JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

(Established by State Act No. 30 of 2008)

Kukatpally, Hyderabad, Telangana (India).

ACADEMIC REGULATIONS FOR B.TECH. REGULAR STUDENTS WITH EFFECT FROM ACADEMIC YEAR 2016-17 (R-16)

1.0 Under-Graduate Degree Programme in Engineering & Technology (UGP in E&T)

1.1 JNTUH offers a 4-year (8 semesters) **Bachelor of Technology** (B.Tech.) degree programme, under Choice Based Credit System (CBCS) at its non-autonomous constituent and affiliated colleges with effect from the academic year 2016-17 in the following branches of Engineering:

Branch
Civil Engineering
Electrical and Electronics Engineering
Mechanical Engineering
Electronics and Communication Engineering
Computer Science and Engineering
Chemical Engineering
Electronics and Instrumentation Engineering
Bio-Medical Engineering
Information Technology
Mechanical Engineering (Mechatronics)
Electronics and Telematics Engineering
Metallurgy and Material Technology
Electronics and Computer Engineering
Mechanical Engineering (Production)
Aeronautical Engineering
Instrumentation and Control Engineering
Biotechnology
Automobile Engineering
Mining Engineering
Petroleum Engineering
Civil and Environmental Engineering
Mechanical Engineering (Nano Technology)
Computer Science & Technology
Pharmaceutical Engineering

2.0 Eligibility for admission

2.1 Admission to the under graduate programme shall be made either on the basis of the merit rank obtained by the qualified student in entrance test conducted by the Telangana State Government (EAMCET) or the University or on the basis of any other order of merit approved by the University, subject to reservations as prescribed by the government from time to time.

2.2 The medium of instructions for the entire under graduate programme in E&T will be **English** only.

3.0 B.Tech. Programme structure

3.1 A student after securing admission shall pursue the under graduate programme in B.Tech. in a minimum period of **four** academic years (8 semesters), and a maximum period of **eight** academic years (16 semesters) starting from the date of commencement of first year first semester, failing which student shall forfeit seat in B.Tech course.

Each semester is structured to provide 24 credits, totaling to 192 credits for the entire B.Tech. programme.

Each student shall secure 192 credits (with CGPA ≥ 5) required for the completion of the under graduate programme and award of the B.Tech. degree.

3.2 **UGC/ AICTE** specified definitions/ descriptions are adopted appropriately for various terms and abbreviations used in these academic regulations/ norms, which are listed below.

3.2.1 Semester scheme

Each under graduate programme is of 4 academic years (8 semesters) with the academic year being divided into two semesters of 22 weeks (≥ 90 instructional days) each, each semester having - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC and curriculum / course structure as suggested by AICTE are followed.

3.2.2 Credit courses

All subjects/ courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject/ course in an L: T: P: C (lecture periods: tutorial periods: practical periods: credits) structure based on the following general pattern.

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

Courses like Environmental Science, Professional Ethics, Gender Sensitization lab and other student activities like NCC/NSO and NSS are identified as mandatory courses. These courses will not carry any credits.

3.2.3 Subject Course Classification

All subjects/ courses offered for the under graduate programme in E&T (B.Tech. degree programmes) are broadly classified as follows. The university has followed almost all the guidelines issued by AICTE/UGC.

S. No.	Broad Course Classification	Course Group/ Category	Course Description
1	Foundation Courses (FnC)	BS – Basic Sciences	Includes mathematics, physics and chemistry subjects
2		ES - Engineering Sciences	Includes fundamental engineering subjects
3		HS – Humanities and Social sciences	Includes subjects related to humanities, social sciences and management
4	Core Courses (CoC)	PC – Professional Core	Includes core subjects related to the parent discipline/ department/ branch of Engineering.
5	Elective Courses (EℓC)	PE – Professional Electives	Includes elective subjects related to the parent discipline/ department/ branch of Engineering.
6		OE – Open Electives	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering.
7	Core Courses	Project Work	B.Tech. project or UG project or UG major project
8		Industrial training/ Mini- project	Industrial training/ Internship/ UG Mini-project/ Mini-project
9		Seminar	Seminar/ Colloquium based on core contents related to parent discipline/ department/ branch of Engineering.
10	Minor courses	-	1 or 2 Credit courses (subset of HS)
11	Mandatory Courses (MC)	-	Mandatory courses (non-credit)

4.0 Course registration

4.1 A 'faculty advisor or counselor' shall be assigned to a group of 15 students, who will advise student about the under graduate programme, its course structure and curriculum, choice/option for subjects/ courses, based on their competence, progress, pre-requisites and interest.

4.2 The academic section of the college invites 'registration forms' from students before the beginning of the semester through 'on-line registration', ensuring 'date and time stamping'. The on-line registration requests for any 'current semester' shall be **completed before the commencement of SEEs (Semester End Examinations) of the 'preceding semester'**.

