104078/
3. https://onlinecourses.science.psu.edu/stat503/node/5
4. http://home.iitk.ac.in/~shalab/anova/chapter4-anova-experimental-design-analysis.pdf
5. https://www.jmp.com/support/downloads/pdf/jmp1001/doe_guide.pdf

MD 572 – FLUIDICSAND CONTROL SYSTEMS

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To identify the elements of hydraulic systems
2. To Explain the working of various pumps and actuators
3. To understand various control elements of hydraulic systems
4. To know the variety of industrial circuits
5. To understand the common methods of designing logic circuits

COURSE OUTCOMES:

CO1 To recognize various elements of hydraulic systems.
CO2 To have good knowledge on working principles of various pumps and actuators.
CO3 To use various control elements of hydraulic systems.
CO4 To design various logic circuits.
CO5 To adapt proper industrial circuits for given application.

UNIT – I

Hydraulic Pumps & Pressure Regulation: Pressure regulation, pump types: Gear Pump, Vane Pump, Piston Pump, Combination Pumps. Selection and specification of pumps pump characteristics.

UNIT – II

Hydraulic & Pneumatic Actuators: Linear and Rotary Actuators-Selection, Specification and Characteristics, Hydraulic and pneumatic accessories

UNIT – III

Control and Regulation elements: Pressure-direction and flow control valves, relief valves, non-return valves and safety valves. Actuation systems. Application circuits.

UNIT – IV

Hydraulic Circuits: Reciprocation, quick return, sequencing synchronizing circuits-accumulator circuits, industrial circuits-press circuits.

UNIT – V

Pneumatic Systems and Circuits Pneumatic fundamentals, Control elements, Sequential circuits, Cascade methods, Mapping Methods, Step counter method, Compound circuit design, Combination circuit design.

TEXT BOOK:

1.Andrew Parr, "Hydraulics and Pneumatics", (HB), Jaico Publishing House, 1999.

REFERENCES:

1. Antony Espossito, "Fluid power with Applications", Prentice Hall, 1980
2. DudleytA.Pease and John J.Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

WEB REFERENCES:

1. http://nptel.ac.in/courses/112105046/m7L27.pdf
2. http://teacher.buet.ac.bd/mmrazzaque/Fluidics/Fluidic%20control.pdf

MD 573 – MECHATRONICSSYSTEM DESIGN

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. Explain mechatronics and its relevance in engineering design.
2. Study of means of measuring various physical variables and to understand the concepts of signal conditioning.
3. Study of different types of actuators and to study pneumatics & hydraulic system and its components.
4. To study PLC system and its applications.
5. To design hydraulic, pneumatic circuits and mechatronics systems.

COURSE OUTCOMES:

CO1 Be able to model and analyze electrical and mechanical systems.
CO2 Understand how different physical variables are measured and illustrate their working principles.
CO3 Have complete understanding of data acquisition and knowledge on signal conditioning.
CO4 Understand different types of actuators and their implementation.
CO5 Design and understand basic logic gates and PLC programming.
CO6 Design of Pneumatic and hydraulic circuits and gain knowledge of designing mechatronics.

UNIT-I:

Introduction: Integrated Design issues in Mechatronics, Mechatronics Design process, Mechatronics Key Elements, Applications in Mechatronics. [6]
Modelling and simulation of physical systems: Electrical systems, Mechanical systems translational & rotational systems, fluid systems. [6]

UNIT-II

Sensors and Transducers: Introduction, sensor for motion and position measurement, force, torque and tactile sensors, vibration – Acceleration sensors, sensor for flow measurement, temperature sensing devices. [6]
Signal Conditioning and Real Time Interfacing: Signal conditioning process, Elements of a Data Acquisition, transducers and signal conditioning, Data Conversion Process: Analog to Digital Conversion and types. [6]

UNIT-III

Actuating Devices: DC Motors, Stepper motors, fluid power Actuation, fluid power design elements: Input devices, Modulation Devices, Output Devices, graphical representation of hydraulic and pneumatic elements and equipment's. [12]

UNIT-IV

System Control – Logic Methods: Number Systems in Mechatronics, Binary Logic, Karnaugh Map Minimization. [6]
PLC: Programmable Logic Controllers, Architecture, Ladder programing. [6]

UNIT-V

FLUIDIC SYSTEM DESIGN: Design of fluid power circuits – Cascade, Furnace door control, Package lifting device, Cylinder sequencing- Oscillating cylinder. [6]

CASE STUDIES: Pick and place robot, Car park barriers, car engine management. [6]

TEXT BOOKS:

1. Devdasshetty, Richard A.Kolk, "Mechatronics System Design", PWS Publishing Company, 1997.
2. Boltan, "Mechatronics-Electronic Control Systems In Mechanical and Electrical Engineering", 2nd Edition, Addison Wesley Longman Ltd., 1999.

REFERENCES:

1. HMT, "Mechatronics", Tata Mcgraw,Hill Publishing Company, Newdelhi,1998
2. D.A Bradley, D.Dawson, N.C BurdAndA.J.Loader, "Mechatronics" Crc Press, 2010.
3. Peter RohnerAndGordron Smith, "Pneumatic Control For Industrial Automation", John Wiley And Sons, 1987.

WEB SOURCES:

1. http://nptel.ac.in/syllabus/syllabus.php?subjectid=112103174

MD 574 – COMPUTATIONALFLUID DYNAMICS

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To make the students know about various governing equations in fluid flow problems and heat transfer with knowledge of partial differential equations and boundary conditions.
2. To make the students discretize the objects in conduction and convective heat transfer problems
3. To make to students how to get the solutions for incompressible viscous flow problems and estimate the error.
4. To make the students to analyze the mac and simple algorithms to get the solutions for Novier stokes equations for incompressible fluid flows.
5. To make the students understand the importance of finite volume and finite difference methods

COURSE OUTCOMES:

CO1 Students can able to write the various governing equations in fluid flow problems and heat transfer and have knowledge of partial differential equations and able to apply boundary conditions.

CO2 Students can discretize the objects in conduction and convective heat transfer problems and also able to estimate the errors and stability analysis.

CO3 Students are able to get the solutions for incompressible viscous flow problems and estimate the error.

CO4 Students can analyze the mac and simple algorithms and able to get the solutions for Novier stokes equations for incompressible fluid flows.

CO5 Students can understand the importance of finite volume and finite difference methods.

UNIT I

REVIEW OF GOVERNING EQUATIONSIN CONNECTIVE FLUID FLOW AND HEAT TRANSFER

Conservation of mass, Newton's second law of motion, Expanded forms of Navier-Stokes equations, Conservation of energy principle, Special forms of the Navier-Stokes equations, Classification of second order partial differential equations, Initial and boundary conditions, Governing equations in generalized coordinates. (12)

UNIT II

FINITE DIFFERENCE, DISCRETIZATISON, CONSISTENCY, STABILITY AND FUNDAMENTAL OF FLUID FLOW MODELING

Elementary finite difference quotients, Basic aspects of finite difference equations, Errors and stability analysis, Some nontrivial problems with discretized equations, Applications to heat conduction and convection. (12)

UNIT III

SOLUTIONS OF VISCOUS INCOMPRESSIBLE FLOWS BY STREAM FUNCTION, VORTICITY FORMULATION

Two dimensional incompressible viscous flow, Incorporation of upwind scheme, Estimation of discretization error, Application to curvilinear geometries, Derivation of surface pressure and drag. (12)

UNIT IV

SOLUTION OF NAVIERSTOKES EQUATIONS FOR INCOMPRESSIBLE FLOWS USING MAC AND SIMPLE ALGORITHMS

Staggered grid, Solution of the unsteady Navier Stokes equations, Solutions of energy equation, Formulation of the flow problems, Simple algorithm. (12)

UNIT V

INTRODUCTION TO FINITE VOLUME METHOD

Integral approach, discretization & higher order schemes, Application to complex geometry.

