MECHANICAL ENGINEERING

M.Tech.(Mechanical-Design Engineering)

Effective from A. Y. 2011-12

INDEX

List of Abbreviations

Sr. No.	Abbreviation	Stands for:
1	DEC	Departmental Elective Course
2	PCC	Program Core Course
3	LC	Laboratory Course
4	HSSC	Humanities and Social Science Course
5	MLC	Mandatory Learning Course
6	LLC	Liberal Learning Course
7	OEC	Open Elective Course
8	SEC	Science Elective Course
9	PSEC	Program Specific Elective Courses

M. Tech., RULES AND REGULATIONS
(Effective from 2011-12)

COLLEGE OF ENGINEERING, PUNE
Wellesley Road, Shivajinagar, Pune 411005

1. Rules

1.1 The Senate and BOG, College of Engineering, Pune, recommends University of Pune to award the degree of Master of Technology (M. Tech) in Engineering to those who have successfully completed the stipulated Postgraduate Masters Program.

1.2 The Postgraduate Masters Program with the governing Rules and Regulations are formulated & approved by the Senate and BOG of the institute. The Senate can modify or change the course structure, the governing rules and regulations from time to time and shall recommend them to BOG for its approval. These rules and regulations will be applicable to any candidate seeking admission for M. Tech/P.G. programme in the institute.

1.3 A candidate becomes eligible for the recommendation to the Pune University for the award of the M. Tech. degree after fulfilling all the academic requirements prescribed by the Senate of the Institute.

1.4 Director, COEP and Chairman Senate would appoint a Professor from the Institute to work as a Chairman of the PG admission committee on his/behalf. Chairman, PG Admissions would be responsible for the entire admission process including scrutiny of applications and conduct of entrance test, interviews of the candidates etc. He/she would be assisted by the respective departmental heads and departmental admission committee appointed by the Director.

2. CATEGORIES OF M. TECH. STUDENTS

The Institute admits M. Tech students under the following categories:

I) REGULAR (FULL-TIME)

These are students who work **full time** for their M. Tech. degree and receive assistantship from the Institute or any other recognized funding agency.

II) SPONSORED (FULL-TIME) STUDENTS

A candidate in the category is sponsored by a recognized R&D organization, national institute, governmental organization or industry for doing M.Tech in the Institute **on a full time basis**. He/she should have at least two years of working experience in the respective field. He/She will not receive any financial support from the Institute. Sponsorship letter (Form I) should be attached with the application. During the course of programme if a regular student secures a job and wishes to join the same, then he/she will be treated as a sponsored candidate and he/she will have to get the sponsorship letter from him employer. He/she would be charged institutional fees as for sponsored candidates.

III) PROJECT STAFF

This category refers to candidates who are working on sponsored projects in the Institute and admitted to the M. Tech. program. The duration of the project at the time of admission should be at least 2 years. This category of students may be registered on a full-time or a part-time basis.

IV) INSTITUTE FACULTY

This category refers to the candidates who are the staff of College of Engineering , Pune, who can attend classes at the Institute while employed. These candidates should be able to attend regular

classes as per the schedule of the Institute. The applicant must be a regular employee of the institute with at least two years of experience with the institute at the time of admission and be engaged in professional work in the discipline in which admission is sought. No financial assistance will be provided by the Institute to such students. A No Objection Certificate from the Head of the Department must be enclosed at the time of applying. This candidate would pay regular fees of the institute under full/part time student category and no concession in institute fees can be allowed.

V) FOREIGN STUDENTS

This category refers to all the Foreign Nationals, who are eligible for Admission to the M.Tech program and who have a certification from the Pune University Foreign Students Cell about their admissions to M.Tech. These students will submit a certificate from the Pune University certifying their Equivalence of Courses at undergraduate levels. These students will have to appear for the institute entrance examination and also a English language test, conducted by the institute. If these students fail in the English language test their applications will be rejected even though they pass in the institute admission test. No financial assistance of any sort will be available for these students. Before admission, these students will have to get a clearance about their background check by the Department of Home, Government of India. A candidate in this category will be admitted **on a full time basis** subject to compliance of various norms laid down by the competent authority from time to time.

3. MINIMUM QUALIFICATIONS

Students for admission to the M. Tech. Program in Engineering Departments must satisfy one of the following criteria:

(i) Bachelor's degree in Engineering/Technology or equivalent in an appropriate area, with a minimum of First Class/60% marks or CGPA of 6.5 on a scale of 10 or equivalent (CGPA of 6.00 or equivalent in case of SC / ST).

(ii) Valid GATE score for Regular (full-time) students.

Departments may specify additional requirements over and above these minimum requirements. All the Non-GATE candidates will have to undergo an entrance test conducted by department in which he/she is applying. Passing in this test will be mandatory for admission.

For the Foreign Students the criteria as in para 2(V) above will be applicable. For these students Institute Admission Test as well as English Test will be mandatory.

4. ADMISSION PROCEDURE

4.1 Admission to the M. Tech. Program of the Institute will normally be in the months of June/July every year. For admission an advertisement will be issued in the month of April/May in National level English news paper, State level Marathi News papers as well as on the Institute website.

4.2 Admission to all the category of students is granted on the basis of GATE scores and / or an interview / admission test held usually during the month of June or July every year. It will be mandatory for every candidate to appear for the Entrance Test and Interview. No absentia of any sort would be allowed.

4.3 The applicants who have completed or are likely to complete all the examinations including the thesis oral examination, viva etc. of the qualifying degree by the date of admission to the program may be considered for admission; however, if admitted, they must produce the evidence of their having passed the qualifying degree examination with the specified minimum marks/CPI (as specified in clause 3) within 8 weeks of the beginning of the semester, failing which their admission is liable to

be cancelled. In case of any dispute or discrepancy decision of the Director COEP and Ex-officio Chairman of the Senate will be final and shall be binding on the candidate.

4.4 Candidates seeking admission for the M.Tech course other than the area in which candidate has completed his/her bachelor's degree will be eligible to apply provided they have a valid GATE score in the area in which they wish to pursue their M.Tech. These candidate will not be eligible for the scholarships from the external funding agencies. These students will have to under go Institute Entrance Test/Interview conducted by the concerned department.

5. FINANCIAL SUPPORT

Students admitted to the M. Tech. Programs will be considered for assistantships, fellowships etc. subject to the following norms:

5.1 A student must have a valid GATE score at the time of admission.

5.2 Students receiving assistantship from the Institute or from any other funding agencies will be required to perform academic duties assigned to them by the departments as per rules in force from time to time.

5.3 The continuation of the assistantship/fellowship will be subject to satisfactory performance of the duties assigned by the department and satisfactory progress in the postgraduate program. Financial assistance of the candidates failing to secure minimum grades in the semester examination would be stopped without any prior notice.

5.4 Financial assistance will normally be for a maximum period of two years. In no case, it will be extended beyond 2 years.

5.5 No financial assistance from the Institute will be available to foreign students. Project staff will get funding from project as per rules but will not get any additional assistance from the Institute.

5.6 Only those students who are currently registered in the postgraduate program shall be entitled to scholarships. The students on leave longer than that specified under the leave rules, and those who are not registered are not entitled to scholarship.

6. LEAVE RULES

6.1 An M Tech student is eligible for maximum 30 days of leave in a calendar year.

6.1.1 The leave of 30 days includes medical and all other leaves, in an academic year. If any Saturday, Sunday or Holiday falls during the leave, they will be counted towards the leave except for such holidays prefixed or suffixed with the leave. **The accumulated leave can be availed during vacation only.**

6.1.2 Out of the 30 days of leave per annum, an M. Tech. Student will be permitted to avail maximum 15 days of leave on completion of each semester. However, any leave not availed at the end of any semester can be carried over to the next semester and the cumulative can be availed together, subject to a maximum of 30 days at a time.

