ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

MACHINE DESIGN

Department of Mechanical Engineering

M.Tech Two Year Degree Course

(Applicable for the batch admitted from 2020-21)

GUDLAVALLERU ENGINEERING COLLEGE

(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)

Seshadri Rao Knowledge Village

GUDLAVALLERU - 521 356, Krishna District, Andhra Pradesh

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VISION & MISSION OF THE COLLEGE

Vision

To be a leading institution of engineering education and research, preparing students for leadership in their fields in a caring and challenging learning environment.

Mission

- To produce quality engineers by providing state-of-the-art engineering education.
- To attract and retain knowledgeable, creative, motivated and highly skilled individuals whose leadership and contributions uphold the college tenets of education, creativity, research and responsible public service.
- To develop faculty and resources to impart and disseminate knowledge and information to students and also to society that will enhance educational level, which in turn, will contribute to social and economic betterment of society.
- To provide an environment that values and encourages knowledge acquisition and academic freedom, making this a preferred institution for knowledge seekers.
- To provide quality assurance.
- To partner and collaborate with industry, government, and R and D institutes to develop new knowledge and sustainable technologies and serve as an engine for facilitating the nation's economic development.
- To impart personality development skills to students that will help them to succeed and lead.
- To instil in students the attitude, values and vision that will prepare them to lead lives of personal integrity and civic responsibility.
- To promote a campus environment that welcomes and makes students of all races, cultures and civilizations feel at home.
- Putting students face to face with industrial, governmental and societal challenges.

VISION & MISSION OF THE DEPARTMENT

Vision

To become a competent centre in moulding students as professional mechanical engineers having ethical standards and social consciousness.

Mission:

- To impart value based education and to enhance competencies of students through effective design and delivery of the curriculum that fulfils the needs of the industry.
- To instill desire and confidence in the students to cater the needs of the society through their activities of excellence.
- To impart technical skills and nurture values, and mould the students as professionals to offer solutions to the technological challenges.
- To guide and support the students for enhancing nation's wealth through entrepreneurship.

III. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO-I : Machine design post graduates have will have strong technical knowledge to design mechanical systems.

PEO-II : Machine design post graduates will have problem solving and decision making skills contributing to overall personality and career development.

PEO-III: Machine design post graduates will have groomed attitude of team work, team building leadership and regard for ethical practices.

PEO-IV: Machine design post graduates will engage in lifelong learning to adapt to socio-economic-technological developments.

IV. PROGRAM OUTCOMES (POs)

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

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

PO-3 : An ability to demonstrate a degree of mastery at a level higher than the bachelor program.

PO-4 : An ability design complex engineering systems in a multi-disciplinary environment.

PO-5 : An ability to apply contemporary techniques and computer aided tools to design mechanical systems.

PO-5 : An ability to design Mechanical Systems considering public health, safety, cultural, ethical, legal societal and environmental aspects.

V. ACADEMIC REGULATIONS

Applicable for the students of M.Tech from the Academic Year 2020-21.

1. PG – M.Tech Programs

The following M.Tech Programs are offered at present

i. Structural Engineering (SE)
ii. Power Electronics and Electric Drives (PEED)
iii. Machine Design (MD)
iv. VLSI Design and Embedded Systems (VLSID & ES)
v. Computer Science and Engineering (CSE)

2. Duration of the Program

The duration of the program is two academic years consisting of four semesters. However, a student is permitted to complete the course work of M.Tech program in the stipulated time frame of four academic years from the date of joining.

3. Minimum Instruction Days

Each semester consists of a minimum of ninety instruction days.

4. Program Credits

Each specialization of the M.Tech programs is designed to have a total of 70 credits and the student shall have to complete the two year course work and earn all the 70 credits for the award of M.Tech Degree.

5. Attendance Regulations

5.1 A student is eligible to write the University examinations if he acquires a minimum of 40% in each subject and 75% of attendance in aggregate of all the subjects.

5.2 Condoning of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester will be considered for genuine reasons such as medical grounds and participation in co-curricular and extra-curricular activities and shall be granted only after approval by the College Academic Committee. Student should submit application for medical leave along with medical certificate from a registered medical practitioner within three days from reporting to the class work after the expiry of the medical leave. In case of participation in co-curricular and extra-curricular activities, either in the college or other colleges, students must take prior written permission from HoD concerned and should also submit the certificate of participation from the organizer of the event within three days after the completion of the event. Only such cases will be considered for condoning attendance shortage.

5.3 A student shall be eligible to claim for condonation of attendance shortage only once during the two years (four semesters) course work.

5.4 A student will not be promoted to the next semester unless he satisfies the attendance requirement of the current semester. He may seek re-admission for that semester when offered next.

5.5 Shortage of Attendance below 65% in aggregate shall in *NO* case be condoned.

5.6 Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that semester and their registration shall stand cancelled.

5.7 A fee stipulated by the college shall be payable towards condoning attendance shortage.

5.8 A Student is required to put up a minimum of 75% attendance in the Mandatory Non-credit courses for getting the satisfactory grade.

6. Examinations and Scheme of Evaluation

6.1 Theory Courses :

Each theory course shall be evaluated for a total of 100 marks, consisting of 30 marks for internal assessment and 70 marks for semester end examination.

Internal Assessment:

i) Of 30 marks for internal assessment, 10 marks are for continuous assessment in the form of two assignments and 20 marks are based on two mid-term examinations.

ii) Each assignment carries 10 marks and the average of two assignments shall be taken as the marks for continuous assessment.

iii) Each mid-term examination is conducted for 30 marks with one and half hour duration. Each mid-term examination consists of three questions, each for 10 marks. All the questions need to be answered.

iv) Sum of the80% marks of better scored mid-term examination and 20% marks of less scored mid-term examination are scaled down for 20 marks.

v) For the project based theory course, the distribution of 30 marks for internal evaluation shall be 20 marks for theory, based on two mid- term examinations and 10 marks for project. Each mid-term examination is conducted for 30 marks with one and half hour duration. Each mid-term examination consists of two questions, each for 15 marks, with internal choice. All the questions need to be answered. Sum of the 80% marks of better scored mid-term examination and 20% marks of less scored mid-term examination are scaled down for 20 marks.

External Assessment:

i) Semester End Examination will be conducted for 70 marks consisting of five internal choice questions i.e. "either" or choice, carrying 14 marks each. There will be two questions from each unit and the student should answer either of the two questions.

ii) For the project based theory course, the pattern of semester end examination is same as the above. There will be no external assessment for project component.

6.2 Laboratory Courses :

i) For practical subjects the distribution shall be 15 marks for Internal Evaluation and 35 marks for the End Examination. There shall be continuous evaluation by the internal subject teacher during the semester for 15 internal marks. Of the 15 marks for internal, 5 marks shall be for day-to-day performance, 5 marks for Record and 5 marks shall be evaluated by conducting an internal laboratory test towards the end of semester.

ii) Semester end examination shall be conducted by an internal examiner and an external examiner for 35 marks.

6.3 Mini Project with Seminar:

Mini Project with seminar shall be evaluated for a total of 100 Marks.

i) Of 100 marks, 30 marks shall be awarded by the project supervisor based on student's involvement in carrying out the project and the remaining 70 marks are based on presentation and viva-voce before a committee consisting of supervisor, head of the department and a senior faculty of the department.

ii) There will be no external assessment for mini project.

6.4 Mandatory Non-credit Course:

i) A student is required to take up two Non-Credit course viz. Constitution of India, English for Research Paper writing, one in I semester and the other in II semester. Marks are awarded based on the day-to-day performance in the seminars organized under each course. A student is required to score 40 marks out of 100 marks despite putting up a minimum of 7 5 % attendance to be declared satisfactory in each mandatory non-credit course. The M.Tech degree shall only be awarded if a student gets satisfactory grade in each of the two mandatory non-credit courses and besides acquiring 70 credits of the M.Tech degree course.

ii) A student whose shortage of attendance is condoned in the case of credit courses in that semester shall also be eligible for condoning shortage of attendance up to 10% in the case of mandatory non-credit courses also.

iii) A student has to repeat the course whenever it is offered, if he does not get satisfactory grade or not fulfilling the attendance requirements in each non-credit course for getting the degree awarded.

6.5 MOOCs:

i) A Student shall register for MOOCs offered by NPTEL, CISCO, MICROSOFT and SAYLOR or any other agency with prior approval of departmental committee.

ii) The courses should be other than those offered under regular curriculum and are to be approved by the Departmental Committee consisting of the head of the department, mentor and one/two senior faculty members before the commencement of each semester.

iii) The duration of the course shall be 12 weeks / 50-70 hrs (maximum).

iv) The schedule of the course must be in line with the academic schedule of that semester.

v) The required credits shall be awarded on submission of certificate from the approved agency.

6.6 Project Work:

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

i) A Project Review Committee (PRC) shall be constituted for each specialization with Head of the Department / a Senior Faculty as Chairman and two other senior faculty members.

ii) Registration of Project Work: A candidate who has been promoted to 3rd semester shall be eligible to register for the project work.

iii) The eligible candidate can choose his project supervisor and submit the title, objective, abstract and plan of action of the proposed project work to the department for approval by the PRC. The candidate whose proposal is approved by the PRC shall register for the project work. The minimum duration of project work will be 36 weeks from the date of registration.

iv) If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the PRC. In case of such changes, the candidate has to register afresh.

v) There shall be three reviews on the progress of the project work by the PRC with an interval of 12 weeks. The candidate needs to submit a report on the progress of his work and present it before the PRC for assessment. The PRC may suggest for an extension of date of submission of dissertation if the progress of work is not satisfactory or absent himself for the review.

vi) A candidate who has passed all the theory, laboratory and Mini project with seminar examinations and shown satisfactory progress of project work is permitted to submit the dissertation after 36 weeks from the date of registration.

vii) If a candidate fails to submit the dissertation by the end of the 4th semester, he has to take the permission for an extension by paying the semester(s) tuition fee.

viii) Three copies of the Project Thesis certified by the supervisor shall be submitted to the Department.

ix) Project evaluation and Viva-Voce examination is conducted at the end of 4th semester by a committee consisting of Project Supervisor, senior faculty of the department, HoD and an External Examiner nominated by the Chief Controller of Examinations out of a panel of three examiners suggested by the department.

The following grades are awarded for the project work:

i. Excellent
ii. Very Good
iii. Good
iv. Satisfactory
v. Unsatisfactory

The Grade "unsatisfactory" is treated as Fail. Failed Students should take supplementary examination after making required modifications, if any, in the dissertation with a minimum gap of 8 weeks by paying the required examination fee.