INTRODUCTION TO FINITE ELEMENT METHOD

Stiffness matrix, Isoparametric elements, Formulation of finite elements for flow and heat transfer problems. (12)

TEXT BOOKS:

1. K. Muralidhar , T. Sundararajan., IIT Kanpur Series of Advanced Tests, "Computational Fluid Flow and Heat Transfer"
2. Niyogi, TMH, "Computational Fluid Dynamics"
3. Anderson D.A., Tannehill J.C., Pletcher R.H., "Computational Fluid Mechanics and Heat Transfer", Hemisphere Publishing Corporation, New York, U.S.A. 2004.

REFERENCES:

1.Ankar S.V., "Numerical Heat Transfer and Flow" Hemisphere Publ., Corporation, 2001.
2.H.K.Versteag and W.Malalsekara, "An Introduction to Computational Fluid Dynamics", Longman, 2000.
3. Carnahan B., "Applied Numerical Methods", John Wiley & Sons 2001.
4. Patankar, "Numerical heat transfer and fluid flow", McGraw Hill, 2002
5. Tapan K. Sengupta, Univeristy Press, "Fundamentals of Computational Fluid Dynamics"

WEB REFERENCES:

1. https://www.iitk.ac.in/tkic/workshop/FEM/ppt/Introduction%20to%20Computational%20Fluid%20Dynamics_SF%20Anwer.pdf
2. http://dragonfly.tam.cornell.edu/teaching/mae5230-cfd-intro-notes.pdf
3. http://nptel.ac.in/courses/101106045/
4. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.538.905&rep=rep1&type=pdf

MD 575 – RELIABILITYENGINEERING

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To apply engineering knowledge and specialist techniques to prevent or to reduce the likelihood or frequency of failures.
2. To identify and correct the causes of failures that do occur, despite the efforts to prevent them.
3. To determine ways of coping with failures that do occur, if their causes have not been corrected.
4. To apply methods for estimating the likely reliability of new designs, and for analyzing reliability data.

COURSE OUTCOMES:

CO1 Students are able to understand the reliability techniques.
CO2 Students are able to solve the problems related to failure conditions.
CO3 Ability to apply learned concepts to improving the maintenance, the maintainability, hazard risk and the safety of a plant.
CO4 Be able to carry out a failure mode effect and criticality analysis.

UNIT-I

PROBABILITY THEORY

Probability: Standard definitions and concepts. Conditional Probability, Baye's Theorem.
Probability Distributions: Central tendency and dispersion: Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersions: Mean, Median, Mode. Range, Mean Deviation, Standard Deviation, Variance, Skewness, Kurtosis. (12)

UNIT-II

Reliability Concepts

Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath tub curve.
Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions.
Reliabilty Hazard Models: Constant Failure Rate, Linearly Increasing. Time Dependent Failure Rate, Weibull Model Distribution functions and reliability analysis. (12)

UNIT-III

System Reliability

System configurations: Series, parallel, mixed configuration, k-out of n structure, complex systems.

Reliability Improvement

Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies, Markov Analysis.
System Reliability Analysis-Enumeration method, Cut-set method. Success Path method, Decompositions method. (12)

UNIT-IV

Maintainability and Availability

System downtime.

Design for maintainability: Maintenance requirements,

Design Methods: Fault Isolation and self-diagnostics. Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability-qualitative aspects. (12)

UNIT-V

Failure Mode, Effects and Criticality Analysis:

Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction. Basic symbols, development of functional reliability block diagram. Fault tree analysis and Event tress Analysis. (12)

TEXT BOOKS:

1. L.S. Srinath, " Reliability Engineering", Affiliated East-west Press(P) Ltd.1985
2. Charles E. Ebeling, "Reliability and Maintainability Engineering ", Tata McGraw Hill

REFERENCE BOOKS:

1. B.S.Dhillion, C.Singh, "Engineering Reliability", John Wiley and Sons

WEB RESOURCES:

1. www.weibull.com
2. guides.lib.monash.edu
3. www.reliasoft.com
4. https://accendoreliability.com

MD 576 – MECHANICS OF COMPOSITE MATERIALS

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. Study various types of composites, reinforcements and matrix materials used in commercial composites and their characteristics.
2. Study some common manufacturing processes of composite materials.
3. Study micro and macro mechanical behavior of lamina and macro mechanical behavior of laminate.
4. Study the strength failure theories of an angle lamina.
5. Study the application developments and future potential of composite materials.

COURSE OUTCOMES:

After completion of this course the student will be able to

CO1 Identify the properties of fiber and matrix materials used in commercial composites.
CO2 Understand and explain the methods employed in composite fabrication.
CO3 Apply constitutive equations of composite materials and understand mechanical behaviour at micro and macro level.
CO4 Predict the failure strength of laminated composite plates.
CO5 Understand the recent developments, applications and future potential of composite materials in various fields.

UNIT I

Introduction to Composite Materials: Definition, Classification – Polymer matrix composites, Metal matrix composites, Ceramic matrix composites, carbon-carbon composites.

Reinforcements and Matrix materials: Types of matrix materialsand reinforcements, Characteristics & selection, Fiber reinforced composites, Particulate composites, Prepegs and sandwich construction. (12)

UNIT II

Manufacturing: Lay-up and curing, open and closed mould processing, Hand lay-uptechniques, Bag moulding, Filament winding, Pultrusion, Thermoforming, Injection moulding, Blow moulding, an overview of metal matrix composite processing and ceramic matrix composite processing. (12)

UNIT III

Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number ofelastic constants, Derivation of nine independent elastic constants for orthotropic material, Two - dimensional relationship of compliance and stiffness matrix, Hooke's law for two-dimensional angle lamina, engineering constants. (12)

UNIT IV

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elasticmoduli, Rule of mixture, Numerical problems.

Strength Failure Theories of an Angle Lamina: Maximum stress theory, Maximum strain theory, Tsai-Hilltheory, Tsai-Wu tensor theory. (12)

UNIT V

Macro Mechanical Analysis of Laminate: Introduction, Lamination code, Stress-strain relations for a laminate, In-Plane and Flexural modulus of a laminate.

Application Developments: Aircrafts, missiles, Space hardware, automobile, Electrical andElectronics, Marine, Recreational and sports equipment-future potential of composites.

(12)

TEXT BOOKS:

1. Composite Materials handbook, M.M. Schwartz, Mc Graw Hill Book Company, 1992.
2. Mechanics of composite materials, Autar K. Kaw, CRC Press, New York, 2005

REFERENCE BOOKS:

1. Mechanics of Composite Materials, Rober M. Joness, CRC Press, New York, 2015.
2. Stress analysis of fiber Reinforced Composite Materials, Michael W. Hyer, DES Tech Publications, Inc., USA, 2009.
3. Composite Material Science and Engineering, Krishan K. Chawla, Springer, 2012.