6.1.3 During the semester period, (i.e. July – November and January – May), a student will be allowed only a maximum of 5 days of leave .

6.2 Absence without obtaining prior sanction of leave will be considered as an act of indiscipline and shall entail reduction of scholarship on a prorata basis, besides any other action that may be decided by the Institute.

6.3 Any absence over and above the prescribed limit of admissible leave shall entail deduction from the scholarship, besides other actions as may be decided by the Institute.

6.4 If a student remains absent or discontinues from the course for a period of more than 3 months his/her admission to the course will be automatically cancelled.
6.5 If a student is unable to complete his/her M.Tech within a period of two years, he/she must apply for permission for the extension of time by six months immediately after completion of two years, with recommendations of the concerned guide and head of the department to Dean Academics. Dean academics will seek the approval of the Director COEP and the Chairman, Senate for granting such extensions on case to case basis. Maximum two extensions of six months duration would be permissible for M.Tech student from any category of students as stipulated in Section(2) above. This extension period will not exceed the total period of three years from the date of admission of the candidate in the institute. Candidate will have to pay institute fees prevailing during this extension period.
6.6 If a student fails to complete his/her M.Tech within a period of four years from the date of admission for the course he/she will automatically cease to be a student of the institute and his/her admission would be automatically cancelled.

7. REGULATIONS

7.1 Rules and regulations

All the rules and regulations pertaining to academics, academic calendar, semesters, discipline etc. will be same as that of B.Tech. regulations.

7.2 Admission

Candidates whose selection is approved by the Chairman, Senate will be admitted to the M. Tech. program of the Institute after payment of the prescribed fees prevailing at the time of admission. BOG reserves the right to modify the Institute fees time to time.

7.3 Academic requirements

7.3.1 Semester load and course units

A semester load would be as per the Syllabus structure in force and as recommended/modified by the Senate from time to time. The minimum credit requirements for the successful completion of M.Tech. would be as specified in the syllabus structure prevailing at the time of admission for the course. The current minimum credits for the completion of M. Tech is 80 credits as specified in the syllabus structure. Any changes subsequently made by the Senate in the minimum credit requirements or syllabus structure will be applicable to only the new/fresh students and not applicable to the old candidates.

7.3.2 The residence requirements for students registered in M Tech. is four semesters. They will be required to complete a minimum credits of load as specified in the course structure in force. Every M Tech student must complete prescribed courses as specified in the syllabi structure. SGPA and CGPA will be calculated on the basis of all the courses taken by the student. No regular student/sponsored student/Research Staff/Institute Faculty/ Foreign student registered for the M Tech program shall continue in the program for more than 3 years after the first registration. The course and research requirements in individual departments/program may be over and above the minimum stated here. The departments/program shall obtain prior approval of the Senate of such requirements and will also inform the students in their postgraduate program at the time of their admission.

7.3.3 Grades and points

(a) The performance of the students in their course work will be evaluated in terms of letter grades: AA, AB, BB, BC, CC, CD, DD & F. These grades are equivalent to the following points/ratings on a 10 point scale representing the quality of performance.
AA = 10, AB = 9, BB = 8, BC = 7, CC = 6, CD = 5, DD = 4, FF = 0.
(b) If a student has done a part of the course work, but has for a genuine reason not been able to do the remaining part, the instructor may send the grade 'I' (incomplete). In this case the student must contact the Instructor soon after the examination and if the Instructor is convinced that the reasons for missing a part of the course/examinations are genuine he may let the student make up for the portion missed. The 'I' Grade can be converted into a regular grade by the Instructor within two weeks of the last date of the End Semester Examination. Otherwise, this will automatically be converted into 'F' Grade.

7.3.4. Academic performance requirements

(a) The SGPA (Semester Grade Point Average) or CGPA (Cumulative Grade Point Average) of a student in any particular semester is calculated as follows:
(i) The points equivalent to the grade awarded in each course for which the student has registered is multiplied by its unit rating.
(ii) These products are added and sum is divided by the total number of units. The ratio is the SGPA or CGPA depending on whether the number of units refer to those in that particular semester or to those in the total period of student's postgraduate program.
(b) **The minimum CGPA requirement for continuing in the M. Tech. program is 5.0**. However, M Tech student securing a CGPA between 4.5 and 5.0 may be allowed to continue in the following semester on the recommendation of the DPPC (Departmental Postgraduate Program Committee) and with approval of the Senate.
Students who secure a CGPA below 5.0 in two consecutive semesters will not be allowed to continue in the postgraduate program. Students must obtain a minimum CGPA of 5.0 in order to graduate. In the first semester in which the student registers the minimum CGPA (SGPA) requirement can be relaxed to 4.5.

7.3.5 Thesis/Project

(a) Project duration shall be one year or two semesters. Thesis supervisor(s) for a student will be appointed from amongst the faculty members of the College of Engineering, Pune. Departments will evolve modalities for appointing of supervisors keeping in view the students' aspirations and faculty interest. The DPPC will co-ordinate this activity and will formally communicate the appointment of thesis supervisor(s) of a student to the COE. No change/addition of Supervisor(s) is allowed after the thesis has been submitted to the academic section. In case there has been a change/addition in the Supervisor(s) the thesis will be submitted not earlier than three months from the date of communication of such change/addition to the academic section.

No student once registered for thesis/project units will be allowed to continue the program without a Thesis Supervisor having been appointed by the DPPC. No student will have more than two

supervisors. No change in thesis supervisor(s) will be allowed without the consent of the Chairman, DPPC. In exceptional cases, with prior approval of the Chairman, Senate on the recommendation of the DPPC and COE a student may be allowed to have a co-supervisor from outside the institute.

(b) Project evaluation:

Project evaluation shall be done in two phases in both the semesters. First phase of evaluation shall be in the middle of the semester and second phase of the examination shall be after the end-semester theory examination of the semester.

There will be separate grades awarded for the project course in two semesters. The credits in the first semester shall be relatively less and evaluation shall be based on the literature survey, problem definition, problem formulation, fabrication or software development and preliminary results.

A brief report is required to be submitted at the end of semester. The evaluation and grading will depend on the candidate's performance in the two phases of evaluation in the semester.

The second semester of the project shall carry relatively more weightage and the evaluation shall involve external examiners. The details are provided in the following sub-section.

(c) Thesis/Project Oral Examination Committee :

The thesis/project will be examined by an oral examination committee consisting of the supervisor(s) or in his/her absence the program co-ordinator with prior consent of the supervisor and at least two but not more than four other faculty members of the institute proposed by the thesis supervisor(s)/program co-ordinator in consultation with Head of the Department, recommended by the convener, DPPC and approved by the Dean Academics and COE. The thesis supervisor/program co-ordinator will act as the convener of the committee and one of the members of the committee will be an External Examiner as a part of the panel of examiners.

(d) The Convenor, DPPC will submit to the academic section for approval of the Chairman, DPPC the names of the thesis/project examiners on the prescribed form, at least two weeks before the submission of the thesis. Unbound typed copies of thesis/project one for each examiner prepared according to the prescribed format available in the academic section will be submitted at least one week before the probable date of the oral examination. The oral

examination will be held within two months from the date of submission of the thesis/project. If however the student does not make available for the examination, his/her program will be deemed to have been terminated. Request for revival of the program by such a student should be addressed to the Chairman, Senate.