7. Criteria for Passing a Course and Award of Grades:

7.1 Criteria for Passing a Course:

i) A candidate shall be declared to have passed in individual theory / laboratory course, if he secures a minimum of 50% aggregate marks (internal & semester end examination marks put together), subject to securing a minimum of 40% marks in the semester end examination.

ii) The candidate shall be declared to have passed in Mini project with seminar if he secures 50% marks.

iii) The candidate shall be declared to have successfully completed the project work if he secures a minimum of 'satisfactory' grade in the project evaluation and viva-voce examination.

iv) On passing a course of a program, the student shall earn assigned credits in that course.

7.2 Method of Awarding Letter Grade and Grade Points for a Course:

A letter grade and grade points will be awarded to a student in each course based on his performance, as per the grading system given below.

Marks Range Theory (Max - 100)	Marks Range Lab (Max. - 50)	Level	Letter Grade	Grade Points
≥ 90	≥ 45	Outstanding	A+	10
≥ 80 & < 89	≥ 40 & < 44	Excellent	A	9
≥ 70 & < 79	≥ 35 & < 39	Very Good	B	8
≥ 60 & < 69	≥ 30 & < 34	Good	C	7
≥ 50 & < 59	≥ 25 & < 29	Above Average	D	6
≥ 40 & < 49	≥ 20 & < 24	Average	E	5
< 40	< 20	Fail	F	0
		Absent	AB	0

7.3 Calculation of Semester Grade Point Average (SGPA)* for semester:

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as given below:

SGPA = $\frac{\sum(CR \, X \, GP)}{\sum CR}$ for each semester.

where CR = Credits of a course

GP = Grade Points awarded for a course

* SGPA is calculated for a candidate who passed all the courses in that semester.

7.4 Eligibility for Award of M.Tech Degree:

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

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

(b) Registered for prescribed **70** credits and secured **70** credits.

(c) Students, who fail to complete their Two years Course of study within Four years or fail to acquire the prescribed **70** Credits for the award of the degree within four academic years from the year of their admission shall forfeit their seat in M. Tech course and their admission shall stand cancelled.

7.5 Calculation of Cumulative Grade Point Average (CGPA) for Entire Program:

The CGPA is calculated as given below:

CGPA = $\frac{\sum(CR \, X \, GP)}{\sum CR}$ for entire program.

where CR = Credits of a course

GP = Grade points awarded for a course

* CGPA is calculated for a candidate who passed all the prescribed courses excluding project work.

7.6 Award of Division:

After satisfying the requirements prescribed for the completion of the program, the student shall be eligible for the award of B.Tech Degree and shall be placed in one of the following grades:

Class of Award	CGPA to be Secured	Remarks
First Class with Distinction	≥ 7.75 (Without any Supplementary Appearance)	From the CGPA secured from 160 Credits
First Class	≥ 6.75	
Second Class	≥ 5.75 & < 6.75	
Pass Class	≥ 5.00 & < 5.75	

* **CGPA** ≥ 7.5 will be awarded first class with distinction provided the student must have fulfilled all the program requirements in two (2) years duration.

8. Supplementary Examinations

i) Supplementary examinations will be conducted once in a year along with regular examinations.

ii) Semester end supplementary examinations shall be conducted till next regulation comes into force for that semester after the conduct of the last set of regular examinations under the present regulation.

iii) Thereafter supplementary examinations will be conducted in the equivalent courses as decided by the Board of Studies concerned.

9. Challenge Valuation

Challenge valuation of failed or passed subjects shall be performed as per the following norms.

i) Students can submit the application for challenge valuation, along with the prescribed fee receipt for evaluation of his answer script(s) of theory course(s) as per the notification issued by the Controller of Examinations.

The Controller of Examinations shall arrange for challenge valuation of such answer script(s).

ii) The challenge valuation will be carried out by a three member committee comprising an external subject expert nominated by the Chief Controller of Examinations, the internal subject expert and the BoS Chairman.

iii) After the challenge valuation, if the grade is improved or there is a change in the status i.e., fail to pass, the improved grade shall be notified, otherwise, the previous grade will remain.

10. Re-admission Criteria

A candidate, who is detained in a semester due to lack of attendance has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling the required norms stipulated by the college and by paying the required tuition fee and special fee in addition to paying an administrative fee of Rs. 1,000/-

11. Break in Study

Student, who discontinues the studies for what-so-ever reason, can get readmission into appropriate semester of M.Tech program only with the prior permission of the Principal of the College, provided such candidate shall follow the transitory regulations applicable to the batch he joins. An administrative fee of Rs.2,000/- per each year of break in study in addition to the prescribed tuition and special fees shall be paid by the candidate to condone his break in study.

12. Transitory Regulations

When a student is detained due to shortage of attendance, he/she may be readmitted into the same semester in which he/she has been detained. However, the academic regulations under which the detained student was first admitted shall continue to be applicable to him/her. A candidate, who is detained in a semester, on readmission shall be required to do all the courses in the curriculum prescribed for the batch of students in which the student joins subsequently. However, exemption will be given to those candidates who have already passed such courses in the earlier semester(s) he was originally admitted into and he will be offered substitute subjects in place of them as decided by the Board of Studies. However, the decision of the Board of Studies will be final.

13. Withholding of Results

If the student has not paid the dues, if any, to the College or if any case of indiscipline is pending against him, the result of the student will be withheld. His degree will be withheld in such cases.

14. Malpractices

i) The Principal shall refer the cases of malpractices in internal assessment tests and semester end examinations to a malpractice enquiry committee constituted by him for the purpose. Such committee shall follow the approved levels of punishment. The Principal shall take necessary action against the erring students based on the recommendations of the committee.

ii) Any action by the candidate trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder.

iii) Malpractices identified at spot centre during valuation

The following procedure is to be followed in the case of malpractice cases detected during valuation, scrutiny etc. at spot centre.

I. A notice is to be served to the candidate(s) involved **(i)** through the Principal of the college, **(ii)** to the candidate(s) to his college address and **(iii)** to the candidate(s) to his permanent address regarding the malpractice.

DISCIPLINARY ACTION FOR MALPRACTICES/IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices / Improper conduct	Punishment
If the candidate		
1.a	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination.)	Expulsion from the examination hall and cancellation of the performance in that subject only.
b	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through Cell phones with any candidates or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester / year. The hall ticket of the candidate shall be cancelled.

3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for the examinations of the remaining subjects of that semester / year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or takes out or arranges to send out the question paper during the examination or answer book during or after the examination.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester / year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of performance in that subject.

6.	Refuses to obey the orders of the Chief Superintendent/Assistant Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in or around the examination hall or organises a walkout or instigates others to walkout or threatens the officer-in-charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the Officer-in-charge or any person on duty in or outside the examination hall of any of his relations or indulges in any other act of misconduct or mischief which results in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the Officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	Expulsion from the examination hall and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester / year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat.

9	If student of the college who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the college will be handed over to the police and a police case is registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester / year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be referred to the Chief Superintendent of Examinations for future action towards suitable punishment.	

II. A committee consisting of the following is to be constituted at spot centre to process such malpractice cases and the recommendations of the malpractice committee are to be sent to the Chief Controller of Examinations.

1. Principal — Chairman
2. Vice Principal - Academics — Member
3. Chief examiner of that subject — Member
4. Controller of Examinations — Convener

The involvement of the staff, who are in charge of conducting examinations, valuing examination papers and preparing / keeping records

of documents related 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 at the examination shall be viewed seriously and appropriate disciplinary action will be taken after thorough enquiry.

15. Other Matters

i) Deserving physically challenged candidates will be given additional examination time and a scribe based on the certificate issued by the concerned authority. Students who are suffering from contagious diseases are not allowed to appear either for internal or semester end examinations.

ii) The students who participated in coaching / tournaments held at State / National / International levels through University / Indian Olympic Association during semester end external examination period will be promoted to subsequent semesters as per the guidelines of University Grants Commission Letter No. F.1-5/88 (SPE/PES), dated 18-08-1994.

iii) The Principal shall deal in an appropriate manner with any academic problem which is not covered under these rules and regulations, in consultation with the Heads of the Departments and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of regulation, approved in the meetings of the Heads of the Departments shall be reported to the Academic Council for ratification.

16. General

i) The Academic Council may, from time to time, revise, amend or change the regulations, schemes of examination and /or syllabi.

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

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

v) Wherever the word he, him or his occurs, it will also include she, her and hers.

VI. CURRICULAR COMPONENT

Sl. No.	Course Work - Subject Areas	Total No.of Credits	% of Total Credits
1	Baisc Sciences (BS)	5	7.14
2	Humanities and Social Sciences (HSS)	3	4.29
3	Professional Core (PC)	15	21.43
4	Professional Electives (PE)	15	21.43
5	Open Electives (OE)	3	4.29
6	Others (Seminar, Term Paper, Dissertation, etc.)	29	41.43

COURSE STRUCTURE

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SYLLABUS

COURSE STRUCTURE

I Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	ME3901	Mechanical Vibrations and Acoustics **	3	-	-	3
2	ME3902	Advanced mechancis of Solids	3	-	-	3
3		Professional Elective - I	3	-	-	3
4		Professional Elective - II	3	-	-	3
5	BA3901	Research Methodology & IPR	3	-	-	3
6	ME3909	Machine Dynamics Lab	-	-	4	2
7	ME3910	Advanced Material Testing Lab	-	-	4	2
		Total	**15**	**-**	**8**	**19**
8	BA3902	Constitution of India (Audit Course)	2	-	-	

II Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	MA3902	Computational Methods in Engineering	3	-	-	3
2	ME3911	Advanced Finite Element Methods **	3	-	-	3
3		Professional Elective - III	3	-	-	3
4		Professional Elective - IV	3	-	-	3
5	ME3918	Modeling and Simulation Lab	-	-	4	2
6	ME3919	Computational Methods Lab	-	-	4	2
7	ME3920	Mini Project with Seminar	-	-	6	3
		Total	**12**	**-**	**14**	**19**
8	EG3901	English for Research Paper Writing (Audit Course)	2	-	-	-

III Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1		Professional Elective - V	3	-	-	3
2		Open Elective	3	-	-	3
3	ME3926	Dissertation Phase - I	-	-	20	10
		Total	**6**	**-**	**20**	**16**

** Project Based Course

L : Lecture T : Tutorial P : Practical

IV Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	ME3927	Dissertation Phase - II	-	-	32	16
		Total	**-**	**-**	**32**	**16**

Professional Electives:

Professional Elective - I

ME3903 Analysis and Synthesis of Mechanisms
ME3904 Advanced Materials
ME3905 Industrial Robotics

Professional Elective - II

ME3906 Gear Engineering
ME3907 Advanced Optimization Techniques
ME3908 Rotor Dynamics

Professional Elective - III

ME3912 Design for Manufacturing and Assembly
ME3913 Mechatronics
ME3914 Vehicle Dynamics

Professional Elective - IV

ME3915 Signal Analysis and Condition Monitoring
ME3916 Fracture Mechanics
ME3917 Experimental Stress Analysis

Professional Elective - V

ME3921 Tribology
ME3922 Composite Materials
ME3923 MOOCs

Open Electives:

CE3924 Sustainable Development
EE3924 Energy Audit, Conservation & Management
ME3924 Rapid Prototyping
EC4924 Automotive Electronics (Otther than VLSID&ES)
CS3924 Soft Computing Techniques

SYLLABUS

MECHANICAL VIBRATIONS AND ACOUSTICS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of mathematical model and solution methodsfor vibrations of the mechanical systems.
- To impart knowledge on fundamental concepts on acoustics.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze the undamped and damped free vibrating system and determine its response
- analyze the forced vibrating system and determine its response
- choose appropriate instrument to measure the vibrations
- determine the natural frequencies and mode shapes of multi degree of freedom and continuous vibratory systems
- assess the impact of noise due to vibrations.