WEB RESOURCES:

1. http://nptel.ac.in/courses/112104168/
2. http://news.mit.edu/topic/composite-materials
3. http://home.iitk.ac.in/~mohite/Composite_introduction.pdf

MD 577– TRIBOLOGY

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

The objectives of this course are:

1. To study the importance of tribology, lubrication theories and measurements of viscosity.
2. To study on concept of wear and its types, Friction behavior on metals and non-metals.
3. To study processes of lubrication in all regimes,Concept of hydrostatic lubrication
4. To study the concept of hydrodynamic lubrication and journal bearing design.
5. To study the importance of bearing materials concept of surface engineering and applications in nano level.

COURSE OUTCOMES:

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

CO1 Understand the importance of tribology, lubrication theories and measurements of viscosity.
CO2 Understand concept of wear and its types, Friction behavior on metals and non-metals.
CO3 Develop processes of lubrication in all regimes, concept of hydrostatic lubrication.
CO4 Understand the concept of hydrodynamic lubrication and journal bearing design.
CO5 Understand the concept of surface engineering and applications in nano level.

UNIT-I

Tribology: Introduction, tribology in design and industry, economic considerations. Lubrication- Regimes of lubrication, Classification of contacts, lubrication theories.

Study of various parameters: Viscosity, flow of fluids, Viscosity and its variation -absolute and kinematic viscosity, Temperature variation-Numerical Problems. Different viscometers used. (12)

UNIT-II

Wear: Types of wear, various factors affecting wear, simple theory of sliding wear, mechanism of sliding wear of metals, abrasive wear, materials of adhesive and abrasive wear situation, corrosive wear, surface fatigue wear situations, brittle fracture wear, wear of ceramics, wear measurement.

Friction: Introduction, laws of friction, sources of sliding friction, adhesion,ploughing, energy dissipation mechanisms, friction characteristics of metals, friction of non metals, friction of ceramic materials, rolling friction, source of rolling friction, stick slip motion, measurement of friction. (12)

UNIT-III

Lubricants and Lubrication Types: Types and properties of lubricants, testing methods, hydro dynamic lubrication, elasto-hydro dynamic lubrication, boundary lubrication, solid lubrication, hydrostatic lubrication.

Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing-Numerical problems. (12)

UNIT-IV

Hydrodynamic Lubrication: Newton's Law of viscous forces, Flow through stationary parallel plates. Hagen's poiseuille's theory-Numerical problems, Concept of lightly loaded bearings, Petroff's equation, Numerical problems.

Journal Bearings: Introduction to idealized full journal bearings. Load carrying capacityof idealized full journal bearings, Sommerfeld number and its significance. Comparison between lightly loaded and heavily loaded bearings, Numerical problems. (12)

UNIT-V

Bearing materials: General requirements of bearing materials, Types of bearing materials.

Surface Engineering: Thermo chemical processes - surface coatings - plating and anodizing - fusion processes - vapour phase processes.

Nano tribology: Nano coatings and applications. (12)

LEARNING RESOURCES

TEXT BOOKS:

1. "Principles of Tribology" by Halling j., McMillan Press Ltd , 1975.
2. Cameron A, Basic lubrication theory, Ellis Horwood Ltd., 2002
3. Stachowaik, G.W., Batchelor, A.W., Engineering Tribology, 3rd Ed., Elsevier, 2010.

REFERENCES:

1. Mujamdar.B.C "Introduction to Tribology of Bearing", Wheeler Publishing, New Delhi, 2001.
2. Neale MJ, Tribology Hand Book, CBS Publications, 2012.
3. Williams JA, Engineering Tribology, Oxford Univ. Press, 2001.
4. Fundamentals of Tribology, Basu, SenGupta and Ahuja/PHI
5. Tribology in Industry: Sushil Kumar Srivatsava, S. Chand &Co.

WEB RESOURCES:

1. http://nptel.ac.in/courses/112102015/
2. http://nptel.ac.in/courses/112102014/
3. http://www.nptelvideos.in/2012/12/tribology.html

MD 578– PRODUCTDESIGNAND DEVELOPMENT

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To explain the strategic importance of product and service design.
2. To discuss the importance of design , re design and concept generation via product planning
3. Discuss the importance of legal, ethical, and environmental issues in product and service design.
4. To learn the Economic issues of product development
5. To link manufacturing concepts in design development

COURSE OUTCOMES:

CO1 Identify and analyse the product design and development processes in manufacturing industry.
CO2 Define the components and their functions of product design and development processes and their relationships from concept to customer over whole product lifecycle.
CO3 Analyse, evaluate and apply the methodologies for product design, development and management.
CO4 Undertake a methodical approach to the management of product development to satisfy customer needs.
CO5 Carry out cost and benefit analysis through various cost models.
CO6 Be familiar with the design protection and Intellectual Property.

UNIT-I

Introduction: Characteristics of Successful Product Development – Duration and Cost of Production Development – Challenges of Product Development.
Development Processes and Organizations: A Generic Development Process – Concept Development: The Front-End Process – Adapting the Generic Product Development Process – Product Development Process Flows – Product Development Organizations. (12)

UNIT – II

Product Planning: Product Planning Process – Four Types of Product Development Projects and the Process - Identifying Customer Needs for product development.
Product Specifications: Specifications – Establishing Target Specifications – Setting the Final Specifications.
Concept Generation: The Activity of Concept Generation – Five Step Methods. (12)

UNIT – III

Concept Selection: Concept Selection – Method for Choosing a Concept – Benefits of Structured Method – Overview of Methodology – Various steps in Concept Screening, Concept Scoring & Concept Testing.
Product Architecture: Implications of the Architecture – Establishing the Architecture – Platform Planning – Related System-Level Design Issues. (12)

UNIT – IV

Industrial Design: What is Industrial Design? – Assessing the Need for Industrial Design – The Impact of Industrial Design – The Industrial Design Process – Management of the Industrial Design Process – Assessing the Quality of Industrial Design.
Design for Manufacturing: Definition –Overview of the steps involved in DFM Process.
Robust Design: Introduction– Steps of Robust Design Process. (12)

UNIT – V

Patents & Intellectual Property: Intellectual property – Various steps in preparing a Disclosure.
Product Development Economics: Elements of Economic Analysis – Various steps of Economic Analysis process.
Managing Projects: Understanding and Representing Tasks – Baseline Project Planning – Accelerating Projects – Project Execution – Post-mortem of Project Execution. (12)

TEXT BOOKS:

1. Product design and development by Karl T. Ulrich and Steven D. Eppinger. Third edition, Tata McGraw Hill.

REFERENCES:

1. Kevin Otto and Kristin Wood, "Product Design", Pearson, 2001.
2. Nigel Cross, "Engineering Design Methods: Strategies for Product Design", John Wiley and Sons, 2000.
3. Chitale A K and Gupta R C, "Product Design and Manufacturing", Prentice Hall of India, 2005.