The Department will record the date of submission of the thesis/project and arrange to send the thesis to the examiners. The supervisor/program co-ordinator will inform the examiners of the date of the oral examination and send a copy to the academic section. The thesis/project will be evaluated and the Oral Examination conducted by the Committee on the scheduled date. The report will be communicated by the Convener, DPPC to the academic section for record and necessary action.

The grade to be awarded to a student shall be evolved by the committee by consensus. The report of the oral examination committee including the grade shall be submitted to the Convenor, DPPC by the committee.

(e) Acceptance/Rejection of the Thesis/Project

A thesis/project will be considered to have been accepted if all members of the committee recommend its acceptance. Otherwise thesis/project will be considered to have been rejected. If a thesis/project is rejected along with a recommendation by the Committee for resubmission after incorporating and modification/correction suggested by the Committee, oral examination for the re-submitted thesis/project will be conducted by the same Committee unless otherwise approved by the Chairman Senate. If the resubmitted thesis/project is rejected, the matter will be reported to the Senate for appropriate action. Acceptance of thesis/project will be reported by the COE to the Senate for approval.

7.3.6. Provision for the Change of Guide

Project Guide may submit his request for change of guide to the HoD of the concerned department stating the reasons for the change request. HOD of the concerned department will forward the Application with his/her recommendations and name of the new proposed guide to the Dean Academics for the permission. Dean Academics in consultation with the Director, COEP and Chairman of the Senate may approve such applications.

Procedure for submission of M. Tech. Project Thesis and Oral Examination

1. The supervisor(s) shall be satisfied that the work has been completed. The supervisor(s) shall forward a list of examiners (comprising of at least two but not more than four faculty members from the department, in addition to the supervisor(s) and one member from outside the department or an external expert) through the Departmental PG Coordinator, to HOD.
2. The HOD will then forward the list of examiners to the Dean of Academics for the approval at least 15 days before submission of the thesis.
3. Following the approval, unbound copies of the thesis (one each for every examiner) shall be submitted to the Department (PG Coordinator) at least one week before probable date of the examination.
4. The PG Coordinator, will fix the date of oral examination, make an announcement (through notices and e-mail) and forward unbound copies of thesis to the examiners. The date of oral examination shall be communicated to the COE.
5. The oral examination of a M. Tech. Project shall be held as per announced schedule and it shall be an open one.
6. The Supervisor / PG Coordinator (if Supervisor is not available at the time of oral examination) shall be the convener of the oral examination committee. The committee shall evaluate the project of the candidate on the basis of presentation of the report, originality of the contents therein, demonstration of equipment model/ hardware/ software developed, the oral presentation and oral examination. In case the committee recommends a major revision and recommends a re-examination of the project, Grade "I" shall be awarded and the student shall be required to continue the project and resubmit the thesis within a period of two months. In case the committee rejects the thesis, Grade "F" shall be awarded and the student shall be required to re-register for the project in the next semester.
7. On successful completion of Oral Examination, each student shall submit bound copies of the thesis making corrections, if any, suggested by the examiners (one each to the supervisor(s), Academic

Section and the department). The academic section will forward the copy of the thesis/report to the Central library after verification.

8. The candidate should also submit a soft copy of the thesis in pdf format to the PG Coordinator who shall compile all the M. Tech project reports of the academic year of the department on a CD and same shall be placed in the dept library and institute website server.

FORM-I

Format of Certificate by the Employer/Management for Sponsored Candidates

This is to certify that ,

Shri./Smt._____

is working in this Institute as _____ since _____and he/she is permitted to study for **M.Tech program** at College of Engineering, Pune. If he/she is admitted to the said program, he/she will be permitted to attend the College as a full time student during the working hours of the College till completion of his/her program. We understand that he/she will fulfill institute norms for the attendance.

This is further to certify that he/she has been appointed on regular basis and his/her appointment is not temporary.

FORM II – APPLICATION FOR THE EXTENSION OF TIME

Reference No.
Date:
To
The Dean Academics,
College of Engineering , Pune

Sub : Grant of six months extension in order to complete M. Tech. Program

Dear Sir,

I of Mr./ Ms .....who is M.Tech student in .....Department and pursuing my M. Tech in .....specialization. I have joined the M.Tech. course in the academic year ..... . I am unable to complete my M.Tech. in the prescribed period of two years. I am aware that maximum duration of my M.Tech. course is four years and my admission for the M.Tech will get cancelled after a period of four years from the date of admission and no extension of time is permissible after three years.

I may be permitted Six months extension for completing M. Tech. Program at your Institute as a full - time student.

Date: Signature of the Student

Recommendation of the Project Guide

FORM III – Undertaking By the Full Time M.Tech (Non-Sponsored Student)

Reference No.
Date:
To
The Dean Academics,
College of Engineering , Pune

Sub : Undertaking by the M.Tech Students who is a Non-Sponsored Full Time Student

Dear Sir,

I of Mr./ Ms ..... is M.Tech student in ……..Department and pursuing my M. Tech in ……..specialization. I have joined the M.Tech course in the academic year …… .

I here by solemnly affirm that I am not in any sort of full time/Part Time or Visiting employment of any sort in any organization while joining my M.Tech as fulltime student. I do here by undertake that I will not engage myself in any sort of employment either fulltime/part time or visiting during my studentship as fulltime M.Tech student of College of Engineering, Pune, unless otherwise I am offered such privilege by COEP under a sponsored project.

I do understand that if I am found to indulge in such employment any time during my tenure as a Full Time M.Tech student of College of Engineering, Pune , my admission to M.Tech course will be immediately cancelled by the institute in addition to financial penalty and other disciplinary action initiated by Dean Academics, on behalf of the institute.

Date: Signature of the Student

Recommendation of the HOD

M Tech (Mechanical)
Specialization: Design Engineering

Structure

Semester I

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	IS 501	Open Elective I (Maths Dept.)	3	--	--	3
2.	DE501	Stress Analysis	3	--	--	3
3.	DE503	Advanced Vibration and acoustics	3	--	--	3
4.	DE505	Computer Aided Design	3	--	--	3
5.	DE507	Elective - I *	3	--	--	3
6.	DE509	Seminar	--	--	3	2
7.	DE511	Lab Practice I	--	--	6	3
		Total	**15**	**--**	**9**	**20**

Semester II

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
9.	IS502	Open Elective II (FE & BE methods)	3	-	--	3
10.	DE502	Analysis and synthesis of mechanisms	3	-	--	3
11.	DE 504	Fracture Mechanics	3	-		3
12.	DE506	Optimization Techniques in design	3	-		3
13.	DE508	Elective - II *	3	-	--	3
14.	DE510	Lab Practice II	-	-	6	3
15.	ML504	Intellectual Property Rights	1	-	-	1
16.	DE512	Mini project/internship	-	-	2	1
		Total	16		**8**	**20**

Semester-III

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	ML603	Environmental Studies	2	--	--	2
2	ML601	Constitution of India	2	--	--	2
3	DE 601	Dissertation-I				16
		Total	--	--	--	20

Semester-IV

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1	DE602	Dissertation-II	--	--	--	20
		Total	--	--	--	20

Environmental Studies during the undergraduate program: Environmental Studies is replaced by Humanities/social science course of credit 3 and constitution of India is replaced by any LLC of credit 1.