4.3 A student can apply for **on-line** registration, **only after** obtaining the '**written approval**' from faculty advisor/counselor, which should be submitted to the college academic section through the Head of the Department. A copy of it shall be retained with Head of the Department, faculty advisor/ counselor and the student.

4.4 A student may be permitted to register for the subjects/ courses of **choice** with a total of 24 credits per semester (minimum of 20 credits and maximum of 28 credits per semester and permitted deviation of ± 17%), based on **progress** and SGPA/ CGPA, and completion of the '**pre-requisites'** as indicated for various subjects/ courses, in the department course structure and syllabus contents. However, a **minimum** of 20 credits per semester must be registered to ensure the '**studentship**' in any semester.

4.5 Choice for '**additional subjects/ courses**' to reach the maximum permissible limit of 28 credits (above the typical 24 credit norm) must be clearly indicated, which needs the specific approval and signature of the faculty advisor/ counselor.

4.6 If the student submits ambiguous choices or multiple options or erroneous entries during **on-line** registration for the subject(s) / course(s) under a given/ specified course group/ category as listed in the course structure, only the first mentioned subject/ course in that category will be taken into consideration.

4.7 Subject/ course options exercised through **on-line** registration are final and **cannot** be changed or inter-changed; further, alternate choices also will not be considered. However, if the subject/ course that has already been listed for registration by the Head of the Department in a semester could not be offered due to any unforeseen or unexpected reasons, then the student shall be allowed to have alternate choice either for a new subject (subject to offering of such a subject), or for another existing subject (subject to availability of seats). Such alternate arrangements will be made by the head of the department, with due notification and time-framed schedule, within the **first week** after the commencement of class-work for that semester.

4.8 Dropping of subjects/ courses may be permitted, only after obtaining prior approval from the faculty advisor/ counselor (subject to retaining a minimum of 20 credits), '**within a period of 15 days**' from the beginning of the current semester.

4.9 **Open electives**: The students have to choose one open elective (OE-I) during III year I semester, one (OE-II) during III year II semester, and one (OE-III) in IV year II semester, from the list of open electives given. However, the student cannot opt for an open elective subject offered by their own (parent) department, if it is already listed under any category of the subjects offered by parent department in any semester.

4.10 **Professional electives**: students have to choose professional elective (PE-I) in III year II semester, Professional electives II, III, and IV (PE-II, III and IV) in IV year I semester, Professional electives V, and VI (PE-V and VI) in IV year II semester, from the list of professional electives given. However, the students may opt for professional elective subjects offered in the related area.

5.0 Subjects/ courses to be offered

5.1 A typical section (or class) strength for each semester shall be 60.

5.2 A subject/ course may be offered to the students, **only if** a minimum of 20 students (1/3 of the section strength) opt for it. The maximum strength of a section is limited to 80 (60 + 1/3 of the section strength).

5.3 More than **one faculty member** may offer the **same subject** (lab/ practical may be included with the corresponding theory subject in the same semester) in any semester. However, selection of choice for students will be based on - '**first come first serve** basis and CGPA criterion' (i.e. the first focus shall be on early **on-line entry** from the student for registration in that semester, and the second focus, if needed, will be on CGPA of the student).

5.4 If more entries for registration of a subject come into picture, then the Head of Department concerned shall decide, whether or not to offer such a subject/ course for **two (or multiple) sections**.

5.5 In case of options coming from students of other departments/ branches/ disciplines (not considering **open electives**), first **priority** shall be given to the student of the '**parent department**'.

6.0 Attendance requirements:

6.1 A student shall be eligible to appear for the semester end examinations, if student acquires a minimum of 75% of attendance in aggregate of all the subjects/ courses (excluding attendance in mandatory courses Environmental Science, Professional Ethics, Gender Sensitization Lab, NCC/NSO and NSS) for that semester.

6.2 Shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each semester may be condoned by the college academic committee on genuine and valid grounds, based on the student's representation with supporting evidence.

6.3 A stipulated fee shall be payable towards condoning of shortage of attendance.

6.4 Shortage of attendance below 65% in aggregate shall in **no** case be condoned.

6.5 **Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examinations of that semester. They get detained and their registration for that semester shall stand cancelled. They will not be promoted to the next semester.** They may seek re-registration for all those subjects registered in that semester in which student was detained, by seeking re-admission into that semester as and when offered; in case if there are any professional electives and/ or open electives, the same may also be re-registered if offered. However, if those electives are not offered in later semesters, then alternate electives may be chosen from the **same** set of elective subjects offered under that category.

6.6 A student fulfilling the attendance requirement in the present semester shall not be eligible for readmission into the same class.

7.0 Academic requirements

The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in item no.**6.**

7.1 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course, if student secures not less than 35% marks (26 out of 75 marks) in the semester end examination, and a minimum of 40% of marks in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of letter grades, this implies securing **'C'** grade or above in that subject/ course.