Course Content

UNIT– I: Fundamentals of Vibration

Basic concepts of vibration -importance of study of vibration -basics of periodic and simple harmonic motion.Mathematical modelling ofvibrating systems-Discrete and continuous systems-Free Vibrations of Single Degree of Freedom System**.**

Damped Free Vibrations-Components of a vibrating system –different types of damping -general differential equation of motion of the system- critical damping coefficient and damping ratio; damped natural frequency-logarithmic decrement; energy dissipated in viscous damping- torsional vibrations-equation of motion-torsional vibrations with viscous damping

UNIT–II: Forced Vibration Analysis - Single Degree of Freedom System#

Response of undamped and damped systems to harmonic excitation; frequency response curve; magnification factor; harmonic excitation of the base, vibration isolation and transmissibility; response of rotating and reciprocating unbalance systems; forcedvibration with coulomb damping.

Vibration measuring instruments –seismic mass, vibrometer, accelerometer– frequency measuring instruments

UNIT–III: Multi Degree Freedom Systems #

Free and forced vibrations of multi-degree freedom systems(two and three) in longitudinal, torsional and lateralmodes ofan undamped systems –Matrix methods of solution- normal modes - orthogonality principle -Semi definite systems; Torsional System-torsionallyequalent shafts –geared systems.

UNIT–IV: Continuous systems #

Longitudinal Vibration of a Bar-transverse vibrations of beams – Governingequations of motion - Natural frequencies and normal modes - Energy methods, Introduction to non-linear and random vibrations.

UNIT–V: Basics of Acoustics

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

Text Books

1. Rao. S. S., "Mechanical Vibrations",4thEdition ,Pearson-Prentice Hall,
2. Grover. G. S.& Nigam.S.P., "Mechanical Vibrations",8th edition,Nem Chand & Bros
3. Munjal. M. L., "Noise and Vibration Control", World Scientific.

Reference Books

1. William. T. Thomson and Marie Dillon Dahleh, "Theory of Vibration with Application", 5th Edition,Pearson New International Edition
2. Singh.V.P.,"Mechanical vibration",4th Edition, DhanpatRai & Co
3. Beranek and Ver, "Noise and Vibration Control Engineering: Principles and Applications", 2006, JohnWiley and Sons.
4. Randall. F. Barron, "IndustrialNoiseControlandAcoustics",2003, Marcel Dekker, Inc.

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested

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ADVANCED MECHANICS OF SOLIDS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of stresses and strains in un-symmetric bending and torsion using classical methods.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply the theory of elasticity including strain/displacement and Hooke's Law relationships.
- solve torsion problems in bars and thin walled sections.
- solve for stresses and deflections of beam under unsymmetrical loading
- assess various failure criteria in engineering problems.

Course Content

UNIT – I: Theories of Stress and Strain

Definition of stress at a point, stress notation, principal stresses, differential equations of motion of a deformable body, deformation of a deformable body, strain theory, principal strains. Elastic and inelastic response of a solid, Hooke's law, anisotropic elasticity, Isotropic elasticity, initiation of yield, yield criteria.

UNIT – II: Shear Center

Shear Center: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections

Unsymmetrical bending: Bending stresses in Beams subjected to unsymmetrical bending; deflection of straight beams due to unsymmetrical bending

UNIT – III: Curved Beam Theory

Winkler Bach formula for circumferential stress –limitations – correction factors – radial stress in curved beams – closed ring subjected to concentrated and uniform loads-stresses in chain links.

UNIT – IV: Axi-Symmetric Problems

Axi-Symmetric Problems: Rotating Discs- flat discs, discs of uniform thickness, discs of uniform strength, rotating cylinders

Torsion: Linear elastic solution, Prandtl elastic membrane (Soap-Film) analogy, narrow rectangular cross section, hollow thin wall torsion members, multiple connected cross sections.

UNIT – V: Introduction to Theory of Elasticity

Equilibrium and Compatibility conditions for elastic solids, 2D elasticity equations for plane stress, plane strain, Airy's stress function, bending of cantilever loaded at the end.

Text Books

1. Boresi & Sidebottom, "Advanced Mechanics of materials" Wiely International, 6th edition
2. Dr Sadhu singh , "Strength of materials" , Khanna Publication, 1st edition.

Reference Books

1. Timoschenko S.P. and Goodier J.N., "Theory of elasticity", McGraw- Hill Publishers, 3rd Edition.
2. L.S Srinath, "Advanced Mechanics of Solids", McGraw Hill Education (India) Pvt. Ltd. 3rd edition.

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - I

ANALYSIS AND SYNTHESIS OF MECHANISMS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To impart the concepts of force analysis of mechanisms.
- To familiarize with the concepts of synthesis of mechanisms.

Course Outcomes

Upon successful completion of the course, the students will be able to

- determine the displacement , velocity and accelerations of links of mechanism.
- evaluate the forces and torque acting by performing force analysis.
- apply path curvature characteristics in analysis of mechanisms.
- apply synthesis techniques in design of mechanisms.

Course Content

UNIT – I: Introduction

Elements of mechanisms ,degrees of freedom , Kutchback equation and Grublers criterion , applications of Grublers criterion, transmission angles- extreme values of transmission angles , toggle positions.

Displacement , Velocity and Acceleration Analysis (Analytical methods only): Analysis for four bar and single slider crank mechanisms.

Analysis of Complex mechanisms : Goodman indirect method and Hall Ault auxiliary point method

UNIT – II: Static Force Analysis #

Static Force Analysis #: Static equilibrium , equilibrium of two and three force members , equilibrium of four force members , static force analysis of four bar and slider crank mechanisms.

Dynamic Force Analysis #: D Alembert Principle , dynamic analysis of four bar mechanism and single slider crank mechanism – dynamically equivalent system – inertia of Connecting Rod – inertia force and torque in reciprocating Engine.

UNIT – III: Path Curvature Theory #

Introduction , fixed and moving centrodes , inflection points and inflection circle , Euler Savary Equation , Bobilliers Construction , Collineation axis , Bobillier theorem ,Hartmann construction.

UNIT – IV:

Kinematic Synthesis: Introduction, type, dimensional and number Synthesis , synthesis for function generation, path and motion generation ,Chebyschev Spacing of accuracy points

Graphical Synthesis Techniques: Motion generation for two prescribed positions and three prescribed positions – path generation for three prescribed positions without and with prescribed timing – function generation for three prescribed positions.

UNIT – V: Analytical Synthesis Techniques

Four bar and slider crank function generator with three accuracy points , Freudenstein equation , use of complex numbers and dyads – three prescribed positions for motion, path and function generation using dyad.

Text Books

1. Erdman and Sandor ,"Advanced Mechanism Design ",Prentice Hall International ,2nd Edition
2. S.S. Rattan, " Theory of Machines",Tata Mc Graw Hill, 3rd Edition

Reference Books

1. Uicker, Pennock and Shigley," Theory of machines and Mechanisms", Oxford Univ Press.
2. Amitabha Ghosh and Ashok Kumar Mallik, " Theory of Mechanism and machines", East West Press pvt Ltd,2nd edition.
3. Robert L.Norton," Design of Machinery", Tata McGraw Hill ,3rd edition.

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - I

ADVANCED MATERIALS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the advanced materials used in manufacturing and their behaviour under service.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze the elastic, yield and fracture behaviour of metals.
- suggest the modern metallic and Non Metallic materials for the applications.
- choose the suitable smart material for manufacturing.
- select the material for the given applications.
- select suitable characterization technique for selection of material.

Course Content

UNIT – I: Fundamentals of Material Science

Elasticity in metals, mechanism of plastic deformation, slip twinning, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening, Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity. Yield criteria: Von mises and Tresca criteria.

UNIT – II: Modern Metallic Materials

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

UNIT – III: Non Metallic Materials

Polymeric materials and their molecular structures - production techniques for fibers, foams, adhesives and coatings, structure, properties and applications.
Composites - Introduction, reinforcement, types of composite materials - properties, processing and application of composite materials.

UNIT – IV: Smart Materials

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

UNIT – V: Selection of Materials

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

Text Books

1. Mechanical behavior of materials/Thomas H.Courtney/2nd Edition, McGraw-Hill, 2000
2. Mechanical Metallurgy/George E.Dieter/McGraw Hill, 1998
3. Material selction in mechanical design by M.F Ashby. Bott
4. Peter E.J. Flewitt and R.K. Wild, Physical Methods of Materials Characterization, 2nd Edition, Taylor & Francis (2003)

Reference Books

1. Selection and use of Engineering Materials 3e/Charles J.A/Butterworth Heiremann. Material science and metallurgy by V.D. Kodgire, Everest publishing house
2. Budinski. G.K. and Budinski. K.M., " Engineering Materials: Properties and Selection", 7th Edition, Prentice Hall of India, 2010.
3. Filnn .R.A. and Trojan .P.K., "Engineering Materials and their Applications", (4th Edition), Jai co, 1999.
4. Metals Hand Book, Vol. 10, "Failure Analysis and Prevention", (10th Edition), 1994.

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - I

INDUSTRIAL ROBOTICS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with anatomy, sensors, motion anlaysis, layout design and programming of a industrial robot manipulators.

Course Outcomes

Upon successful completion of the course, the students will be able to

- select appropriate type of sensors and actuators for a robot manipulator.
- analyze kinematics of a robot.
- select suitable end effector and configuration of the machine vision system
- program the robot for a given application.
- design the robot cell for industrial applications.

Course Content

UNIT – I: Introduction

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

Control System and Components: basic concepts and motion controllers, control system analysis, robot actuation and feedback components.

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

UNIT – II: Motion Analysis and Control #

Manipulator kinematics, position representation, forward and inverse transformations, homogeneous transformations, manipulator path control, robot arm dynamics, configuration of a robot controller, Robot joint control design.

UNIT – III: End Effectors and Machine Vision

End Effectors: Grippers – types, operation, mechanism, force analysis, tools as end effectors, consideration in gripper selection and design.