(PCC) DE-501: STRESS ANALYSIS

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2- 20 marks, End Sem 60 marks

Course outcomes:

- Students will understand the tensorial approach of continuum mechanics and comprehend modern research material.
- Student will learn basic field equations such as equilibrium equations, compatibility and constitutive relationship.
- Students will be able to apply basic field equations to torsion, bending and two dimensional problems, energy methods and plastic hinges.
- Students will be proficient in using FEM software packages with framing correct boundary conditions.

Syllabus Contents:

Continuum & Tensors, Stress tensor, Displacement and strains, compatibility, Conservation Laws, Constitutive relations and Linear Elasticity, Two dimensional problems, Torsion, Bending, Energy methods, Plasticity in structures, Thick cylinders and Disks, Contact stresses

References:

- Sadd, Martin H., Elasticity: Theory, applications and Numerics, Academic Press 2005 (Text Book)
- Boresi, A.P. and K. P. Chong, Elasticity in Engineering Mechanics, Second Edition, John Wiley & Sons, 2000
- Budynas, R. G. Advance strength and Applied Stress Analysis, Second Edition, WCB/ McGraw Hill 1999
- Dally, J. W. and W.F. Riley, Experimental Stress Analysis, McGraw Hill International, Third Edition, 1991

(PCC) DE-505: COMPUTER AIDED DESIGN

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2- 20 marks, End Sem 60 marks

Course outcomes:

At the end of the course students will

- Have a conceptual understanding of the principles of CAD systems, the implementation of these principles, and its connections to CAM and CAE systems.
- understand 2D, 3D transformations and projection transformations
- get knowledge of various approaches of geometric modeling
- understand mathematical representation of 2D and 3D entities
- understand basic fundamentals of FEM

Syllabus Contents:

Unit 1: CAD Hardware and Software, Types of systems and system considerations, input and output devices, hardware integration and networking, hardware trends, Software modules,

Unit 2: Computer Communications, Principle of networking, classification networks, network wring, methods, transmission media and interfaces, network operating systems,

Unit 3: Computer Graphics Introduction, transformation of geometric models: translation, scaling, reflection, rotation, homogeneous representation, concatenated transformations; mappings of geometric models, translational mapping rotational mapping, general mapping, mappings as changes of coordinate system; inverse transformations and mapping;

Unit 4 : Projections of geometric models, orthographic projections, Geometric Modeling, curve representation: Parametric representation of analytic curves, parametric representation of synthetic curves, curve manipulations. Surface representation,

Unit 5 : Fundamentals of solid modeling, boundary representation (B-rep), Constructive Solid Geometry (CSF), sweep representation, Analytic Solid Modeling (ASM), other representations; solid manipulations, solid modeling based applications: mass properties calculations, mechanical tolerancing, etc.

Unit 6: Finite Element Modeling and Analysis, Finite Element Analysis, finite element modeling, mesh generation mesh requirements, semiautomatic methods, fully automatic methods, design and engineering applications, System Simulation, Need of simulation, areas of applications, when simulation is appropriate tool / not appropriate, concept of a system, components of a system, discrete and continuous systems, model of a system, types of models, types of simulation approaches

References:

- Ibrahbim Zeid, “CAD / CAM Theory and Practice”.
- Jim Browne, “Computer Aided Engineering and Design”.
- P. Radhakrishnan / V. Raju / S. Subramanyam, “CAD / CAM / CIM”.
- P.N. Rao, “CAD / CAM principles and applications”, Tata Mcraw-Hill, 2002.
- Rogers / Adams, “Mathematical Elements for Computer Graphics”.
- Rooney and Steadman, “Principles of Computer Aided Design”, Aug. 1993.

(PCC) DE-503: ADVANCED VIBRATION AND ACOUSTIC

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2- 20 marks, End Sem 60 marks

Course outcomes:

- The students will be able to model a given vibratory system as SDOF or MDOF system, with or without damping. He would also identify the type of given base or force excitation as periodic or aperiodic. He would be able to

write, mathematically, the excitations of the types such as impulse, step, ramp, half sinusoidal, or such simple arbitrary excitations.

- The student will be able to predict response of a SDOF system, damped or undamped, subjected to simple arbitrary base or force excitations mentioned above using convolution integral; They will be able to obtain Shock Response Spectrum of SDOF systems for such excitations and understand use of the SRS.
- The students will be able to write differential equations of motion for MDOF systems, and through the technique of decoupling and orthogonal properties of natural modes, should be able to obtain the eigen-values and mode shapes of natural vibrations and response to harmonic and arbitrary excitations.
- The students will be able to obtain the eigen-values and mode shapes of natural vibrations and response to harmonic excitations using orthogonal properties of natural modes.
- Student will be able to obtain natural frequencies and mode shapes of MDOF and continuous systems using computational methods such as Rayleigh-Ritz method, Holzer method, Dunckerley's method, and Stodola's method.
- The student should be able to obtain natural frequencies and mode shapes of MDOF and continuous systems and their response to harmonic excitation using MATLAB
- Student will know various terminologies used in acoustics and acoustic wave transmission.
- The student will able to derive plane and spherical wave equations, and will be able to obtain sound pressure level at a given distance from a simple sound source of known strength.
- Students will be able to understand the mechanism of hearing by human and principles of Psychoacoustics and noise control.
- The student will be able to measure and analyze signals received from vibrating and/or noise radiating structure by use of accelerometers, microphones and signal analyzer. They should be able to carry out FFT analysis and know the dominant frequency components in the signal and their correlation with the vibration of the structure. They should be able to identify correlation between two signals being received from two sources.

Syllabus Contents:

Unit 1 Transient Vibrations, Response of a single degree of freedom system to step and any arbitrary excitation, convolution (Duhamel's) integral, impulse response function

Unit 2 Multi degree of freedom systems, Free, damped and forced vibrations of two degree of freedom systems, Eigen values and Eigen vectors, normal modes and their properties, mode summation method, use of Lagrange's equations to derive the equations of motion,

Unit 3 Continuous Systems, Vibrations of strings, bars, shafts and beams, discretised models of continuous systems and their solutions using Rayleigh – Ritz method, Mode summation method,

Unit 4 Vibration Control, Methods of vibration control, Non-linear vibrations, Systems with non-linear elastic properties, principle of superposition, Numerical and computer methods in vibrations: Rayleigh, Rayleigh-Ritz and Dunkerley's

methods, matrix iteration method for eigen-value calculations, Holzer's method,
Unit 5 Plane and Spherical acoustic waves, Transmission Phenomena, transmission from one fluid medium to another, normal incidence, reflection at the surface of a solid, standing wave patterns, transmission through three media, Resonators and filters, Absorption of sound waves in fluids : Phase log between pressure and condensation, viscous absorption of plane waves, heat conduction as a source of acoustic attenuation,
Unit 6 Speech, Hearing and Noise, The voice mechanism, acoustic power output of a speech, anatomy of the ear, mechanism of hearing, thresholds of the ear, loudness, pitch and timbre, beats, aural harmonics and combination tones, masking by pure tones, masking by noise.

References:

- Thomson W.T., "Theory of Vibrations with applications", George Allen and Unwh Ltd. London, 1981.
- S.S. Rao, Addison, "Mechanical Vibrations", Wesley Publishing Co., 1990.
- Leonard Meirovitch, "Fundamentals of vibrations", McGraw Hill International Edition.
- S. Timoshenko, "Vibration problems in Engineering", Wiley, 1974.
- Lawrence E. Kinsler and Austin R.Frey, "Fundamentals of acoustics", Wiley Eastern Ltd., 1987.
- Michael Rettinger, "Acoustic Design and Noise Control", Vol. I & II. , Chemical Publishing Co., New York, 1977.