WEB RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc17_me16/preview
2. http://nptel.ac.in/courses/112107217/

MD 579– RAPID PROTOTYPING

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

The objectives of this course are to make the students:

1. Learn the principles of CAD Systems and comprehend various concepts such as CAD design process and data exchange formats.
2. Understand and analyze the concepts of geometric transformation techniques in CAD.
3. Understand and analyze the concepts of curves used in modelling.
4. Understand and analyze the concepts of analytical and synthetic surfaces.
5. Understand and analyze the concepts of solid modeling techniques.

COURSE OUTCOMES:

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

CO1 Design and analysis of engineering components.
CO2 Understand and apply geometric transformation techniques in CAD.
CO3 Develop mathematical models to represent curves.
CO4 Design surface models for engineering applications.
CO5 Model engineering components using solid modeling techniques.

UNIT-I

Introduction: Introduction to RP, Prototype Fundamentals, Historical developments, Advantages, Terminology, Classification of RP Systems.

RP Process Chain:

Fundamentals of Automated Process , Process Chain , 3D Modelling , Data Conversion and Transmission , Checking and preparing , Building , Post Processing. (12)

UNIT-II

Liquid Based RP Systems:

3D systems SLA, SGC, SCS, SOUP , Rapid Prototyping for Jewelry Industry , Rapid Freeze Prototyping , Micro Fabrication, Other Commercial RP systems. (12)

UNIT-III

Liquid Based RP Systems:

Laminated Object Manufacturing (LOM), Fused Deposition Modelling (FDM), PLT, MJM, SSM, MEM and M-RPM Systems. (12)

UNIT-IV

Powder Based RP Systems:

SLS, 3DP, LENS, DSPC, MJS, EBM Systems. (12)

UNIT-V

Data Formats: STL Format, File Problems, Building a Model, File Repair, other Translators
Applications: Applications in Material Relationship, Applications in Design, Engineering, Analysis, Planning. (12)

TEXT BOOKS:

1. Ibrahim Zeid and Sivasubramanian, R., CAD/CAM Theory and Practice, Tata McGraw Hill Publications, New Delhi, 2009.
2. David F. Rogers, J. A. Adams, Mathematical Elements for Computer Graphics, TMH, 2008.

REFERENCE BOOKS:

1. Mikell P Groover and Emory W Zimmers Jr., CAD/CAM – Computer Aided Design and Manufacturing, Prentice Hill, International.
2. P.N.Rao, CAD/CAM, Tata McGraw Hill Publications, New Delhi.

WEB RESOURCES:

1. http://nptel.ac.in/courses/112102102/
2. http://nptel.ac.in/courses/112102101/
3. http://nptel.ac.in/courses/112102101/29
4. http://www.engr.uvic.ca/~mech410/old/2_Lecture_Notes/5_Geometric_Modeling.pdf
5. https://www.slideshare.net/illpa/geometric-modeling-1450567

MD 580 – FRACTURE MECHANICS

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES

1. To treat linear and nonlinear fracture mechanics principles and their applications to structural design and to study Fracture phenomena in metals and nonmetals will be discussed and testing methods will be highlighted.
2. To Express Stress strain relations along with modes
3. To Characterize brittle and ductile fractures from the macroscopic and microscopic point of view and to describe basic conditions for crack initiation for the brittle and ductile failure mode
4. To study Crack initiation under plasticity condition
5. To find various testing procedures for crack propagation

COURSE OUTCOMES

On completion of the course the student should be able to:

CO1 Predict material failure for any combination of applied stresses.
CO2 Estimate failure conditions of a structure.
CO3 Determine the stress intensity factor for simple components of simple geometry.
CO4 Predict the likelihood of failure of a structure containing a defect.
CO5 Analyze the crack propagation by various techniques.

UNIT-I

Introduction: Introduction to historical review, Source of micro and macro cracks, an atomic view of fracture stress concentration flaws. NDT and various NDT methods used in fracture mechanics.

Fatigue: Introduction to High and low cycle fatigue, process of fatigue fracture, effect of mean stress, cyclic stress/strain response of materials, establishment of cyclic stress/strain curve. (12)

UNIT-II

Stress Intensity Factor: Introduction, Linear Elastic Fracture Mechanics (LEFM), stress and displacement fields in isotropic elastic materials, stress intensity factor.

Field Equations: Equilibrium Equations, Strain Displacement and Compatibility Relations, Stress-Strain Relations, Bi-harmonic Differential Equation,Elementary Properties of Complex Variables, Westerguard's approach-Mode I (Opening Mode). (12)

UNIT-III

An elastic Deformation at the Crack Tip

Further investigation at the crack tip, approximate shape and size of the plastic zone, Plastic Zone Shape for Plane Stress.

Plastic Zone Shape for Plane Strain: Effective crack length, approximate approach, The Irwin Plastic Zone Correction, Plastic Zone Size through the Dugdale Approach, effect of plate thickness. (12)

UNIT-IV

J-Integral: Relevance and scope, Definition of the J-integral, Path Independence, stress-strain relation, further discussion on j-integral, A Simplified Relation for the J-Integral, Applications to Engineering Problems, Equivalence of G and J for Elastic Materials. (12)

UNIT-V

Crack Tip Opening Displacement: Introduction, relationship between CTOD, k_1 and G_1 for small scale yielding, equivalence between CTOD and J.

Test methods: Introduction, K_{IC}-Test technique, Various Test Specimens, Constraints on Specimen-Dimensions, Fatigue Crack Growth to Sharpen the Tip, ClipGauge, load-displacement test. (12)

TEXT BOOKS:

1. Fracture Mechanics-Fundamental and Application - Anderson, T.L CRC press1998.
2. Elementary Engineering Fracture Mechanics - David Brock, Noordhoff.

REFERENCE BOOKS:

1. Engineering fracture mechanics - S.A. Meguid Elsevier.
2. Fracture of Engineering Brittle Materials, Applied Science - Jayatilake, London.
3. Fracture and Fatigue Control in Structures - Rolfe and Barsom, Prentice Hall.
4. Introduction to fracture mechanics - Karen Hellan, McGraw Hill.
5. Fundamentals of fracture mechanisms - Knott, Butterworths.

WEB RESOURCES:

1. http://nptel.ac.in/courses/112106065/
2. http://www.fracturemechanics.org/
3. http://www.fatiguefracture.com/

MD 581 – ROBOTIC ENGINEERING

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To study and know basics on robot anatomy, drive systems and controllers.
2. To study and analyze robot kinematics both forward and inverse solutions as per D-H Convention.
3. To study and know the methods to estimate robot work space and trajectory planning.
4. To study &analyze robot dynamics and modelling of manipulators.
5. To study and know the sensing and vision systems, industrial applications and typical programming languages.

COURSE OUTCOMES:

CO1 The student will basics on robot anatomy, drive systems and controllers.
CO2 The student will be able to learn in depth knowledge on robot kinematics both forward and inverse solutions as per D-H Convention.
CO3 The student will be able to know how to use the methods to estimate robot work space and trajectory planning.
CO4 The student will be gain in depth knowledge towards robot dynamics and modelling of manipulators using both Lagrangian and Elerian concepts.
CO5 The student able to understand various sensing and vision systems in the field of robotics, able to know the various industrial applications and learn how to write a Programming for Palletizing, Loading a Machine of robotic systems.

UNIT – I

Introduction:

Automation and Robotics, Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits.