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

UNIT – IV:

Robot Programming [#] : Lead through programming, Robot program as a path in space, Motion interpolation, WAIT, SIGNAL and DELAY commands, Branching, capabilities and Limitations of lead through methods.

Robot Languages : Textual robot languages, generations of robot programming languages, robot language structure, elements and function.

UNIT – V:

Robot Cell: DESIGN AND CONTROL: Robot cell layouts – Robot centred cell, In – line robot cell, Considerations in work design, Work and control, Inter locks, error detection, work cell controller.

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

Text Books

1. Industrial Robotics , Groover M P , Pearson Edu.
2. Introduction to Robotic Mechanisms and Control , JJ Craig, Pearson, 3rd Edition.

Reference Books

1. Robotics , Fu K S, McGraw Hill.
2. Robotic Engineering , Richard D Klafter , Prentice Hall.
3. Robot Analysis and Intelligence ,Asada and Slotine , Wiley Inter-Science.
4. Robot Dynamics and Control , Mark W. Spong and M. Vidyasagar , John Wiley.

[#] Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - II

GEAR ENGINEERING

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the design of gears and different modes of failure.
- To impart the knowledge of gear box design and its optimization.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify the types of gear failures.
- design spur and helical gears for the given application .
- design bevel and worm gears for the given application .
- design the gear box for given specifications.
- optimize the parameters of gear like weight, space and cost.

Course Content

UNIT – I: Introduction to Gears

Basic principles, nomenclature, gear manufacturing processes, gear inspection methods. Gear Failure**-** failure due to bending, pitting, scoring, abrasive, corrosive wear.

UNIT – II: Spur & Helical Gears #

Lewis Method - design of gear teeth - beam strength, Buckingham's dynamic load and wear load.

American Gear Manufacturers Association (AGMA) Method: Plastic deformation using AGMA method - gear design against bending and compressive strength.

UNIT – III: Bevel & Worm Gears #

Lewis Method - design of gear teeth - beam strength, Buckingham's dynamic load and wear load.

American Gear Manufacturers Association (AGMA) Method: Plastic deformation using AGMA method - gear design against bending and compressive strength.

UNIT – IV: Gear Box

Introduction, construction, working principle, ray diagram, kinematic arrangement of gears. design of multi speed gear box.

UNIT – V: Optimal Gear Design

Optimization of gear design parameters, constraints in gear train design- weight and space minimization, cost optimization.

Text Books

1. J.E.Shigley, "Mechanical Engineering Design", TATA Mc.Graw Hill Education Pvt., Ltd.
2. T.V.Sundarajanmurthy, N.Shanmugam, "Machine Design", Anuradha Publication, Chennai.

Reference Books

1. V.B.Bandari, "Design of Machine Elements " TATA Mc.Graw Hill Education Pvt., Ltd..
2. Norton, "Machine Design - An Integrated Approach", Pearson Publications, 2nd Edition.
3. S. Jalaluddien," Machine Design" Anuradha Publications, Chennai.

Note: Design data book is allowed for examination.

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Professional Elective - II

ADVANCED OPTIMIZATION TECHNIQUES

I Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the advanced optimization techniques for solving engineering problems.

Course Outcomes

Upon successful completion of the course, the students will be able to

- classify the optimization problems.
- solve the design issues by using techniques of classical optimization.
- apply optimization techniques to design various mechanical elements.
- apply genetic algorithm for solving the design problems.

Course Content

UNIT–I: Introduction

Classification of optimization problems, concepts of design vector, Design constraints, Design space constraints surface, objective function, surface and multilevel optimization, parametric linear programming.

UNIT–II: Classical Optimization Techniques #

Single variable optimization, Multilevel Optimization without constraints – Multilevel Optimization with Equality and inequality constraints – Lagrange multipliers methods Kuhn – Tucker conditions.

UNIT–III:

Non – Linear Optimization #: One – Dimensional Minimization methods – Fibonacci method, Golden section method,

Unconstrained Optimization Methods #: Hooke and Jeeves methods, Powell's method, Gradient of a function, Cauchy method, Fletcher – Reeves method, Types of Penalty methods for handling constraints.

UNIT–IV: Applications of Optimization in Design and Manufacturing Systems#

Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

UNIT–V: Non-Traditional Optimization Techniques

Genetic Algorithm (GA) - Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA, concepts of simulated annealing, ANN, optimization of Fuzzy Systems.

Text Books

1. Optimization for Engineering Design ,Kalyanmoy Deb, 2nd Ediction , PHI Publishers
2. Engineering Optimization , S.S.Rao, 3rd Edition , New Age Publishers

Reference Books

1. Genetic algorithms in Search, Optimization, and Machine learning , D.E. Goldberg, Addison ,13th Edition, Wesley Publishers
2. Multi objective Genetic algorithms , Kalyanmoy Deb,2nd Edition , PHI Publishers
3. Optimal design ,Jasbir Arora, 4th Edition , Mc Graw Hill (international) Publishers.

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Professional Elective - II

ROTOR DYNAMICS

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To develop expertise on rotor dynamics and vibration in rotating machinery.
- To expose to rigid rotor dynamics, rotor vibration and critical speeds.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze vibrations in rotating machinery.
- determine the whirling speed of rotor.
- identify the effect of bearings on rotor vibrations.
- analyze balancing and condition monitoring of rotors.

Course Content

UNIT–I: Introduction to Vibration and the Laval-Jeffcott Rotor Model

Co-ordinate systems, steady state rotor motion, elliptical motion, single degree of freedom systems, free and forced vibrations. The two degrees of freedom rotor system, translational motion, natural frequencies and natural modes, steady state response to unbalance, the effect of flexible support.

UNIT–II: Torsional Vibration in Rotating Machinery #

Modeling of rotating machinery shafting - Multi degree of freedom systems - Determination of natural frequencies and mode shapes - Branched systems - Holzer method.

UNIT–III: Rigid Rotor Dynamics and Critical Speeds #

Rigid disk equation - Rigid rotor dynamics- Rigid rotor on flexible rotor - The gyroscopic effect on rotor dynamics - Whirling of an unbalanced simple elastic rotor, simple shafts with several disks - Effect of axial stiffness - Determination of bending critical speeds - Campbell diagram.

UNIT–IV: Influence of Bearing on Rotor Vibration

Support stiffness on critical speeds- Stiffness and damping coefficients of journal bearings-computation and measurements of journal bearing coefficients -Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip- Design configurations of stable journal bearings.

UNIT–V: Balancing and Condition Monitoring of Rotors

Single plane balancing, multi-plane balancing, balancing of rigid rotors, balancing of flexible rotors Noise spectrum, real time analysis, knowledge based expert systems.

Text Books

1. J. S.Rao, "Rotor Dynamics", New Age International Publishers, New Delhi, 2 nd Edition.
2. S.Timoshenko, D H.Young and W. Weaver , *Vibration Problems in Engineering*, John Wiley, 3rd Edition.

Reference Books

1. Weng Jeng Chen and J Edger Gunter, *Introduction to Dynamics of Rotor – Bearing Systems*, Trafford Publishing Ltd. 3rd Edition.
2. T. Yamamoto and Y.Ishida , *Linear and Nonlinear Rotordynamics: A Modern Treatment with Applications*, John Wiley and Sons Inc, 2nd Edition.
3. J. S.Rao, *Vibratory Condition Monitoring of Machines,* Narosa Pubulishing House, 2nd Edition.

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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RESEARCH METHODOLOGY & IPR

I Semester

Practical	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To impart the importance of research & IPR in professional growth.

Course Outcomes

Upon successful completion of the course, the students will be able to

- analyze various research methodologies
- perform research design
- collect and analyze the data required for research
- able to write research reports
- apply for Patents, Designs, Trade and Copyright.

Course Content

UNIT–I: Introduction

Research Methodology: Meaning of Research – Objectives – Types – Research Approaches – Significance of Research - Research Methods versus Methodology – Research and Scientific Method – Research Process – Criteria of Good Research – Research Ethics – Problems Encountered by Researchers in India.

Defining the Research Problem: What is a Research Problem? – Selecting the Problem – Necessity of Defining the problem – Technique Involved in Defining a Problem – An Illustration – Conclusion.

UNIT–II: Research Design

Meaning of Research Design – Need for Research Design – Features of a Good Design – Important Concepts Relating to Research Design – Different Research Designs – Basic Principles of Experimental Designs – Important Experimental Designs – Conclusion.

UNIT–III: Data Collection & Preparation, Report Writing

Data Collection: Introduction – Experiments and Surveys – Collection of Primary Data – Collection of Secondary Data – Selection of Appropriate Method for Data Collection – Case Study Method

Data Preparation: Data Preparation Process – Some Problems in Preparation Process – Missing Values and Outliers – Types of Analysis – Statistics in Research

Report Writing: Significance of Report Writing – Difference 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 - Conclusion.

UNIT–IV: Nature of Intellectual Property

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

UNIT–V: Patent Rights & Developments

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

Text Books

1. Kothari C.R "Research Methodology-Methods and Techniques",New age international Publishers, New Delhi.
2. T. Ramappa, "Intellectual Property Rights in India"

Reference Books

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students".
2. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.

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MACHINE DYNAMICS LAB

I Semester

Practical	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To demonstrate the experimental determination of dynamic response of machine elements.

Course Outcomes

Upon successful completion of the course, the students will be able to

- determine the natural frequencies of vibrating systems.
- determine moment of inertia of vibrating plate
- determine gyroscopic effect of a rotating body.
- analyze pressure profile of journal bearing
- perform dynamic balancing of rotating and reciprocating masses.
- determine the whirling speed of shaft.
- analyze the effect of friction wear.

List of Experiments:

1. Determination of natural frequency of torsional vibration for single rotor system
2. Determination of damped frequency of torsional vibration for the flywheel
3. Determination of the natural frequency of torsional vibrations for two rotor system
4. Determination of the damped frequency of transverse vibration of the beam
5. Determination the radius of gyration and the moment of inertia of a given free-vibrating rectangular plate.
6. Determination the radius of gyration and the moment of inertia of a given free-vibrating circular plate.
7. Determination of gyroscopic couple using motorized gyroscope.
8. Interpretation of pressure profile of hydraulic journal bearing.
9. Determination of effect of reciprocating mass for single cylinder engine.
10. Determination of balancing mass for system of rotating masses.
11. Determine the whirling speed of shaft
12. Determination of effect of friction wear using friction-wear apparatus

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ADVANCED MATERIAL TESTING LAB

I Semester

Practical	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To familiarize with the concepts of fabrication of composite materials and their properties

Course Outcomes

Upon successful completion of the course, the students will be able to

- select a suitable technique for fabrication of composite material
- determine the properties of composite materials.