(PSEC) DE-513: ADVANCED MACHINE DESIGN

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2- 20 marks, End Sem 60 marks

Course outcomes:

- Students will realize that creativity, manufacturability, assembly, maintainability, emotions, reliability are also important aspects of design other than finding dimensions and stresses in the highly competitive, dynamic and customer centered market.
- Students will demonstrate the ability to identify needs of the coustomer and convert them in to technical specifications of a product.
- Students will be able to generate different ideas after identifying the need and determining the specifications and constraints of a product for a particular purpose.
- Students will understand the principals used while designing for manufacture, assembly, emotions and maintenance.
- Students will know various methods of rapid prototyping the products to test and modify the designs.
- Students will be able to design the components considering strength based reliability.

Syllabus Contents:

Unit 1 : Development processes and organizations, Product Planning generation and selection, evaluation, creativity methods, Concept testing
Unit 2: Need Identification and problem definition, product specification, concept
Unit 3 : Design for manufacture, assembly, maintenance, casting, forging,
Unit4: Design for Reliability, strength based reliability, parallel and series systems, robust design,
Unit 5: Industrial design: Design for Emotion and experience, Introduction to retrofit and Eco design, Human behavior in design Unit 6: Rapid Prototyping

.

References:

- George E Dieter, "Engineering Design", McGraw Hill Company, 2000.
- Prashant Kumar, "Product Design, Creativity, Concepts and Usability", Eastern Economy Edition, PHI New Delhi. 2012
- Woodson T.T., "Introduction to Engineering Design", McGraw Hill Book Company, 1966.
- John J.C. "Design Methods", Wiley Inter science, 1970.
- Averill M. Law and W. David Kelton "Simulation, modelling and analysis", McGraw Hill Book Company, 1991.
- Pahl, G.and W.Beitz, *Engineering Design–A Systematic Approach* – Springer, 2nd Ed., 1996.
- Product Design and development Karl T. Ulrich, Steven Eppinger

(OEC) IS-501: ADVANCED MATHEMATICS

Teaching Scheme	Examination Scheme
Lectures:3 hrs/week	T1, T2- 20 marks, End Sem 60 marks

Course outcomes:

At the end of the course students will understand

- the basic optimization techniques
- importance of reliability theory
- numerical methods used to solve ordinary and partial differential equations which will help them to solve many application problems in engineering, especially those which involve experimental data
- use of statistical quality control in engineering

Syllabus Contents:

Unit 1: Numerical Methods for Differential Equations:Numerical solutions to the ordinary differential equations of first and second order with intial and boundary conditions, Picard's Method, Taylor's Method, Euler's Method, modified Euler's Method, Milne's Method and Runge-Kutta Method
Numerical solutions to the partial differential equations: Finite difference equivalence to partial derivatives, elliptical, parabolic and hyperbolic equations,

applications to one dimensional and two dimensional equations, Schmidt and Crank-Nicholson's Method. **Unit 2:** Optimization Techniques:
Introduction, Statement of optimization problem, Engineering Applications, classification of optimization, Single variable and Multivariable of Optimization with no constraints, Multivariable of Optimization with Equality constraints, Multivariable of Optimization with Inequality constraints **Unit 3:** Linear Programming Problems:Introduction and formulation of the problem, graphical method, simplex method, duality concept in LPP and solution of the dual. **Unit 4:** Statistical Quality Control: Introduction, control charts of all types, ISO 9000 series and their importance, OC curves advantages and limitations of SQL in industries. **Unit 5 :** Reliability Theory: Theory of reliability, maintainability, availability, failure distribution, MTTF, MTBF, Hazard rate, Bath tub curve, state dependent systems, series and parallel connections, redundancy of systems

References:

- Numerical Mehods – S. S. Sastry
- Statistical methods- S. P. Gupta
- Reliability and Maintainability Engineering-Charles Ebeling
- Operations Research- S. D. Sharma
- Theory and Problems in Numerical Methods – T. Veerarajan, T.Ramachandran
- Higher Engineering Mathematics – B.V.Ramana
- Engineering Optimization – S.S.Rao
- Probability and Statistics in Engineering – W.W.Hines et al

LC DE 509: SEMINAR

Teaching: 1hr/week

Assessment: End Sem : 100

Course outcomes:

At the end of the course students will

- Develop self learning attitude.
- Interact with various libraries, resource persons to get information about a selected topic.
- Be familiar with various refereed national/international journals.
- Improve their oral and written communication skills and will be conversant with technical writing.

Seminar shall consists of the in depth study of a topic, related to the field of Design engineering and should have research orientation. The student should know recent developments and applications in the chosen field of study. The topic of study/research is mutually decided by the student and the supervisor and a detailed technical report will be prepared. The study is to be presented in front of the committee of examiners, faculty and students of the department. The committee of examiners is decided by the PG coordinator and the Head of the department of Mechanical engineering.

LC DE511: Lab Practice I

Teaching:
2hrs/week

Assessment:
End Sem : 100

Course outcomes:

At the end of the course students will

- Be able to undertake experimental techniques in various core subjects.
- Be able to comprehend modern research topics through assignments
- Be exposed to research environment through experimentation
- Work with others in multidisciplinary environment.
- The lab practice consists of experiments, tutorials and assignments decided by the course supervisors of the program core courses and program specific elective courses.

(OEC) IS-502: FINITE ELEMENT AND BOUNDARY ELEMENT METHODS

Teaching Scheme
Lectures:3hrs/week

Examination Scheme
T1, T2- 20 marks, End Sem 60 marks

Course outcomes:

For one and two dimensional, linear, static and dynamic problems in Structural Mechanics and Heat Transfer, the student will be able to demonstrate the learning outcomes as mentioned below:

- The student will be able to classify a given problem on the basis of its dimensionality as 1-D, 2-D, or 3-D, time-dependence as Static or Dynamic, Linear or Non-linear.
- The students will be able to develop system level matrix equations from a given mathematical model of a problem following the Galerkin weighted residual method or principle of stationary potential.
- While demonstrating the process mentioned in 2 above, he will be able to identify the primary and secondary variables of the problem and choose correct nodal degrees of freedom and develop suitable shape functions for an element, implement Gauss-Legendre scheme of numerical integration to evaluate integrals at element level, and assemble the element level equations to get the system level matrix equations. He will also be able to substitute the essential boundary conditions correctly and obtain the solution to system level matrix equations to get the values of the field variable at the global nodes.
- The student will be able to state three sources of errors in implementing FEM and suggest remedies to minimize the same for a given problem, viz. Modeling errors, Approximation errors, and numerical errors.
- The student will be able to obtain consistent and lumped mass matrices for axial vibration of bars and transverse vibration of beams and obtain fundamental frequency of natural vibration using the methods mentioned in the curricula.

- The students will be able use MATLAB for implementation of FEM to obtain elongations at nodes of a bar subjected to traction and concentrated loads and prescribed boundary conditions
- The students will be able to use commercial software like ANSYS or ABAQUS for implementation of FEM to obtain stress concentration due to a small hole in a rectangular plate subjected to traction on edges and concentrated loads at points on the edges and prescribed boundary conditions
- The student will be able to apply principles of boundary element method to solve field problems

Syllabus Contents:

Unit 1 Introduction, steps in finite element method, discretisation, types of elements used, Shape functions

Unit 2 Linear Elements, Local and Global coordinates, Nodal degrees of freedom, Finite element formulation - variational, weighted residual and virtual work methods

Unit 3 Field problems, conduction heat transfer, electromagnetic and electrostatic fields, Quasi harmonic equation, Axisymmetric field problems, computer implementation,

Unit 4 Higher order elements, isoparametric version, Serendipity elements – Derivation of shape functions, h and p methods of improve
ements of accuracy, Criteria of making a choice between them , error analysis

Unit 5 Application to non-linear problems, solution to Nervier Strokes equations, phase change, radiation, temperature dependant materials, stress analysis in simple cases, axisymmetric solids, stress concentration factors,

Unit 6 Boundary element approach, numerical implementation, analyzing time domain, boundary element formulation, discretisation and matrix formulation, adaptive mesh refinement.