Types of Drive Systems and their Relative Merits, the Wrist & Gripper Subassemblies, Concepts and Model about Basic Control System, Transformation and Block Diagram of Spring Mass System, Control Loops of Robotic Systems, PTP and CP Trajectory Planning, Different Types of Controllers, Control ApproachesofRobots. (12)

UNIT-II

Kinematics of Robot Manipulator:

Introduction, General Description of Robot Manipulator, Mathematical Preliminaries on Vectors & Matrices, Homogenous Representation of Objects, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw(RPY) Transformation, Relative Transformation, Direct & Inverse Kinematics' Solution, D H Representation & Displacement Matrices for Standard Configurations, Geometrical Approach to Inverse Kinematics. Homogeneous Robotic Differential Transformation: Introduction, Jacobian Transformation in Robotic Manipulation. (12)

UNIT – III

Robotic Workspace & Motion Trajectory:

Introduction, General Structures of Robotic Workspaces, Manipulations with n Revolute Joints, Robotic Workspace Performance Index, Extreme Reaches of Robotic Hands, Robotic Task Description.

Robotic Motion Trajectory Design:

Introduction, Trajectory Interpolators, Basic Structure of Trajectory Interpolators, Cubic Joint Trajectories - General Design Consideration on Trajectories: - 4-3-4 & 3-5-3 Trajectories, Admissible Motion Trajectories. (12)

UNIT – IV

Dynamics of Robotic Manipulators:

Introduction - Brief Discussion on Lagrange–Euler (LE) Dynamic Modeling of Robotic Manipulators: - Preliminary Definitions, Generalized Robotic Coordinates, Dynamic Constraints, Velocity & Acceleration of Moving Frames, Robotic Mass Distribution & Inertia Tensors, Newton's Equation, Euler Equations, The Lagrangian& Lagrange's Equations. Application of Lagrange–Euler (LE) Dynamic Modeling of Robotic Manipulators: - Velocity of Joints, Kinetic Energy T of Arm, Potential Energy V of Robotic Arm, The Lagrange L, Two Link Robotic Dynamics with Distributed Mass. (12)

UNIT – V

Robot Sensing & Vision:

Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors.

Industrial Applications:

Objectives, Automation in Manufacturing, Robot Application in Industry, Task Programming, Goals of AI Research, AI Techniques, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges and Case Studies. Languages Such as VAL II, RAIL, AML and their Features, Typical Programming Examples such as Palletizing, Loading a Machine Etc. (12)

TEXT BOOKS:

1. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI.

REFERENCE BOOKS:

1. Robotics, control vision and intelligence, Fu, Lee and Gonzalez. McGraw Hill International
2. Introduction to Robotics, John J. Craig, Addison Wesley Publishing
3. Robotics for Engineers, YoramKoren, McGraw Hill International
4. Industrial Robotics, Groover, Weiss, Nagel, McGraw Hill International
5. Fundamentals of Robotics Analysis and Control, Schilling, PHI
6. Foundation of Robotics, Yoshikawa, PHI (EEE).

WEB REFERENCES:

1. http://nptel.ac.in/downloads/112101098/
2. http://nptel.ac.in/courses/112101099/
3. http://nptel.ac.in/courses/112108093/
4. http://www.ohio.edu/people/williar4/html/PDF/IntroRob.pdf

MD 582 – SIGNAL ANALYSIS AND CONDITION MONITORING

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To study the fundamentals of Signal Analysis
2. To analyse the stationary signals with various methods
3. To discuss various non stationary signals and its importance in practical applications
4. To get familiar with the signals of constant And variable bandwidth of signals
5. To deal with condition monitoring techniques

COURSE OUTCOMES:

CO1 To identify various signals that arise from mechanical problems.
CO2 To propose the solutions for the existing problems by various methods.
CO3 To familiar with practical analysis of continuous and non stationary signals.
CO4 To relate the learned basic for transient analysis.
CO5 To apply various condition monitoring techniques.

UNIT I

Introduction: Basic concepts. Fourier analysis. Bandwidth. Signal types. Convolution.
Signal analysis: Filter response time. Detectors. Recorders. Analog analyzer types. (12)

UNIT II

Practical analysis of stationary signals: Stepped filter analysis. Swept filter analysis. High speed analysis. Real-time analysis. (12)

UNIT III

Practical analysis of continuous non-stationary signals: Choice of window type. Choice of window length. Choice of incremental step. Practical details. Scaling of the results. (12)

UNIT IV

Practical analysis of transients: Analysis as a periodic signal. Analysis by repeated playback(constant bandwidth). Analysis by repeated playback (variable bandwidth). (12)

UNIT V

Condition monitoring techniques: Visual monitoring, Thermography, Vibration monitoring, Shock pulse monitoring, Wear debris monitoring, Motor current and signature analysis, Acoustic emission, Ultrasound monitoring, ISO standards, Fault detection sensors, Structural HealthMonitoring (SHM), integrated Vehicle Health Monitoring (IVHM). (12)

Condition monitoring in real systems: Diagnostic tools. Condition monitoring of two stagecompressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Airseparator. Preheater fan. Field balancing of rotors. ISO standards on vibrations. (12)

TEST BOOK:

1. Condition Monitoring of Mechanical Systems / Kolacat.

REFERENCES:

1. Frequency Analysis /R.B.Randall.
2. Mechanical Vibrations Practice with Basic Theory / V. Ramamurti/ NarosaPublishingHouse.
3. Theory of Machines and Mechanisms/ Amitabh Ghosh & AK Malik/ EWP
4. Machinery Condition Monitoring: Principles and Practices *by* A. R. Mohanty (ISBN:9781466593046, CRC Press, 2014)

WEB REFERENCES:

1. NPTEL II Video Lectures: Machinery Condition Monitoring and Signal Processing *by* A.R.MOHANTY (NPTEL, 2013).

MD 583 – DESIGNFOR MANUFACTURING AND ASSMBLY

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To study and know about basics of DFMA. To understand the selection of various materials and processes required for product.
2. To study and read the concepts of DFM for machining and injection molding.
3. To study and read the concepts of DFM for sand casting, die casting and sheet metal working methods.
4. To study and read about the Design for Manual as well as Automatic Assembly & Robot Assembly.
5. To read about Design for serviceability, Reliability and Quality with some failure modes.

COURSE OBJECTIVES:

CO1 The students will be able to understand the quality aspects of design for manufacture, as well as will be able to select best materials and processes to manufacture.
CO2 The students will be able to apply the concept of DFM for machining and injection molding.
CO3 The students will be able to apply the concept of DFM forcasting and sheet metal working.
CO4 Apply Boothroyd method of DFMA for product design and manual assembly as well as automatic assembly.
CO5 The students will be able to know some important aspects related to serviceability, reliability and quality.