List of Experiments:

1. Sample preparation for microscopic examination
   i. Ferrous alloys
   ii. Non ferrous alloys
2. Preparation of Aluminium metal matrix composite by stir Casting.
3. Metallographic analysis of Aluminium metal matrix Composite.
4. Density Analysis of composite specimens based on Archimedes' principle
5. Determination of Tensile, compression strength of composite by UTM.
6. Determination of Macro & Micro hardness of composite.
7. Determination of Impact strength of composite.
8. Dry Sliding wear Analysis of Aluminum metal matrix composites
9. Micro structure and Grain size analysis of Aluminum Alloy.
10. Corrosion analysis of Composite.
11. Preparation of a Fiber reinforced polymer composite.
12. Hardness and impact strength of polymer composite

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Audit Course - I

CONSTITUTION OF INDIA

I Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To understand the structure of Executive, Legislature and Judiciary.
- To understand the autonomous nature of Constitutional bodies like Supreme Court and High court controller and Auditor general of India and Election Commission of India.
- To understand the Central and State relation financial and administrative.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply the knowledge on Fundamental Rights and Duties and Directive principles of state policy.
- explain the role of President and Prime Minister and also know the Structure of Supreme court and High court.
- understand the Structure of State Government and also analyze the role of Governor and Chief Minister.
- compare and Contrast District administration role and importance.
- evaluate the various commissions of viz., SC/ST/OBC and Women.

Course Content

UNIT–I:

History of Making of the Indian Constitution: Sources. Features – Citizenship, Preamble, Fundamental Rights and Duties, Directive principles of State Policy.

UNIT–II:

Union Government and its administration Structure of the Indian Union: Federalism – Centre – state relationship. President: Role, power and position. Prime Minister and Council of ministers. Loksabha, Rajyasabha The Supreme Court and High Court: Powers and Functions.

UNIT–III:

State Government and its Administration Governor – Role and Position – Chief Minister and Council of ministers.

UNIT–IV:

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Functions, PRI: ZilaPachayat. Elected offi-

cials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT–V:

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Text Books

1. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Subash Kashyap, Indian Constitution, National Book Trust.
3. J.C.Johari, Indian Government and Politics Hans.
4. H.M.Sreevani, Constitutional Law of India, 4th edition in 3 Volumes (Universal Law of Publication).

Reference Books

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

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COMPUTATIONAL METHODS IN ENGINEERING

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of numerical methods.

Course Outcomes

Upon successful completion of the course, the students will be able to

- solve eigen value problems and system of D.E.s
- solve ODE and PDE related problems numerically
- apply the different procedures of statistics in their fields
- apply the procedures to optimize constrained and unconstrained problems.

Course Content

UNIT–I: Numerical Analysis

Numerical Methods: Lagrange interpolation, Cubic spline interpolation. Eigen value problems, system of differential equations, stiffness. Accuracy, stability and convergence.

UNIT–II: Numerical Solutions of Ordinary Differential Equations

Boundary Value Problems : Shooting Method – solution through a set of equations - derivative boundary conditions - Rayleigh Ritz Method.

UNIT–III: Numerical Solutions of Partial Differential Equations

Finite-Difference Approximations to Derivatives, Laplace Equation – Jacobi Method - ADI Method, Parabolic Equation – Crank Nicolsen method.

UNIT–IV: Applied Statistics

Correlation Coefficient for grouped bi-variate data.Regression Analysis - linear regression. Multiple linear regression and Curve fitting of parabolic, exponential curves by method of least squares; Basic types of factorial design.

UNIT–V: Optimization

Linear Programming Problem – Big-M method. Non-linear Programming - Constraints in the form of equalities and inequalities [maximum one constraint for arriving feasible solution]. Unconstrained optimization techniques: Indirect search method – Steepest descent method.

Text Books

1. Introductory Methods of Numerical Analysis by S. S. Sastry (PHI)
2. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar, R. K. Jain (New Age)
3. An Outline of Statistical Theory, Vol. I, II by A. M. Goon, M. K. Gupta, B. Dasgupta (The World Press Pvt. Ltd.)
4. Linear and Nonlinear Optimization: Second Edition, Igor Griva, Stephen G. Nash, Ariela Sofer

Reference Books

1. Advanced Engineering Mathematics by Stanley Grossman & William R. Derrick (Harper & Row Publishers).
2. Advanced Engineering Mathematics by Erwin Kreyszig (John Wiley & Sons, Inc).

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ADVANCED FINITE ELEMENT METHODS

II Semester

Lecture	: 3	nternal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of finite element method to solve engineering problems.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply finite element formulations to analyze 1-D structural problems such as bar , beam and frame problems
- develop finite element formulations to solve 2-D structural problems using triangular and rectangular elements.
- analyze thin plates using finite element method
- apply finite element formulation to dynamic problems determine frequencies and mode shapes.
- explain the non linear analysis and perform error analysis

Course Content

UNIT–I:

Finite Element Method: Concepts of discretization - Nodes as Discontinuities , Refining Mesh, Element Aspect Ratio, types of elements, interpolation function, node numbering scheme, assembly and boundary conditions.

Analysis of Bar Problems: Two noded bar element , shape functions , stiffness matrix and load vectors , determination of displacements , stresses , Three noded quadratic bar element.

UNIT–II:

Analysis of Beams and Frames# : Two noded beam element , Analysis of beam problems , Analysis of rigid frames

Analysis of Two Dimensional problems#: Plane stress and plane strain problems, Analysis of 2-D problems using constant strain triangle element, axi symmetric solids subjected to axi symmetric loading.

UNIT–III:

Isoparametric Formulations#: Coordinate Transformation, Sub, iso and super parametric elements, iso parametric quadrilateral element, numerical integration – Gaussian quadrature approach.

Bending of Thin Plates# : Basic Relations in Thin Plate Theory, Displacement

Models for Plate Analysis,Three noded Triangular membrane and bending element , four noded rectangular membrane and bending element , shear locking.

UNIT–IV:

Dynamic Analysis#: Finite element formulation in dynamic problems in structures using Lagragian Method, consistent and lumped mass models, free vibration analysis, longitudinal and transverse vibrations , mode superposition methods and reduction techniques.

UNIT–V:

Introduction to Non Linear Analysis : Sources of Non linearity ,Analysis of material non linearity problems, Analysis of geometric non linearity problems - incremental procedure , iterative procedure , mixed procedure

Error Analysis : Approximation Errors , Various measures of errors , Convergence of solution , Accuracy of solution.

Text Books

1. Chandraputla, Ashok and Belegundu , "Introduction to Finite Elements in Engineering ", Prentice – Hall,2011
2. Daryl L Logan, "A first course in finite element method", Cengage Learning. 5th Edition

Reference Books

1. SS Rao , "The Finite Element Methods in Engineering", Butterworth-Heinemann,5th Edition
2. JN Reddy, "An introduction to Finite Element Method", McGrawHill, 4th Edition.
3. S.S. Bhavikatti ," Finite Element Analysis", New Age Inernational Pvt Ltd Publishers
4. C. S. Krishnamurthy, "Finite Element Analysis -Theory and Programming", Tata Mc Graw Hill,2nd Edition.

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - III

DESIGN FOR MANUFACTURING AND ASSEMBLY

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the design factors used in manufacturing and assembly.

Course Outcomes

Upon successful completion of the course, the students will be able to

- incorporate the process constraints & other influencing factors for design.
- design a metal casting product considering troubleshooting elements.
- design a defect free weldment.
- select appropriate material and manufacturing process for product development.
- suggest an assembly for ease of manufacture and automation.

Course Content

UNIT – I: Design for Manufacturing

Reduce the cost of manufacturing process, understanding the process and constraints, standard components and process, impact of DFM on industry with case studies.

UNIT – II: Design Consideration in Metal Casting

Overview of various casting**s,** Mold and gating system design of a sand casting with design considerations, directional solidification, and troubleshooting.

UNIT – III: Design Considerations for Welding, Forging, Sheet Metal and Powder Metal Process

Overview of joining and forming operations, Design guidelines for joining and forming operations, Keeler Goodman forming limit diagram, defects, concept of residual stresses.

UNIT – IV: Design Considerations in Machining

Overview of various machining processes, design rules and recommendations for various machining and machined parts.

UNIT – V: Design for Assembly and Automation

Application of design for manufacture and assembly with selection of materials and ranking of processes like casting, injection moulding, sheet metal working, die casting, powder metal process, investment casting and hot forging. Design for assembly guidelines and automation.

Text Books

1. George E. Dieter, “Engineering Design – A Material Processing Approach”, McGraw Hill International, 2nd Edition

Reference Books

1. Geofrey Boothroyd, Peter Dewhurst, “Product Design for Manufacture and Assembly”, CRC Press, 3rd Edition.
2. O. Molloy, “Design for Manufacturing and Assembly: Concepts, Architectures and Implementation”, Chapman and Hall, 1st Edition.

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Professional Elective - III

MECHATRONICS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To impart knowledge on design of complex engineering systems using sensors, actuators, controllers.
- To familiarize with the intelligent systems used in Mechatronics.

Course Outcomes

Upon successful completion of the course, the students will be able to

- identify the elements of Mechatronics System
- design mechatronics control application using Hydraulics, Pneumatics and electrical applications.
- select suitable sensors, actuators and controllers to meet specific requirements
- understand the concepts of intelligent systems and its application in control of mechatronics systems
- understand the concepts of intelligent systems and its application in control of mechatronics systems

Course Content

UNIT–I: Mechatronics Systems

Elements & levels of mechatronics system, Mechatronics design process, measurement systems, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT–II: Hydraulic and Pneumatic Actuating Systems

Fluid systems, Hydraulic systems, and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems. Mechanical actuating systems and electrical actuating systems – basic principles and elements, Circuit Diagrams – Hydraulics and Pneumatics.

UNIT–III: Digital Electronics and Systems

Digital logic control, micro processors and micro controllers, process controllers, programmable logic controllers, PLCs versus computers, Basic programming and input-output devices interfacing with micro-controllers and programmable logic controllers, ladder programming. Design and modeling of computer controlled electro-mechanical systems.

UNIT–IV: System Interfacing and Data Acquisition

Data Acquisition Systems, Analog to Digital and Digital to Analog conversions; Digital Signal Processing – data flow in DSPs, block diagrams, typical layouts, interfacing motor drives.

UNIT–V: Intelligent Systems

Fuzzy Logic – Basics of fuzzy, Sets, Membership function, Fuzzification & defuzzification. Artificial neural network – Nomenclature of ANN, back propagation algorithm, supervised and unsupervised learning, Artificial Intelligence. Design of mechatronics systems & future trends. Case Studies - Mechatronics in Automobiles, prosthetics and artificial limbs, Machine Control etc.