References:

- Cook R.D. “Concepts and applications of finite element analysis” Wiley, New York, 1981.
- Bathe K.J., Cliffs, N.J. “Finite element procedures in Engineering Analysis”, Englewood. Prentice Hall, 1981.
- Desai C.S. and J.F. Abel “Introduction to the finite element method.” New York, Van Nostrand Reinhold, 1972.
- Chandrupatla and Belegundu “Introduction to finite elements in Engineering”, Prentice Hall of India Pvt. Ltd. New Delhi, 2001.
- O. P. Gupta, “Finite and boundary element methods in Engineering”, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2000.

PCC DE-502: ANALYSIS AND SYNTHESIS OF MECHANISMS

Teaching Scheme
Lectures:3 hrs/week

Examination Scheme
T1, T2- 20 marks, End Sem 60 marks

Course outcomes:

At the end of the course, students will be able

- To develop analytical equations describing the relative position, velocity and acceleration of all moving links.
- To select, configure, and synthesize mechanical components into complete systems.
- Use kinematic geometry to formulate and solve constraint equations
- to design linkages for specified tasks.
- Formulate and solve four position synthesis problems for planar and spherical four-bar linkages by graphical and analytical methods.
- Analyze and animate the movement of planar and spherical four-bar linkages.
- students will be able to apply modern computer-based techniques in the selection, analysis, and synthesis of components and their integration into complete mechanical systems.
- Finally Students will demonstrate ability to think creatively, participate in design challenges, and present logical solutions.

Syllabus Contents:

Unit 1 Basic Concepts; Definitions and assumptions; planar and spatial mechanisms; kinematic pairs; degree of freedom; equivalent mechanisms; Kinematic Analysis of Planar Mechanisms. Review of graphical and analytical methods of velocity and acceleration analysis of kinematically simple mechanisms, velocity-acceleration, analysis of complex mechanisms by the normal acceleration and auxiliary-point methods. **Unit 2** Curvature Theory: Fixed and moving centrodes, inflection circle, Euler-Savary equation, Bobillier constructions, cubic of stationary curvature, Ball's point, Applications in dwell mechanisms. **Unit 3** Kinematic Synthesis of planar mechanisms, accuracy (precision) points, Chebesychev spacing, types of errors, Graphical synthesis for function generation and rigid body guidance with two, three and four accuracy points using pole method, centre and circle point curves, Analytical synthesis of four-bar and slider-crank mechanisms. **Unit 4** Freudenstein's equation, synthesis for four and five accuracy points, compatibility condition, synthesis of four-bar for prescribed angular velocities and accelerations using complex numbers, three accuracy point synthesis using complex numbers.**Unit 5** Coupler Curves : Equation of coupler curve, Robert-Chebychev theorem, double points and symmetry. **Unit 6** Kinematic Analysis of Spatial Mechanisms, Denavit-Hartenberg parameters, matrix method of analysis of spatial mechanisms

References:

- R.S. Hartenberg and J. Denavit, "Kinematic Synthesis of Linkages", McGraw-Hill, New York, 1980.
- Robert L.Nortan ,"Design of Machinery',Tata McGraw Hill Edition
- Hamilton H.Mabie,"Mechanisms and Dynamics of Machinery",John Wiley and sons New York

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

PCC DE-504: FRACTURE MECHANICS

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
T1, T2- 20 marks, End Sem 60 marks

Course outcomes:

At the end of the course,

- Students will be able to use any one of the four parameters for finding out damage tolerance: stress intensity factor, energy release rate, J integral, Crack tip opening displacement.
- Students will be able to manage singularity at crack tip using complex variable.
- Students will understand important role played by plastic zone at the crack tip.
- Students will learn modern fatigue and will able to calculate the fatigue life of a component with or without crack in it.
- Students will learn modern sophisticated experimental techniques to determine fracture toughness and stress intensity factor.

Syllabus Contents:

Unit 1: Modes of fracture failure, Brittle and ductile fracture, Unit 2: Energy release rate: crack resistance, stable and unstable crack growth. Unit 3 Stress intensity factor: Stress and displacement fields, edge cracks, embedded cracks. Unit 4: Crack tip plasticity: Shape and size of plastic zone, effective crack length, effect of plate thickness, J-Integral. Crack tip opening displacement. Unit 5: Test methods for determining critical energy release rate, critical stress intensity factor, J-Integral. Unit 6: Fatigue failure: Crack propagation, effect of an overload, crack closure, variable amplitude fatigue load. Environment-assisted cracking. Dynamic mode crack initiation and growth, various crack detection techniques.

References:

- Brook D, “Elementary engineering fracture mechanics”.
- Liebowitz H., “Fracture” Volume I to VII.
- A Nadai, W. S. Hemp, “Theory of flow and fracture of solids”, McGraw Hill Book Company, 1950.

PCC DE-506: OPTIMIZATION TECHNIQUES IN DESIGN

Teaching Scheme	Examination Scheme
Lectures: 3 hrs/week	T1, T2- 20 marks, End Sem 60 marks

Course outcomes:

At the end of the course:

- Students will know the principles of optimization.
- Students will have knowledge of algorithms for design optimization
- Students will be able to formulate an optimization problem.
- Students should be able to find the optimum solution of their problems using optimization techniques.

Syllabus Contents:

Unit 1: Introduction to optimization, classification of optimisation problems, classical optimisation techniques, Unit 2: Linear programming, simplex method and Duality in linear programming, sensitivity or post-optimality analysis, Karmarkar's methods, Unit 3: Non-Linear Programming: - One dimensional minimization, unconstrained and constrained minimization, direct and indirect methods, Unit 4: Geometric programming, Optimum design of mechanical elements like beams, columns, gears, shafts, etc.Unit 5: Introduction to Genetic Algorithms, Operators, applications to engineering optimization problems.

References :

1. S. S. Stricker, "Optimising performance of energy systems" Battelle Press, New York, 1985.
2. R.C. Johnson, "Optimum Design of Mechanical Elements", Willey, New York, 1980.
3. J. S. Arora, "Introduction to Optimum Design", McGraw Hill, New York, 1989.
4. Kalyanmoy Deb, "Optimization for Engineering Design", Prentice Hall of India, New Delhi, 2005
5. L.C.W. Dixon, "Non-Linear Optimisation - Theory and Algorithms", Birkhauser, Boston, 1980.
6. R.J. Duffin, E.L. Peterson and C.Zener "Geometric Programming-Theory and Applications", Willey, New York, 1967.
7. G.B. Dantzig "Linear Programming and Extensions Princeton University Press", Princeton, N. J., 1963.
8. R. Bellman "Dynamic Programming-Princeton" University Press, Princeton, N.J. 1957.

PSEC DE-516: MECHANICS OF COMPOSITE MATERIALS

Teaching Scheme	Examination Scheme
Lectures:3 hrs/week	T1, T2- 20 marks, End Sem 60 marks

Course outcomes:

At the end of the course,

- Student will be able to understand the basic concepts and difference between composite materials with conventional materials.
- Students will be able to understand role of constituent materials in defining the average properties and response of composite materials on macroscopic level.
- Students will be able to apply knowledge for finding failure envelopes and stress-strain plots of laminates.
- Students will be able to develop a clear understanding to utilize subject knowledge using computer programs to solve problems at structural level.