UNIT-1

Introduction to DFM, DFMA: How Does DFMA Work? Reasons for Not Implementing DFMA, What Are the Advantages of Applying DFMA During Product Design?, Typical DFMA Case Studies, Overall Impact of DFMA on Industry.
Selection of materials and processes: General Requirements for Materials and Process Selection, Selection of Manufacturing Processes, Process Capabilities, Selection of Materials, Primary Process/Material Selection, Systematic Selection of Processes and Materials. (12)

UNIT-II

Design for Machining: Machining Using Single-Point & Multi point cutting tools, Choice of Work Material, Shape of Work Material, Machining Basic Component Shapes, Cost Estimating for Machined Components,
Design for Injection Molding: Injection Molding Materials, The Molding Cycle, Injection Molding Systems, Molding Machine Size, Molding Cycle Time, Estimation of the Optimum Number of Cavities, Design Guidelines. (12)

UNIT- III

Design for sand casting and die casting: Sand Casting Alloys, Basic Characteristics and Mold Preparation, Sand Cores, Melting and Pouring of Metal, Cleaning of Castings, Cost Estimating, Design Rules for Sand Castings, Example Calculations. The Die Casting Cycle, Auxiliary Equipment for Automation, Determination of the Optimum Number of Cavities, Determination of Appropriate Machine Size, Die Casting Cycle Time Estimation, Die Cost Estimation, Design Principles.

Design for Sheet Metal working: Dedicated Dies and Press-working, Press Selection, Turret Press working, Press Brake Operations, Design Rules. (12)

UNIT-IV

Design for Manual Assembly: General Design Guidelines for Manual Assembly, Development of the Systematic DFA Methodology, Assembly Efficiency, Effect of Part Symmetry, Thickness, and Weight on Handling Time, Effects of Combinations of Factors, Application of the DFA Methodology.

High speed Automatic Assembly & Robot Assembly: Design of Parts for High-Speed Feeding and Orienting, Additional Feeding Difficulties, High-Speed Automatic Insertion, General Rules for Product Design for Automation, Design of Parts for Feeding and Orienting, Product Design for Robot Assembly. (12)

UNIT-V

DESIGN FOR SERVICEABILITY AND QUALITY

Failure Mode and Effect Analysis (FMEA), FMEA history, various failure modes, failure analysis techniques. **Design for Quality**- Importance, Benefits and Strategy to implement Design for Quality. Types of maintenance: Preventive and Breakdown.

Design for Reliability Define Risk, Reliability and Safety, Requisiteness of Reliability of Product, Difference between Quality and Reliability, Steps to ensure Design for Reliability.(12)

REFERENCES:

1. **Product Design for Manufacture and Assembly** by Geoffrey Boothroyd, Peter Dewhurst and Winston A. Knight, 3rd Edition, CRC Press, 2010. **(Unit-1-4)**
2. **ENGINEERING DESIGN** by George E. Dieter, Linda C. Schmidt, 4th Edition, McGraw Publication. **(Unit- 5)**

WEB RESOURCES:

1. http://nptel.ac.in/courses/107103012/1
2. http://nptel.ac.in/downloads/112101005/
3. http://164.100.133.129:81/eCONTENT/Uploads/15%20Design%20for%20Serviceability.pdf
4. https://www.routledge.com/Product-Design-for-Manufacture-and-Assembly-Third-Edition/Boothroyd-Dewhurst-Knight/p/book/9781420089271

MD584– VEHICLE DYNAMICS

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To understand the principle and performance of vehicle in various modes such as longitudinal, vertical and lateral directions.
2. Able to identify, design and fabricate Braking systems and suspensions systems for vehicle.
3. Able to understand effects of various loads on the vehicle performance.
4. Able to understand about Tyres and its physics and how it influence the ride comfort.

COURSE OUTCOMES:

After learning the course the students should be able to

CO1 Understand the dynamics of vehicle ride.
CO2 Calculate and refer the loads and forces associated to the vehicles.
CO3 Analyse the behavior of the vehicles under acceleration, ride and braking.
CO4 Understand the suspension systems.
CO5 Understand the Tyre design and types.

UNIT – I

Introduction: Fundamental approach to Modelling: Lumped mass, Vehicle Fixed coordinate system, Motion variables, Earth fixed coordinate system, Euler angles, Forces, Newton second law., Dynamic Axle loads: Static loads on level ground, Low-speed acceleration, Loads on grades, Problems. (6)

Acceleration Performance: Power limited acceleration: Engines, power train, Automatic transmission. Traction-Limited acceleration: Transverse weight shift due to drive Torque, Traction limits. Problems. (6)

UNIT – II

Braking Performance: Basic Equations, Braking forces, Brake factor, Tire-Road friction: Velocity, Inflation Pressure and vertical load,. Federal requirements for Braking performance, Brake Proportioning, Antilock Brake systems, Braking efficiency, Rear wheel lockup, Pedal force gain, Problems. (6)

Road Loads: Aerodynamics: Mechanics of air flow around vehicle, Pressure distribution on a vehicle, Aerodynamic forces, Drag components, Aerodynamics aids, Drag, Side force, Lift force, Pitching moment, Yawing Moment, Rolling Moment, Cross wind sensitivity,. Rolling Resistance: Factors affecting Rolling resistance, Typical coefficients,. Total Road loads: Fuel Economy effects, Problems. (6)

UNIT – III

Ride: Excitation Sources, Vehicle Response Properties, Perception of Ride. (6)

Steady state cornering: Introduction, Low speed turning, High speed cornering: Tire cornering forces, cornering equations, Understeer gradient, Characteristic speed, Lateral acceleration gain, Yaw velocity gain, side slip angle, static margin,. Suspension effects on cornering: Roll Moment distribution, Camber change, Roll steer, Lateral force compliance steer, Aligning Torque, Effect of Tractive forces on cornering, Understeer effects, Measurement of Understeer gradient. (6)

UNIT – IV

Suspensions: Solid Axles: Hotchkiss, Four link, De Dion,. Independent Suspensions: Trailing arm suspension, SLA Front suspension, MacPherson strut, Multi-Link rear suspension, Trailing-Arm rear suspension, Semi- Trailing arm, Swing axle., Anti-Squat and Anti- Pitch suspension geometry: Eqivalent trailing arm analysis, Rear solid drive axle, Independent rear drive, Front solid drive axle, Independent front-drive axle, four wheel drive., Roll center analysis : solid axle roll centers, Independent suspension roll centers. Active suspension: Suspension Categories, Functions, Performance. (6)

The steering system: Introduction, The steering Linkages, Steering geometry error, Front wheel Geometry, Steering system forces and Moments, steering system models, steering systems effects: steering ratio, Understeer, Braking stability,. Influence of front- wheel drive, Four-wheel steer: low speed turning and High speed cornering. (6)

UNIT – V

Rollover: Quasi-static Rollover of Rigid Vehicle, Quasi-Static Rollover of suspended vehicle, Transient Rollover: Simple Roll models, Yaw-Roll models, Tripping,. Accident Experience. (6)

Tyres: Construction, Size and Load ration, Terminology and axis system, Mechanics of Force generation, Tractive Properties, cornering properties: Slip angle, Tire Type, Load, Inflation Pressure, Size and Width, Thread design, Other forces, Relevance to Vehicle Performance,. Camber Thrust: Tire Type, Load, Inflation Pressure, Tread design, Other forces, Relevance to Vehicle Performance,. Aligning Moment, Combined Braking and cornering: Friction circle, Variables, Conicity and Ply steer, Durability forces, Tire Vibrations. (6)

TEXT BOOKS:

1. Fundamentals of Vehicle Dynamics by Thomas D. Gillespie published by Society of Automotive Engineers, Inc. 1992
2. Vehicle Dynamics Theory and Practice by Reza N. Jazar, Springer, 2008.
3. Advanced Vehicle Technology by Heinz Heisler, Butterworth- Heinemann, 2002.