Text Books

1. Bolton. W, "Mechatronics", 4th Edition, Addison Wesley, New Delhi.
2. Devadas Shetty, Richard A Kolk, "Mechatronics System Design", 2nd edition, Cengage Learning.
3. Michael B.Histand and David G.Aliatore, "Introduction to Mechatronics and Measurement Systems" Special Indian 3rd edition, McGraw-Hill.

Refernce Books

1. Dan Nesulescu, "Mechatronics", 3rd Edition, Pearson Education.
2. N. Sivanandam and S.N.Deepa, "Principles of Soft Computing", 2nd edition, Wiley India Pvt.Ltd.
3. B.P.Singh and Renu Singh, "Advanced Microprocessor and Microcontrollers" 3rd edition, New Age International Publisher.
4. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 2nd edition, Pearson Education.
5. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and application", 2nd edition, PHI.

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Professional Elective - III

VEHICLE DYNAMICS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of vehicle dynamics.

Course Outcomes

Upon successful completion of the course, the students will be able to

- develop different approaches for modeling of vehicles for dynamic analysis
- analyse pneumatic tyres by considering forces and moments
- determine the characteristics of vehicles and vehicle ride.

Course Content

UNIT–I: Introduction to Vehicle Dynamics

Various kinds of vehicles, Motions, Mathematical modelling methods, Multibody system approach, Lagrangian formulations, Methods of investigations, Stability concepts.

UNIT–II: Mechanics of Pneumatic Tyres

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

UNIT–III: Performance Characteristics of Road Vehicle

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

UNIT–IV: Handling and Stability Characteristics of Road Vehicles

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

UNIT–V: Vehicle Ride Characteristics

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

Text Books

1. Wong , “Theory of Ground Vehicles”, John Wiley and Sons, NY,4th edition, 1993.

Reference Books

1. Gillespie, T.D. “Fundamentals of Vehicle Dynamics”, SAE Publication, Warrendal, USA, 1992.
2. Dixon, J.C., “Tyres, Suspension and Handling”,SAE Publication, Warrendal, USA and Arnold Publication, London, 1997.

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Professional Elective - IV

SIGNAL ANALYSIS AND CONDITION MONITORING

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of maintenance and condition monitoring methods.

Course Outcomes

Upon successful completion of the course, the students will be able to

- apply maintenance strategies for plant maintenance to reduce the cost.
- analyze the machine condition with the aid of measuring instruments and signal analysis.
- select appropriate test for fault identification for a given application.
- carry out lubrication oil analysis and temperature analysis for given applications.
- analyze the case study including the fault identification and root causes of malfunction.

Course Content

UNIT–I: Maintenance

Maintenance history, Maintenance strategies, influence of maintenance on cost of the product, role of maintenance in condition monitoring, applications of condition monitoring in various sectors.

UNIT–II: Vibration Monitoring and Flaw Detection Methods

Vibration Monitoring: Rotating machinery - machine faults, root causes, trouble shootings of machine faults, vibration analysis - ISO Standards, types and benefits.

Flaw Detection Methods: classification of Flaws, fault detection methods in NDT- Liquid Penetration Technique, ultrasonic testing and magnetic particle inspection, Eddy current Testing.

UNIT–III: Signal Analysis & Vibration Measuring Instruments

Signal Analysis: Introduction**,** basic concepts, Fourier analysis, Bandwidth, Signal types, Convolution, Signal analysis - Filter response time, Detectors, Recorders, Analog analyzer types.

Vibration Measuring Instruments: Vibration transducers – displacement, velocity and acceleration. Laser vibrometer. accelerometers – piezo resistive, capacitive and inductive type. FFT analyzer - working principle, vibration signature analysis.

UNIT–IV: Wear Debris Analysis and Temperature Monitoring

Wear Debris Analysis: Wear mechanisms, types of wear, wear particles analysis - Ferrography, spectrometric oil analysis program (SOAP).

Temperature Monitoring: Need for temperature monitoring, principle of thermography, types - active and passive thermography, IR thermography.

UNIT–V: Case Studies

Gear box, induction motor, transformer, roller bearings, wind mill, Induced Draught and Forced Draught fans.

Text Books

1. R.A. Collacote, "Mechanical Fault diagnosis and Condition Monitoring", Springer publications.

References Books

1. R.B.Randall , "Frequency Analysis" , Bruel & KJaer publications
2. V. Ramamurti," Mechanical Vibrations Practice with Basic Theory" , Narosa Publishing House.

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - IV

FRACTURE MECHANICS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the basic concepts of fracture mechanics and its applications.

Course Outcomes

Upon successful completion of the course, the students will be able to

- elaborate different mechanisms of fracture failure.
- determine stress intensity factors by applying Linear Elastic and Elastic Plastic fracture mechanics.
- evaluate stresses induced at crack tip and different fracture parameters.
- apply different approaches to determine the plastic zone at the crack tip.
- select suitable nondestructive test to identify the cracks.

Course Content

UNIT–I:

Introduction: History and over view, fracture mechanics approach to design, effect of material properties on fracture.

Fracture Mechanisms: Ductile fracture, cleavage, ductile-brittle transition, inter granular fracture, environment assisted cracking.

Linear Elastic Fracture Mechanics : Griffith energy balance , energy release rate , crack resistance , R curve , stable and unstable crack growth.

UNIT–II:

Stress Analysis of Cracks#: Modes of fracture - opening , sliding and shearing mode , Airy stress function , crack tip stress field using Westergaurd approach, effect of finite size , relation between stress intensity factor and energy release rate.

UNIT–III:

Crack Tip Plastic Zone#: Plastic zone shape , Irwin plastic zone correction, Dugdale approach, shape of the plastic zone, plastic constraint factor, thickness effect.

UNIT–IV:

Elastic-Plastic Fracture Mechanics: Crack-tip-opening displacement, J contour integral, relationships between J and CTOD, crack-growth resistance curves, J-controlled fracture.

UNIT – V:

Test Methods: Introduction, K_{Ic}-test technique, test methods to determine J_{Ic}, test methods to determine G_{Ic} AND G_{IIc}, determination of critical CTOD.

Crack Detection Through Non-Destructive Testing: Introduction, examination through human senses, liquid penetration inspection, ultrasonic testing, radiographic imaging, magnetic particle inspection.

Text Books

1. T. L. Anderson, Fracture Mechanics: Fundamentals and Applications, CRC Press, 3rd edition
2. Prashant Kumar, Elements Of "Fracture Mechanics, Mcgraw Hill Education,First edition.

References Books

1. David Broek, Elementary engineering fracture mechanics, Kluwer Academic Publishers, 4th edition
2. J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths, 1973.
3. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials, 2nd Edition.

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - IV

EXPERIMENTAL STRESS ANALYSIS

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of experimental methods to determine stresses and strains

Course Outcomes

Upon successful completion of the course, the students will be able to

- determine the three dimensional stresses and interpret with different loading conditions
- measure strains using different types of strain gauges and also identify different frequency recording systems
- identify and evaluate stresses using modern optical techniques of experimental methods
- identify and evaluate stresses and strains developed in coating materials
- determine and distinguish effecting parameters in the fringe formation of birefringent coating materials.

Course Content

UNIT–I:

Introduction: stress, strain, plane stress and plane strain conditions, compatibility conditions. problems using plane stress and plane strain conditions, stress functions, Mohr's circle for stress strain, three- dimensional stress strain relations.

UNIT–II:

Strain Measurement and Recordings: various types of strain gauges, electrical resistance strain gauges, semiconductor strain gauges, strain gauge circuits. static recording and data logging systems, dynamic recording at very low, intermediate, high and very high frequencies.

UNIT–III:

Photo elasticity: photo elasticity – Polariscope – plane and circularly polarized light –isochromatic fringes – isoclinics fringe formation.

Three dimensional Photo elasticity#: locking in model deformation, three dimensional photo elastic materials, slicing three-dimensional models and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions.

UNIT–IV:

Brittle coatings: Introduction, coating stresses, brittle coating crack patterns, crack detection, ceramic and resin brittle coatings, testing and calibration procedures for brittle coatings analysis.

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

UNIT – V:

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

Text Books

1. Timoshenke and Goodier Jr ,"Theory of Elasticity", 3rd edition, McGraw Hill Education (India) Pvt Ltd.

Reference Books

1. Love .A.H, "A treatise on Mathematical theory of Elasticity vol-1" Nabu Publishers.
2. Sadhu Singh," Experimental stress analysis", Khanna Publishers.
3. Dally and Riley," Experimental stress analysis", Mc Graw-Hill.

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MODELING AND SIMULATION LAB

II Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To impart the skills required for modeling and analysis using software packages.

Course Outcomes

Upon successful completion of the course, the students will be able to

- model mechanical components using modeling package
- analyze different engineering problems using analysis package.

List of Experiments:

a) Using Modeling Package:

1) Modeling of Stuffing Box parts
2) Assembly of parts of Flanged Coupling
3) Modeling of parts of Eccentric and generation of orthographic views
4) Modeling of links of four bar mechanism and simulation of mechanism

b) Using analysis Package :

5) 2- D truss analysis.
6) Static Analysis of Beam.
7) Static Analysis of 3-D structure.
8) Harmonic Analysis of a Beam
9) Analysis of Axisymmetric Problem.
10) Analysis of Plane Stress problem.
11) Stress analysis of a composite plate.
12) Buckling analysis of column.

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COMPUTATIONAL METHODS LAB

II Semester

Lecture	: 4	Internal Marks	: 30
Credits	: 2	External Marks	: 70

Course Objectives

- To impart the skills required for developing MATLAB code.

Course Outcomes

Upon successful completion of the course, the students will be able to

- execute MATLAB code for solving engineering problems.

List of Experiments:

1. Solution of System of equations using Gauss Elimination method.
2. Response of a viscously damped single degree of freedom system using central difference method.
3. Solution of differential equations using Runge – Kutta Method.
4. Implementation of Least Square Method for Curve Fitting.
5. Analysis of truss problem using concepts of mechanics of solids.
6. Displacement, velocity and acceleration analysis of four bar mechanism.
7. Response of free damped vibrations of single degree of freedom system
8. Response of forced damped vibrations of single degree of freedom system
9. Response of damped vibrations of two degree of freedom system.
10. Analysis of Bar using Finite Element Method.
11. Analysis of Beam using Finite Element Method.
12. Analysis of Truss using Finite Element Method.

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Audit Course - II

ENGLISH FOR RESEARCH PAPER WRITING

II Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To equip the trainees with the critical thinking skills required for crafting research issues into researchable questions.
- To develop in them research paper writing skills in three areas – vocabulary, discourse, and style;
- To enhance their awareness of the referencing conventions vis-à-vis scholarly communication;
- To develop in them an understanding of the knowledge-constructing practices of their disciplines (under the guidance of a research mentor on an apprenticeship programme) and sharpen that understanding so as to enable them to identify research issues, investigate them, and then present and publish papers on them.