Syllabus Contents:

Unit1: Definition and characteristics, Overview of advantage and limitations of composite materials, Significance and objectives of composite materials, Science and technology, current status and future prospectus **Unit 2.** Structural performance of conventional material, Geometric and physical definition, Material response, Classification of composite materials, Scale of analysis; Micromechanics, Macromechanics, Basic lamina properties, Constituent materials and properties, Properties of typical composite materials**Unit 3.** Stress-strain relations, Relation between mathematical and engineering constants, transformation of stress, strain and elastic parameters **Unit 4.** Micromechanics of failure; failure mechanisms, Macromechanical strength parameters, Macromechanical failure theories, Applicability of various failure theories **Unit 5.** Basic assumptions, Strain-displacement relations, Stress-strain relation of layer within a laminate, Force and moment resultant, General load–deformation relations, Analysis of different types of laminates **Unit 6.** Hygrothermal effects on mechanical behavior, Hygrothermal stress-strain relations, Hygro-thermoelastic stress analysis of laminates, Residual stresses, Warpage **Unit 7.** Types of failures, Stress analysis and safety factors for first ply failure of symmetric laminates, Micromechanics of progressive failure; Progressive and ultimate laminate failure, Design methodology for structural composite materials

References:

- Isaac M. Daniels, Ori Ishai, “Engineering Mechaincs of Composite Materials”, Oxford University Press, 1994.
- Bhagwan D. Agarwal, Lawrence J. Broutman, “Analysis and Performance of fiber composites”, John Wiley and Sons, Inc. 1990.
- Mathews, F. L. and Rawlings, R. D., “Composite Materials: Engineering and Science”, CRC Press, Boca Raton, 2003.
- Madhujit Mukhopadhyay, “Mechanics of Composite Materials and Structures”, University Press, 2004.

- Mazumdar S. K., “Composaite Manufacturing – Materials, Product and Processing Engineering”, CRC Press, Boca Raton, 2002.
- Robert M. Jones, “Mechanics of Composite Materials”, Taylor and Francis, Inc., 1999.

MLC ML-504: Intellectual Property Rights

Teaching Scheme	Examination Scheme
Lectures : 1 hr/week	T1, T2 20 marks each, End-Sem Exam 60

Course Outcomes:

After learning this course students will be able to

a. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
b. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
c. Understand how IP is an important element of the institutional fabric of an efficiently organized society.
d. Understand that Intellectual property is about preserving the differences between competitors.
e. Understand that Intellectual property right (IPR) is an attempt to safeguard the rights of original contributor of ideas, concept, and creativity of individuals.
f. Understand that how at present, IPR are regarded as a source of national wealth and mark of an economic leadership in the context of global market scenario.
g. understand the national IP system.
h. Got familiarized with the origins and the development of the international framework of IP
i. Created internal vigilance and enlightenment among students to generate new ideas.
j. makes students understand that things are dynamic and more complex than they appear which reinforces the motivation of the students to learn
k. Students find answers to many of the whys and why not’s.
l. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.
m. As such the importance to emphasis the need of awareness and knowledge about IPR in engineering students, who are tomorrow’s technocrats and creator of new technology

(2 Hrs)

Introduction: Nature of Intellectual Property: Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

(2 Hrs)

International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

(3 Hrs)

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

(3 Hrs)

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

Registered and unregistered trademarks, design, concept, idea patenting. **(3 Hrs)**

Reference:

- Industrial Design by Mayall, Mc Graw Hill
- Resisting Intellectual Property by Halbert,Taylor & Francis Ltd,2007
- Product Design by Niebel, Mc Graw Hill
- Introduction to Design by Asimov, Prentice Hall
- Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley
- Intellectual Property Rights Under WTO by T. Ramappa, S. Chand.

LC DE512: MINI PROJECT/INTERNSHIP

Teaching:	**Assessment:**
2hrs/week	End Sem 100

Course outcomes:

- Students will get an opportunity to work in actual industrial environment if they opt for internship.
- In case of mini project, they will solve a live problem using software/analytical/computational tools.
- Students will learn to write technical reports.
- Students will develop skills to present and defend their work in front of technically qualified audience.

Students can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

The mini project should not be related to the Dissertation to be done in III rd and IVth semester.

LC DE510 : LAB PRACTICE II

Teaching:
2hrs/week

Assessment:
100 marks

Laboratory Outcomes:

Same as Labwork I

List of Experiments /Assignments:

The lab practice consists of experiments, tutorials and assignments decided by the course supervisors of the program core courses.

PSEC DE514:TRIBOLOGY IN DESIGN

Teaching Scheme
3hrs/week

Examination Scheme
T1, T2- 20 marks, End Sem 60 marks

Course outcomes:

At the end of the program:

- The students will be able to apply theories of friction and wear to various practical situations by analysing the physics of the process.
- They will understand the various surface measurement techniques and effect of surface texture on Tribological behaviour of a surface.
- They will be able to select materials and lubricants to suggest a tribological solution to a particular situation.
- The students will be able to design a hydrodynamic bearing using various bearing charts.
- The students will be able to understand the recent developments in the field and understand modern research material.

Syllabus Contents:

Unit 1: Friction, theories of friction, Friction control, Surface texture and measurement, genesis of friction, instabilities and stick-slip motion.**Unit 2:** Wear, types of wear, theories of wear, wear prevention.**Unit 3:** Tribological properties of bearing materials and lubricants. **Unit 4:** Lubrication, Reynolds's equation and its limitations, idealized bearings, infinitely long plane pivoted and fixed show sliders, infinitely long and infinitely short (narrow) journal bearings, lightly loaded infinitely long journal bearing (Petroff's solution),Finite Bearings , Design of hydrodynamic journal bearings **Unit 5:** Hydrostatic, squeeze film Circular and rectangular flat plates, variable and alternating loads, piston pin lubrications, application to journal bearings.
Unit 6: Elasto-hydrodynamic lubrication – pressure viscosity term in Reynolds's equation, Hertz' theory, Ertel-Grubin equation, lubrication of spheres, gear teeth and rolling element bearings, Air lubricated bearings, Tilting pad bearings,

References:

- A. Cameron, “Basic Lubrication Theory”, Ellis Horwood Ltd, 1981.
- Principles in Tribology, Edited by J. Halling, 1975
- Fundamentals of Fluid Film Lubrication – B. J. Hamrock, McGraw Hill International,1994
- D.D. Fuller, “Theory and Practice of Lubrication for Engineers”, John Wiley and Sons, 1984.
- “Fundamentals of Friction and wear of Materials” American Society of Metals.
- Introduction to Tribology of Bearings –B. C. Majumdar, A. H. Wheeler & co. pvt. ltd 1985.
- T.A. Stolarski, “Tribology in Machine Design”.