REFERENCE BOOKS:

1. Tire and Vehicle Dynamics by Hans Pacejka, Elsevier, 2012.
2. Vehicle Dynamics & control by Rajesh Rajamani , Springer.
3. Vehicle dynamics, R.V. Dukkipati, Narsova Publications.
4. Theory of Ground Vehicles by Wong J Y, John Wiley & Sons, New York, 1978.
5. Race car Vehicle Dynamics by Milliken W F and Milliken D L, , SAE.
6. Motor Vehicle by Garrett T K, Newton K and Steeds W, Butter Worths& Co., Publishers Ltd.,New Delhi, 2001.
7. Vehicle and Engine Technology by Heinz Heister, SAE Second Edition, 1999.
8. Motorcycle Dynamics by Vittore Cossalter, 2nd Edition, Publisher: LULU.com

WEB REFERENCES:

http://nptel.ac.in/courses/107106080/
http://ftp.demec.ufpr.br/disciplinas/EngMec_NOTURNO/TM355/Prof_Jorge_Erthal/Matlab/Dinamica_de_Veiculos/Short_Course_Brasil_2007.pdf

MD 585 – THOERYOF PLATES AND SHEELS

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

The objectives of this course are:
1. To study and analyze thin plate behavior using small deflection theory for various support conditions.
2. To study and analyze the behavior of laterally loaded circular plates with various supports.
3. To introduce the Navier solution method for analysis of rectangular plates with different support conditions.
4. To introduce the concept of shell behavior, their classifications, characteristics and stress-strain, force relations in curvilinear coordinates.
5. To analyze the symmetrically loaded shells like cylinders and shells due to surface revolution.

COURSE OUTCOMES:

At the end of the course the students should be able to:
CO1 Understand and apply the small deformation theory for analyzing thin plates.
CO2 Analyze and solve problems related to laterally loaded circular plates and symmetrical plates.
CO3 Apply Navier solution method to solve thin rectangular plate problems.
CO4 Understand the shell stress-strain behavior under various loads and stress strain relations in curvilinear coordinates.
CO5 Apply shell theory for solving problems on symmetrical shells and cylinders.

UNIT I

Plates: Introduction to thin plates, small deflection theory, plate equation. Isotropic and orthotropic plates, bending and twisting of plates, stability of plates.

Pure bending of plates: Slope and curvature of slightly bent plates - Relations between bending moments and curvature in pure bending of plates - Particular cases of pure bending – Strainenergy in pure bending of plates. (12)

UNIT II

Symmetrical bending of circular plates: Differential equation for symmetrical bending of laterally loaded circular plates - Uniformly loaded circular plates - Circular plate with a circular hole at the center - Circular plate loaded at the center.

Small deflections of laterally loaded plates: The differential equation of the deflection surface-Boundary conditions - Alternate method of derivation of the boundary condition - Reduction ofthe problem of bending of a plate to that of deflection of a membrane. (12)

UNIT – III

Simply supported rectangular plates: Simply supported rectangular plates under sinusoidalload - Navier solution for simply supported rectangular plates.

Rectangular plates with various edge conditions: Bending of rectangular plates by momentsdistributed along the edges - Rectangular plates with two opposite edges simply supported andthe other two edges clamped.

(12)

UNIT IV

Continuous rectangular plates: Simply supported continuous plates - Approximate design of space continuous plates with equal spans - Bending symmetry with respect to a center.

Shells: Introduction, Shell behavior, shell surfaces and characteristics, classification of shells equilibrium equations in curvilinear co-ordinates. Stress strain & force displacement relations.

(12)

UNIT V

Deformation of shells without bending: Definition and notation - Shells in the form of asurface of revolution and loaded symmetrically with respect to their axis - Particular cases ofshells in the form of surfaces of revolution - Shells of constant strength.

General theory of cylindrical shells: A circular cylindrical shell loaded symmetrically with respect to its axis - Particular cases of symmetrical deformation of circular cylindrical shells - Pressure vessels. (12)

TEXT BOOKS:

1. S.Timoshenko, “Theory of Plates and Shells”, McGraw-Hill Publishing Company.
2. J.N.Reddy, “Theory and analysis of Elastic plates and shells”, secondedition,C.R.C press.

REFERENCE BOOKS:

1. Edward Venstel, “Thin Plates and Shells: Theory: Analysis & Applications”, C.R.C Press.
2. R.Szilard, “Theory & Analysis of Plate - Classical & Numerical Methods”, John Wiley &Sons.
3. Ramaswamy, G. S., “Design & Construction of Concrete Shell Roofs”, McGrawHill Publishers.
4. Glibson J. E., “Theory of Cylindrical Shells”, North-Holland Publishing Co.
5. N. K. Bairagi, “Shell Analysis”, Khanna Publishers

WEB RESOURCES:

1.https://web.stanford.edu/.../Introduction%20to%20the%20Theory%20of%20Plates.pd...
2. web.mst.edu/.../Plates%20and%20Shells_Chapter_Encyclopedia%20of%20Aerospace...
3.www.nptel.ac.in/courses/105105041/module%206.pdf
4. nptel.ac.in/courses/105105041/m6l1-6.pdf

MD 586 – MECHANICSOF SHEET METAL FORMING

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To Identify the unique characteristics of metals that lead to plastic deformation as a processing strategy
2. Explain the processes involved in metal forming mechanics, materials
3. Analyze the interrelationships between various factors that influence the quality of manufactured products
4. Describe sheet metal characteristics and forming
5. Describe the wide variety of processes used to shape and deform metals, Hydroforming, tailor welded blanks, friction stir welding of sheets.

COURSE OUTCOMES:

CO1 Students will be equipped with basic knowledge on metal forming processes.
CO2 Students will be able to approach metal forming processes both analytically and numerically.
CO3 Students will be able to design metal forming processes.
CO4 Students will learn how to put metal forming processes in a project form.
CO5 Students will learn to develop approaches and solutions to analyze metal forming processes and the associated problems.

UNIT-I

Basics of metal forming - Mohr's circle - isotropic elasticity - yield theories - plastic stress strain relationship - plastic work - the principle of normality - incremental plastic strain. Constitutive relationships - mechanical properties - work hardening - compression test, bulge test, plane strain compression test - plastic instability in tension tests. Strain rate - super plasticity. (12)

UNIT-II

Concept of solid and flow formulations: Plastic Deformation Analysis Techniques-Slab Method, Upper Bound Method and Slip Line Method. (12)

UNIT-III

Stamping analysis: 2-D and 3-D model of stamping, stretch and draw ratios in stamping. Load instability and tearing: uniaxial tension of perfect strip and imperfect strip, tensile instability in stretching continuous sheet.
Sheet formability: Forming limit curve – concept and evaluation, formability tests, theoretical prediction, factors affecting FLC. (12)

UNIT-IV

Sheet bending: Variables in bending a continuous sheet, equilibrium conditions, material models, bending without tension, spring back.
Analysis of circular shells: Equilibrium equations, Models for forming axisymmetric shells.
Cylindrical deep drawing: Drawing the flange, cup height, redrawing cylindrical cups, wall ironing of deep drawn cups. Stretching circular shells: Analysis of bulging with fluid pressure, stretching over punch. (12)

UNIT-V

Cupping, Redrawing, and Ironing: Cup drawing, Anisotropic effects in drawing, Effects of strain hardening in drawing, Analysis of assumptions Effects of tooling on cup drawing, Earing, Redrawing, Ironing, Residual stresses.
Recent advances: Hydroforming, tailor welded blanks, friction stir welding of sheets. (12)

TEXT BOOKS:

1. Mechanics of sheet metal forming. Marciniak Z., Duncan J. L & Hu S. J. Elsevier. 2002.
2. Metal forming Mechanics and Metallurgy. Hosford W. F &Caddell R. M. PrinticeHall, 2007.