Course Outcomes

Upon successful completion of the course, the students will be able to

- craft research issues into researchable questions;
- write appropriate introductions and conclusions to academic / research texts;
- review research literature using the skills of analysis, synthesis, critical evaluation, paraphrasing, and summarising and avoiding the risk of plagiarism;
- use the right vocabulary for different research communication purposes, such as stating study aims, reviewing sources, describing research designs, presenting arguments, evaluating and emphasizing, and analysing and discussing results.
- organise texts following the discourse rules of coherence and cohesion;
- write research paper abstracts; and
- communicate their research in academic style with grammatical accuracy.

Course Content

UNIT–I:

Understanding Researchability: Evaluating research questions in order to gain awareness of researchability - Identifying research issues, developing research questions from them, and crafting them into researchable questions

Academic Vocabulary: Neutral, and formal vocabulary - Nominalisation - Phrases commonly used in research communication

UNIT–II:

Writing and Rhetorical Conventions: Writing introductions - Writing conclusions - Discourse organization

Academic Vocabulary: Research and Study aims.

UNIT–III:

Writing and Rhetorical Conventions: Summarising - Paraphrasing -

Academic Vocabulary: Evaluating and critiquing

UNIT–IV:

Writing and Ahetorical Conventions: Writing abstracts - Varying sentence length and structure

Remedial Grammar

UNIT–V:

Writing and Rhetorical Conventions: Avoiding repetition and redundancy - Style of academic / scholarly communication - Referencing

Academic Vocabulary: Analysing and discussing results

Apprenticeship

The apprenticeship will involve each individual trainee, under the guidance of a research mentor in his/her department, developing and crafting research questions on issues of his/her concern, investigating at least one of those issues during the course of the internship, and writing a paper on it which, before its presentation or publication, will be reviewed or assessed, as part of the internal assessment, by a panel of experts in the trainees' own departments. The entire process could be broken down into the following skills:

a. Identifying research issues
b. Framing the issues – developing research questions from them, refining them, and crafting them
c. Addressing literature
d. Investigating one of those issues by selecting an appropriate research design and data collection procedures and arriving at conclusions
e. Gaining competence in disciplinary specialized discourse conventions
f. Presenting arguments which scholars anticipate
g. Writing a paper on the study, presenting it before a panel of experts, and revising the paper on the basis of feedback from the panel
h. Determining the prestige of journals
i. Establishing a paper-journal fit and submitting the revised paper for publication
j. Learning to negotiate two principal audiences in one's scholarly communication – the community of scholars and journal gate-keepers
k. Negotiating peer review and editorial commentary

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Professional Elective - V

TIBOLOGY

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the selection of lubricating system for different machine components
- To impart knowledge on design of bearings for a given application.

Course Outcomes

Upon successful completion of the course, the students will be able to

- select the appropriate bearing lubricant for given application.
- select the rolling element bearing for the given conditions.
- design hydrostatic, hydrodynamic and air lubrication systems used in bearings.
- select a suitable seal for a given application.
- analyze the condition of bearing with the aid of instruments to avoid machine failure.

Course Content

UNIT–I:

Surfaces and Friction: Topography of engineering surfaces- Contact between surfaces, friction and wear mechanisms.

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

UNIT–II:

Selection of Rolling Element Bearings[#]: Nominal life, Selection of Bearing-type -Static and Dynamic Capacity-Equivalent Load, Bearing with Probability of Survival other than ninety percent - Cubic mean load -Pre-loading of bearings.

UNIT–III:

Hydrostatic Bearings[#]: Introduction to hydrostatic lubrication- Viscous Flow through Rectangular Slot, thrust bearings – Hydrostatic Circular Step Bearing - Load carrying capacity and energy losses and optimum design and Oil-film thickness. Aerostatic Bearing lubrication: Introduction, merits and demerits, applications, externally pressurized gas bearings.

UNIT–IV:

Hydrodynamic bearings[#]: Principles of hydrodynamic lubrication–mechanism of pressure development in the oil-film, Lubrication Regimes-Reynolds's equation

for two-dimensional flow; hydrodynamic journal bearings-Analysis of infinitely long and infinitely short bearings- Raimondi and Boyd solution-Sommerfeld Number-Performance Parameters– friction-heat generated and heat dissipated. Hydrodynamic thrust bearings- Analysis of plane slider bearing with fixed and tilting pads.

UNIT – V:

Seals: Different type-mechanical seals-essential properties of the seals, lip-ring seals, soft piston seals, Mechanical piston rod packing, labyrinth seal- packed glands- mechanical contact seals- selection of mechanical seals. Gaskets- oil flinger rings and drain grooves.

Failure of Tribological Components: Failure analysis of plain bearings, rolling bearings, gears and seals-

Vibration based condition monitoring: Vibration data collection; techniques; instruments; transducers; commonly bearing faults diagnosed by vibration analysis, shock pulse method.

Text Books

1. Rowe WW& O' Dionoghue, "Hydrostatic and Hybrid bearing design", Butterworths & Co. Publishers Ltd, 1st edition,1983,(UNITS-I,III,IV,V)
2. Collacott R.A, "Mechanical Fault diagnosis and condition monitoring", Chapman and Hall, London ,1st edition,1977.(UNITS-I,II)

Reference Books

1. Shigley J, E Charles, " Mechanical Engineering Design", McGraw Hill Co.,6th Edition.
2. Bernard J. Hamrock, "Fundamentals of fluid film lubricant", McGraw-Hill Co.,1st edition, 1994.(UNITS-I,II,III)
3. Neale MJ, (Editor) "Tribology hand Book" ,Neumann Butterworths,1975.
4. Connor and Boyd JJO (Editors) "Standard hand book of lubrication engineers" ASLE, McGraw Hill Book & Co.,1968.

Note: Design data book is allowed for examination

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Professional Elective - V

COMPOSITE MATERIALS

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with the concepts of composite materials, fabrication techniques and their properties.

Course Outcomes

Upon successful completion of the course, the students will be able to

- explain the fundamental concepts of composite materials.
- select a suitable technique for fabrication of composite material.
- determine the various properties of composite materials.
- choose a suitable technique to evaluate micro structural properties.

Course Content

UNIT–I:

Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.

Reinforcements: Carbon, boron, silicon carbide, and born carbide, Fibres- Glass, Silica, Kevlar, Natural fibres (cellulose, jute, coir etc).

UNIT–II:

Liquid State Fabrication Techniques: Stir Casting, Infiltration, Gas Pressure Infiltration, Squeeze Casting Infiltration, Pressure Die Infiltration, nano composites,

Manufacturing of Laminated composite plates:

Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

UNIT–III:

Solid State Fabrication Techniques: Powder Metallurgy, Hot Isostatic Pressing, Hot Forging (Powder Forging), Metal Injection Moulding (MIM), Diffusion Bonding, Vapour Deposition, Physical Vapour Deposition.

Solid State Fabrication Techniques: Friction Stir Welding – fabrication method – change of translational speed and rotational speed – nature of cooling system.

UNIT–IV:

Properties of composites: Rule of mixtures, ASTM standard specimens, determination of physical properties - density, mechanical properties –Tensile, compression, micro hardness, impact strength, wear properties and corrosion properties.

UNIT–V:

Microstructure Properties – Grain size, Micro Structure - X-ray diffraction (XRD), Transmission Electron Microscope (TEM), Scanning Electron Microscope (SEM), Electron microprobe analysis (EDAX).

Text Books

1. Krishan K. Chawla, "Composite Materials, Science and Engineering", Springer, 3rd Edition.
2. Suresh G. Advani, E. Murat Sozer, "Process Modelling in Composites Manufacturing", 2nd Ed. CRC Press, 2009.

Reference Books

1. Lawrence E. Nielsen, Nielson, Paul Nielsen, Mechanical Properties of Polymers and Composites, Second Edition, CRC press, 2000.
2. Steven L. Donaldson, "ASM Handbook Composites", Material Park, Ohio : ASM International, ©2001, [ie 10th ed.].

Awareness on solving problems by developing computer codes / mechanical engineering software tools is suggested.

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Open Elective

SUSTAINABLE DEVELOPMENT

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To help the students understand the fundamental key concepts on Sustainable Development (SD),suchasintra-andinter-generational equity, economic, social and environmental,sustainability, strong and weak sustainability, natural capitalism, steady state and green economy.
- To enable students to identify and discuss in detail the key empiricalissues on sustainable development, such as renewable energy transitions, urban agriculture and green architecture.
- To empower students with the expertise to distinguish between "greeneconomy" and "sustainability" and various efforts at multiple levels ofgovernance:from individual to governments.
- To exposestudents to awide varietyof research areas to apply and therefore appropriate the oretical knowledge on public policy and international relations to the issue area of sustainable development, insuch aspects as international aid, global climate change negotiations, the importance of international regimes as opposed to voluntary private governance.
- To empower Students to make their own lives more sustainable and join social movements to bring about more of sustainable development.

Course Outcomes

Upon successful completion of the course, the students will be able to

- gainknowledgeofsustainabilityandbiodiversity
- studyaboutgreenhousegases
- learndynamicsofsustainability
- gainKnowledgeonsocio-economicsystems
- studyabouttheconventionsonsustainabledevelopment
- learnconceptofSustainableDevelopmentanditsrolein buildingofenvironment

Course Content

UNIT–I: Concept of Sustainable Development

Definition of sustainability - History and emergence of the concept of Sustainable development – Our Common Future - Objectives of Sustainable Development - Millennium Development Goals - Environment and Development linkages – Globalization and environment - Population, Poverty and Pollution –Global, Regional

and Local environmental issues–Resource Degradation–Greenhouse gases and climate Change – Desertification – Industrialization –Socialinsecurity.

UNIT–II: Sustainability and thetriple bottom line

Components of sustainability–Complexity of growth and equity-Social, economic and environmental dimensions of sustainable development–Environment–Biodiversity–Natural Resources–Ecosystem integrity–Clean air and water–Carrying capacity–Equity, Quality of Life, Prevention, Precaution, Preservation and Public participation. - Structural and functional linking of developmental dimensions – Sustainability in national and regional context..

UNIT–III: Sustainable Development and International Response

Role of developed countries in the development of developing countries–International summits–Stock holm to Johannes burg–Rio Principles–Agenda 21-Conventions–Agreements–Tokyo Declaration-Doubling Statement - Trans boundary issues – Integrated approach for resource protection and management.

UNIT–IV: Sustainable Development of Socio-Economic Systems

Demographic dynamics of sustainability – Policies for socio-economic development –Strategies for implementing eco-development programmes – Sustainable development through trade – Economic growth – Action plan forimplementing sustainable development – Urbanization and Sustainable Cities –Sustainable Energy and Agriculture –Sustainable Livelihoods – Ecotourism.