MLC ML-601 CONSTITUTION OF INDIA

Teaching Scheme
Lectures : 1 hr/week

Examination Scheme
T1, T2 20 marks each, End-Sem Exam 60

Course outcomes:

- Students will be aware of Fundamental rights of a citizen of India, their limitations and duties of a citizen of India and their significance.
- Students will realize the hierarchy in the governance of country and the state.
- Students will know the constitutional provisions for Scheduled Castes & Tribes, Women & Children & Backward classes. Emergency Provisions.
- Students will also know Electoral process, Amendment procedure, 42nd, 44th, 74th, 76th, 86th and 91st Constitutional amendments

Syllabus Contents:

Unit 1 Preamble to the constitution of India. Fundamental rights under Part – III, details of Exercise of rights, Limitations & Important cases. **Unit 2** Relevance of Directive principles of State Policy under Part – IV, Fundamental duties & their significance **Unit 3** Union Executive – President, Prime Minister, Parliament & the Supreme Court of India **Unit 4** State executive – Governors, Chief Minister, State Legislator and High Courts **Unit 5** Constitutional Provisions for Scheduled Castes & Tribes, Women & Children & Backward classes. Emergency Provisions. **Unit 6** Electoral process, Amendment procedure, 42nd, 44th, 74th, 76th, 86th and 91st Constitutional amendments.

References:

- Durga Das Basu Introduction to the Constitution of India (Students Edn.) Prentice – Hall EEE, 19th/20th Edn., 2001.
- Charles E.Haries Michael. S.Pritchard and Michael J.Robins Engineering Ethics, Thompson Asia, 2003-08-05.
- M.V. Pylee, An Introduction to Constitution of India Vikas Publishing, 2002.

MLC ML-603: ENVIRONMENTAL SCIENCES

Teaching Scheme	ExaminationScheme
Lectures : 1 hr/week	T1, T2 20 marks each, End-Sem Exam 60

Course outcomes:

At the end of the course:

- Students will understand multidisciplinary nature of Environmental studies.
- Students will be aware of renewable and non-renewable resources of energy, their advantages, problems associated with them and exploitation of those resources.
- Students will understand the importance of Biodiversity and its conservation, the value of biodiversity, its consumptive use, productive use and its social, ethical, aesthetic and option values.
- Students will be aware of different types of pollutions and their cause effects and control.
- Students will recognize Social and Environmental Issues related to unsustainable and sustainable development.

Syllabus Contents:

Unit 1 Multidisciplinary nature of Environmental studies: Definition, scope and importance, need for public awareness.**Unit 2** Natural Resources : Renewable and non-renewable resources: Natural resources and associated problems. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources **Unit 3** Biodiversity and its conservation: Introduction – Definition : genetic, species and ecosystem diversity, Biogeographically classification of India, Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values,**Unit 4** Environmental Pollution: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards, Solid waste Management **Unit 5** Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns.

References:

- Brunner R.C Hazardous Waste Incineration.1989, McGraw Hill Inc. 480p
- Clark R.S. Marine Pollution Clanderson Press Oxford
- De A.K Environmental Chemistry., Wiley Eastern Ltd.
- Gleick, H.P. Water in Crisis, Pacific Institute for Studies in Dev., Environment & Security 1993. Stockholm Env. Institute Oxford Univ. Press. 473p
- Heywood, V.H & Waston, R.T. Global Biodiversity Assessment 1995.. Cambridge Univ. Press
- Bharucha Erach The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad –380 013, India, Email:mapin@icenet.net

- Trivedi R.K Handbook of Environmental Laws.,Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media

LLC LL-601: Liberal Learning course

Course outcomes:

- Student will find a topic of his interest.
- It will improve the Students' personality.
- Student will learn to interact with people to get inputs for the topic of their study.
- Student will learn to convince his point of view on a particular topic to a non cohesive group of people.

DE 601 DISSERTATION I
Course category: Project Work

Teaching Scheme	Assessment
2hr/week	End Sem **:** 100

Course outcomes:

- Students will be exposed to self learning various topics.
- Students will learn to survey the literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.
- Students will learn to write technical reports.
- Students will develop oral and written communication skills to present and defend their work in front of technically qualified audience.

The project work starts at semester III and should involve scientific study or research of an engineering problem involving design and development, experimentation, analysis of experimental results, mathematical modeling of the studied problem**,** simulation etc.
The student has to submit a detailed report on his work in the format prescribed by the department and has to present it in front of the panel of examiners comprising of guide, co guide, external and internal examiners, as decided by the pg coordinator and the Head of the department.

DE 602 DISSERTATION II
Course category: Project Work

Teaching Scheme	Assessment
2hr/week	End Sem : 100

Course outcomes:

- Students will be able to use different experimental techniques.
- Students will be able to use different software/ computational/analytical tools.

- Students will be able to design and develop an experimental set up/ equipment/test rig.
- Students will be able to conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them.
- Students will be able to either work in a research environment or in an industrial environment.
- Students will be conversant with technical report writing.
- Students will be able to present and convince their topic of study to the engineering community.

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar in front of the panel of examiners comprising of guide, co guide, external and internal examiners, as decided by the pg coordinator and the Head of the department.

Annexure I

Sample list of Professional Science/Elective courses offered by various departments

Branch Name	Subject Name
Civil Engineering (Construction and Management)	Environmental Impact Assessment
Civil Engineering (Environmental and Water)	Numerical Method
Civil Engineering (Geotechnical Engineering)	Advanced Mathematical Methods
Civil Engineering	Introduction to Coastal Engineering
Civil Engineering	Fortran Programming for Engineering Application
Civil Engineering	Housing and Social aspects of planning
Computer/ Information Technology	Financial Computing
Electrical Engineering (Control System)	Matrix and linear Algebra
Electrical Engineering (Power System)	Wind and Solar Energy
Electrical Engineering (Power System)	Engineering Optimization
Electrical Engineering (Power System)	Linear Systems Theory and Design
Electrical Engineering	Industrial Motion Control
Electronics and Telecommunications (Signal Processing)	Mobile Communication
Electronics and Telecommunications	Applied Statistical Physics
Electronics and Telecommunications(VLSI and Embedded)	Image processing and analysis
Electronics and Telecommunications	Artificial Intelligence
Mechanical Engineering	Finite Element and Boundary Element Methods
Mechanical Engineering	Energy Conservation and Management
Mechanical Engineering	Operation Research
Mechanical Engineering	Introduction to Nuclear Energy
Metallurgical Engineering (Physical/Process)	Electronics and Magnetic Materials
Metallurgical Engineering (Physical/Process)	Thermomechanical Processing of Metals
Metallurgical Engineering	Nanotechnology
Town and Country Planning	Quantitative Techniques
Production Engineering (Manufacturing Engineering and Automation)	Microcontroller and Applications
Production Engineering (Manufacturing Engineering and Automation)	Reliability Engineering
Production	Robot Dynamics and Analysis
Production	Commercial Law
Project Management	Project Planning and Control
Applied Physics	Laser Technology
Mathematics	Complex Analysis
Mathematics	Advanced Mathematical Methods (for all except Mech. and Instru.)
Mathematics	Advanced Mathematics
Mathematics	Engineering Mathematics for Problem Solving
Mathematics	Linear Algebra

Annexure-II:

Sample list of Liberal Learning courses offered at Institute level

Course Outcome:
Student will be able to choose and enhance practical learning and application in the subject of his/her choice.

One credit course spread over the semester to enhance practical learning and application

1. **Agriculture (**Landscaping, Farming, etc.**)**
2. **Business (**Management, Entrepreneurship, etc.**)**
3. **Defense (**Study about functioning of Armed Forces**)**
4. **Education (**Education system, Policies, Importance, etc.**)**
5. **Fine Arts (**Painting, Sculpting, Sketching, etc.**)**
6. **Linguistics**
7. **Medicine and Health (**Diseases, Remedies, Nutrition, Dietetics, etc.**)**
8. **Performing Arts (**Music, Dance, Instruments, Drama, etc.**)**
9. **Philosophy**
10. **Social Sciences (**History, Political Sc., Archeology, Geography, Civics, Economics, etc.**)**