REFERENCE BOOKS:

1. Sheet metal forming processes Constitutive Modelling &Numerical Simulation. Banabic.D, Springer-Verlag Berlin. 2010.
2. Fundamentals of metal forming. Wagoner R. H &Chenot J. L. John Wiley & Sons. 1997.
3. Theory of Plasticity. Chakrabarty J. McGraw Hill. 1998.

WEB RESOURCES:

1. https://archive.org/details/Mechanics_of_Sheet_Metal_Forming
2. srv02.infra.digitaltrends.com
3. https://www.ukessays.com
4. www.emeraldinsight.com

MD 587 – RESEARCHMETHODOLOGY

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

COURSE OBJECTIVES:

1. To develop understanding of the basic framework of research process.
2. To develop an understanding of various research designs and techniques.
3. To identify various sources of information for literature review and data collection.
4. To develop an understanding of the ethical dimensions of conducting applied research
5. Appreciate the components of scholarly writing and evaluate its quality.

COURSE OUTCOMES:

CO1 Increased awareness of conceptualizing a study, observations, interviewing, analysis, and textualization.

CO2 Increase critical thinking skills. Demonstrate this by seriously considering multiple viewpoints and perspectives in class discussions, in-class writing, group work, and the final paper.

CO3 Apply course material to your own research.

CO4 Demonstrate in-class discussions and activities, and in applying course concepts to class assignments.

CO5 Become active in the process of seeking, analyzing, and synthesizing information.

UNIT I

Foundations of Research: Meaning and significance, Objectives, Motivation, types of research. Characteristics of scientific method, Research Process, Criteria of Good Research. [4]

Research Problem: Definition, selection, Necessity, techniques involved in defining a problem. [4]

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, and Basic Principles of Experimental Designs. [4]

UNIT II

Design of Sample Surveys: Introduction, Sample Design, Sampling and Non-Sampling Errors, Sample Survey Vs. Census Survey, Types of Sampling Designs. [6]

Data Collection: Introduction, Experiments and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method. [6]

UNIT III

Processing of Data: processing, processing operations, statistics in research, frequency distribution, Hypothesis testing. [6]

Analysis of Data:Chi-square test, Simple Regression Analysis, ANNOVA. [6]

UNIT IV

Interpretation and Report Writing:

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. [12]

UNIT V

RESEARCH ETHICS:

Ethical and Moral Issues in Research, Plagiarism, tools to avoid plagiarism – Intellectual Property Rights – Copy right laws – Patent rights, Reproducibility and accountability. [12]

LEARNING RESOURCES:

TEXT BOOKS:

1. Research Methodology: Methods and Techniques - C. R. Kothari, 2nd Edition, New Age International Publishers.
2. Research Methodology – P. Sam Daniel and Aroma G Sam, Kalpaz Publications

REFERENCE BOOKS:

1. Chawla, Deepak &Sondhi, Neena (2011). Research methodology: Concepts and cases, Vikas Publishing House Pvt. Ltd. Delhi.
2. Kerlinger, F.N., & Lee, H.B. (2000). Foundations of Behavioural Research (Fourth Edition), Harcourt Inc.

WEB REFERENCES:

1. http://fll.univ-biskra.dz/images/houadjli%20Ahmed%20Chaouki.pdf

MD 588 – GEOMETRIC MODELLING

Elective Subject

Lectures / Tutorials	:	*4 Periods / week*	*Sessional Marks*	:	*40*
Semester End Exam.	:	*3 hrs.*	*Semester End Exam. Marks*	:	*60*

Course Objectives:

The objectives of this course are to make the students:

1. Learn the principles of CAD Systems and comprehend various concepts such as CAD design process and data exchange formats.
2. Understand and analyze the concepts of geometric transformation techniques in CAD.
3. Understand and analyze the concepts of curves used in modelling.
4. Understand and analyze the concepts of analytical and synthetic surfaces.
5. Understand and analyze the concepts of solid modeling techniques.

Course Outcomes:

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

CO1 Perform design and analysis of Engineering components.
CO2 Understand and apply geometric transformation techniques in CAD.
CO3 Develop mathematical models to represent curves.
CO4 Design surface models for Engineering applications.
CO5 Model engineering components using solid modeling techniques.

UNIT-I

Introduction to CAD: Introduction to CAD, conventional and computer aided design processes, CAD input devices, CAD output devices, CAD Software, Data exchange formats and CAD applications. (12)

UNIT-II

2D Transformations of geometry: 2D Translation, 2D Scaling, 2D Reflection, 2D Rotation, Homogeneous representation of transformation, Concatenation of transformations.

3D Transformations of geometry and Projections: 3D Translation, 3D Scaling, 3D Reflection, 3D Rotation, Homogeneous representation of transformation, Concatenation of transformations, Perspective, Isometric projections and Orthographic projections, Inverse transformations. (12)

UNIT-III

Design of Curves: Analytic Curves, Synthetic curves, Hermite cubic spline, Bezier Curve, B-spline curve, Curve manipulations-Evaluting points on curves- Curve Trimming, Blending, Segmentation and intersection. Bernstein polynomials, NURBS. (12)

UNIT-IV

Design of Surfaces: Surface analysis and representation, Analytical surfaces- Plane, Ruled, Surfaces of revolution and Tabulated cylinder. Synthetic surfaces- Hermite bi-cubic surface, Bezier surfaces, B-spline surfaces, Coons surface, Blending surface and Offset surface. Surface manipulation. (12)

UNIT-V

Design of Solids: Solid entities, Boolean operations, B-rep of Solid Modelling, CSG approach of solid modelling, advanced modelling methods. (12)

TEXT BOOKS:

1. Ibrahim Zeid and Sivasubramanian, R., CAD/CAM Theory and Practice, Tata McGraw Hill Publications, New Delhi, 2009.
2. David F. Rogers, J. A. Adams, Mathematical Elements for Computer Graphics, TMH, 2008.

REFERENCE BOOKS:

1. Mikell P Groover and Emory W Zimmers Jr., CAD/CAM – Computer Aided Design and Manufacturing, Prentice Hill, International.
2. P.N.Rao, CAD/CAM, Tata McGraw Hill Publications, New Delhi.

WEB RESOURCES:

1. http://nptel.ac.in/courses/112102102/
2. http://nptel.ac.in/courses/112102101/
3. http://nptel.ac.in/courses/112102101/29
4. http://www.engr.uvic.ca/~mech410/old/2_Lecture_Notes/5_Geometric_Modeling.pdf
5. https://www.slideshare.net/illpa/geometric-modeling-1450567