UNIT–V: Framework for Achieving Sustainability

Sustainability indicators - Hurdles to Sustainability - Operational guidelines – Inter connected pre-requisites for sustainable development – Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry-Science and Technology for sustainable development – Performance indicators of sustainability and Assessment mechanism – Constraints and barriers for sustainable development.

Text Books

1. Austin, James and Tomas Kohn. 1990. Strategic Management in DevelopingCountries.TheFreePress.
2. Berger. 1994. “The Environment and the Economy.” In Smelser and Swedberg(eds.)
3. TheHandbookofEconomicSociology.RusselSageFoundation.D’Arcy,David. Transcript of broadcast, Dec. 5, 2002, “In Houston, a Treasure of ExiledAfghanArt,”National PublicRadio,

Reference Books

1. Elkington, John. Cannibals with Forks:TheTriple Bottom Line for 21stCenturyBusiness Oxford:Capstone Publishing,October 1997.
2. Guillen, Mauro and Sandra L. Suarez. 2002. “The Institutional Context of Multinational Activity.”In Organization Theory and the Multinational Corporation” .2ndedition. New York: St.Martin’s Press.

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Open Elective

ENERGY AUDIT, CONSERVATION & MANAGEMENT

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To learn principle of energy audit as well as management for industries and utilities and buildings.
- To study the energy efficient motors and lighting.
- To learn power factor improvement methods and operation of different energy instruments.
- To compute depreciation methods of equipment for energy saving.

Course Outcomes

Upon successful completion of the course, the students will be able to

- understand the principle of energy audit and their economic aspects.
- recommend energy efficient motors and design good lighting system.
- understand advantages to improve the power factor.
- evaluate the depreciation of equipment.

Course Content

UNIT–I: Basic Principles of Energy Audit

Energy audit- definitions, concept , types of audit, energy index, cost index ,pie charts, Sankey diagrams and load profiles, Energy conservation schemes- Energy audit of industries- energy saving potential, energy audit of process industry, thermal power station, building energy audit.

UNIT–II: Energy Management

Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting. Energy manager, qualities and functions, language,Questionnaire – check list for top management.

UNIT–III: Energy Efficient Motors and Lighting

Energy efficient motors, factors affecting efficiency, loss distribution, constructional details, characteristics – variable speed , variable duty cycle systems, RMS - voltage variation-voltage unbalanceover motoring-motor energy audit. lighting system design and practice, lighting control, lighting energy audit.

UNIT–IV: Power Factor Improvement and Energy Instruments

Power factor – methods of improvement, location of capacitors, Power factor with non-linear loads, effect of harmonics on p.f, p.f motor controllers – Energy

Instruments- watt meter, data loggers, thermocouples, pyrometers, lux meters, tongue testers,application of PLC s.

UNIT–V: Economic Aspects and their Computation

Economics Analysis depreciation Methods, time value of money, rate of return, present worth method, replacement analysis, lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method, net present value method-Power factor correction, lighting – Applications of life cycle costing analysis, return on investment.

Text Books

1. Energy management by W.R.Murphy&G.Mckay Butter worth, Heinemann publications, 1982.
2. Energy management hand book by W.CTurner, John Wiley and sons, 1982.

Reference Books

1. Energy efficient electric motors by John.C.Andreas, Marcel Dekker Inc Ltd-2nd edition,1995
2. Energy management by Paul o Callaghan, Mc-graw Hill Book company-1st edition, 1998
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO.

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Open Elective

RAPID PROTOTYPING

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- To familiarize with Rapid Prototype tools and techniques for design and Manufacturing.

Course Outcomes

Upon successful completion of the course, the students will be able to

- assess the need of RPT in Product development.
- use appropriate RT Software for development of Prototype model.
- judge the correct RP Process for Product/Prototype development.
- predict the technical challenges in 3D printing.
- list the applications of RPT.

Course Content

UNIT–I: Introduction to Rapid Prototyping

Introduction to prototyping, traditional prototyping Vs. rapid prototyping (RP), need for time compression in product development, usage of RP parts, generic RP process, distinction between RP and CNC, other related technologies, classification of RP.

UNIT–II: RP Software and Software Issues of RP

RP Software: Need for RP software, MIMICS, magics, surgiGuide, 3D-doctor, simplant, velocity2, voxim, solidView, 3Dview, etc., software.

Software Issues of RP: Preparation of CAD models, problems with STI, files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

UNIT–III: Photopolymerization RP Processes, Powder Bed Fusion RP Processes and Extrusion-Based RP Systems

Photopolymerization RP Processes: Sterolighography (SL), SL resin curing process, SL scan patterns, microstereolithography, applications of photopolymerization processes.

Powder Bed Fusion RP Processes: Selective laser sintering (SLS), powder fusion mechanism and powder handling, SLS metal and ceramic part creation, electron beam melting (EBM), applications of powder bed fusion processes.

Extrusion-Based RP Systems: Fused deposition modelling (FDM), principles, plotting and path control, applications of extrusion-based processes..

UNIT–IV: Printing RP Processes, Sheet Lamination RP Processes and Beam Deposition RP Processes

Printing RP Processes: 3D printing (3DP), research achievements in printing deposition, technical challenges in printing, printing process modeling, applications of printing processes.

Sheet Lamination RP Processes: Laminated Object Manufacturing (LOM), ultrasonic consolidation (UC), gluing, thermal bonding, LOM and UC applications.

Beam Deposition RP Processes: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), processing – structure - properties, relationships, benefits and drawbacks.

UNIT–V: Rapid Tooling, Errors in RP Processes and RP Applications

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, classification of rapid tooling, direct and indirect tooling methods, soft and hard tooling methods.

Errors in RP Processes: Pre-processing, processing, post-processing errors, part building errors in SLA, SLS, etc.,

RP Applications: Design, engineering analysis and planning applications, rapid tooling, reverse engineering, medical applications of RP.

Text Books

1. Chua Chee Kai., Leong KahFai., Chu Sing Lim, “Rapid Prototyping: Principles and Applications in Manufacturing”, World Scientific

Reference Books

1. Ian Gibsn., David W Rosen., Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010
2. Pham, D.T, Dimov, S.S, Rapid Manufacturing, Springer, 2001.

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Open Elective

AUTOMOTIVE ELECTRONICS

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- familiarize with the electronic systems inside automotive vehicle.
- introduce with the concepts of advanced safety systems

Course Outcomes

Upon successful completion of the course, the students will be able to

- learn the fundamentals of automotive technology.
- describe the operation of microcomputer systems.
- acquire knowledge in automotive sensors and control systems.
- develop communications & navigation/routing in automotive vehicles.

Course Content

UNIT–I: Automotive Fundamentals

Use of electronics in the automobile, evolution of automotive electronics, the automobile physical configuration, evolution of electronics in the automobile, survey of major automotive systems, engine control or electronic control unit, ignition system.

UNIT–II: Automotive Micro-Computer System

Binary number system, binary counters, Microcomputer fundamentals-digital versus analog computers, basic computer block diagram, microcomputer operations, CPU registers, accumulator registers, condition code register-branching; microprocessor architecture, memory-ROM, RAM; I/O parallel interface, digital to analog converter and analog to digital converters with block diagram.

UNIT–III: Basics of Electronics Engine Control

Motivation for electronic engine control, exhaust emissions, fuel economy, concept of an electronic engine control system, engine functions and control, electronic fuel control configuration, electronic ignition with sensors.

UNIT–IV: Sensors and Actuators

Introduction; basic sensor arrangement; types of sensors such as oxygen sensors, crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow sensors, throttle position sensors, solenoids, stepper motors, actuators – fuel metering actuator, fuel injector, and ignition actuator.

UNIT–V: Electronic Vehicle Management System and Automotive Instrumentation System

Cruise control system, antilock braking system, electronic suspension system, electronic steering control, and transmission control, safety: air bags, collision avoidance radar warning system with block diagram, low tire pressure warning system, advanced cruise control system.

Speech synthesis, sensor multiplexing, control signal multiplexing with block diagram, fibre optics inside the car, automotive internal navigation system, GPS navigation system, voice recognition cell phone dialling.

Text Books

1. William B. Ribbens, "Understanding Automotive Electronics", SAMS/Elsevier Publishing, 6th Edition. (UNITS I -V).
2. Robert Bosch Gambh, "Automotive Electrics Automotive Electronics Systems and Components", John Wiley& Sons Ltd., 5th edition, 2007.

Reference Books

1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
2. G. Meyer, J. Valldorf and W. Gessner, "Advanced Microsystems for Automotive Applications", Springer, 2009.
3. Robert Bosch, "Automotive Hand Book" SAE, 5th Edition, 2000.

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Open Elective

SOFT COMPUTING TECHNIQUES

III Semester

Lecture	: 3	Internal Marks	: 30
Credits	: 3	External Marks	: 70

Course Objectives

- Develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
- Introduce students to artificial neural networks and fuzzy theory from an engineering perspective

Course Outcomes

Upon successful completion of the course, the students will be able to

- comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
- understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic
- understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
- understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
- reveal different applications of these models to solve engineering and other problems.

Course Content

UNIT–I: Fuzzy Set Theory

Introduction to Neuro – Fuzzy and Soft Computing, Fuzzy Sets, Basic Definition and Terminology, Set-theoretic Operations, Member Function Formulation and Parameterization, Fuzzy Rules and Fuzzy Reasoning, Extension Principle and Fuzzy Relations, Fuzzy If-Then Rules, Fuzzy Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models, Surgeon Fuzzy Models, Tsukamoto Fuzzy Models, Input Space Partitioning and Fuzzy Modeling.

UNIT–II: Optimization

Derivative based Optimization, Descent Methods, The Method of Steepest Descent, Classical Newton's Method, Step Size Determination, Derivative-free Optimization, Genetic Algorithms, Simulated Annealing and Random Search – Downhill Simplex Search..

UNIT–III: Artificial Intelligence

Introduction, Knowledge Representation, Reasoning, Issues and Acquisition: Prepositional and Predicate Calculus Rule Based knowledge Representation Symbolic Reasoning under Uncertainty Basic knowledge Representation Issues Knowledge acquisition, Heuristic Search: Techniques for Heuristic search Heuristic Classification State Space Search: Strategies Implementation of Graph Search based on Recursion Patent directed Search Production System and Learning.

UNIT–IV: Neuro Fuzzy Modeling

Adaptive Neuro-Fuzzy Inference Systems, Architecture – Hybrid Learning Algorithm, Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling, Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

UNIT–V: Applications of Computational Intelligence

Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Color Recipe Prediction.

Text Books

1. J.S.R.Jang, C.T.Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI, 2004, Pearson Education 2004.
2. N.P.Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2006.

Reference Books

1. Elaine Rich & Kevin Knight, Artificial Intelligence, Second Edition, Tata Mcgraw Hill Publishing Comp., 2006, New Delhi.
2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw-Hill, 1997.
3. Davis E.Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.

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