7.2 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to UG Mini Project and seminar, if student secures not less than 40% marks (i.e. 40 out of 100 allotted marks) in each of them. The student would be treated as failed, if student (i) does not submit a report on UG Mini Project, or does not make a presentation of the same before the evaluation committee as per schedule, or (ii) does not present the seminar as required in the IV year I Semester, or (iii) secures less than 40% marks in industry UG Mini Project / seminar evaluations.

Student may reappear once for each of the above evaluations, when they are scheduled again; if student fails in such 'one reappearance' evaluation also, student has to reappear for the same in the next subsequent semester, as and when it is scheduled.

7.3 Promotion Rules

S. No.	Promotion	Conditions to be fulfilled
1	**First year first semester to first year second semester**	**Regular course of study of first year first semester.**
2	**First year second semester to second year first semester**	**(i) Regular course of study of first year second semester.** **(ii) Must have secured at least 24 credits out of 48 credits i.e., 50% credits up to first year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.**
3.	**Second year first semester to second year second semester**	**Regular course of study of second year first semester.**
4	**Second year second semester**	**(i) Regular course of study of second**

	to third year first semester	**year second semester.** **(ii) Must have secured at least 58 credits out of 96 credits i.e., 60% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.**
5	**Third year first semester to third year second semester**	**Regular course of study of third year first semester.**
6	**Third year second semester to fourth year first semester**	**(i) Regular course of study of third year second semester.** **(ii) Must have secured at least 86 credits out of 144 credits i.e., 60% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.**
7	**Fourth year first semester to fourth year second semester**	**Regular course of study of fourth year first semester.**

7.4 A student shall register for all subjects covering 192 credits as specified and listed in the course structure, fulfills all the attendance and academic requirements for 192 credits, 'earn all 192 credits by securing SGPA $\geq$ 5.0 (in each semester), and CGPA (at the end of each successive semester) $\geq$ 5.0, to successfully complete the under graduate programme.

7.5 After securing the necessary 192 credits as specified for the successful completion of the entire under graduate programme, the student can avail exemption of two subjects up to 6 credits, that is, one open elective and one professional elective subject or two professional elective subjects for optional drop out from these 192 credits earned; resulting in 186 credits for under graduate programme performance evaluation, i.e., the performance of the student in these 186 credits shall alone be taken into account for the calculation of 'the final CGPA (at the end of under graduate programme, which takes the SGPA of the IV year II semester into account)' , and shall be indicated in the grade card of IV year II semester. However, the performance of student in the earlier individual semesters, with the corresponding SGPA and CGPA for which grade cards have already been given will not be altered.

7.6 If a student registers for some more '**extra subjects'** (in the parent department or other departments/branches of engg.) other than those listed subjects totaling to 192 credits as specified in the course structure of his department, the performances in those '**extra subjects**' (although evaluated and graded using the same procedure as that of the required 192 credits) will not be taken into account while calculating the SGPA and CGPA. For such '**extra subjects'** registered, % of marks and letter grade alone will be indicated in the grade card as a performance measure, subject to completion of the attendance and academic requirements as stated in regulations 6 and 7.1 – 7.5 above.

7.7 A student eligible to appear in the end semester examination for any subject/ course, but absent from it or failed (thereby failing to secure **'C'** grade or above) may reappear for that subject/ course in the supplementary examination as and when conducted. In such cases, internal marks (CIE) assessed earlier for that subject/ course will be carried over, and added to the marks to be obtained in the SEE supplementary examination for evaluating performance in that subject.

7.8 A student **detained in a semester due to shortage of attendance may be re-admitted when the same semester is offered in the next academic year for fulfillment of academic requirements**. The academic regulations under which student has been readmitted shall be applicable. However, no grade allotments or SGPA/ CGPA calculations will be done for the entire semester in which student has been detained.

7.9 A student detained **due to lack of credits, shall be promoted to the next academic year only after acquiring the required academic credits.** The academic regulations under which student has been readmitted shall be applicable to him.

8.0 Evaluation - Distribution and Weightage of marks

8.1 The performance of a student in every subject/course (including practicals and UG major project) will be evaluated for 100 marks each, with 25 marks allotted for CIE (Continuous Internal Evaluation) and 75 marks for SEE (Semester End-Examination).

8.2 For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of one objective paper, one descriptive paper and one assignment. The objective paper and the descriptive paper shall be for 10 marks each with a total duration of 1 hour 20 minutes (20 minutes for objective and 60 minutes for descriptive paper). The objective paper is set with 20 bits of multiple choice, fill-in the blanks and matching type of questions for a total of 10 marks. The descriptive paper shall contain 4 full questions out of which, the student has to answer 2 questions, each carrying 5 marks. While the first mid-term examination shall be conducted on 50% of the syllabus, the second mid-term examination shall be conducted on the remaining 50% of the syllabus. Five marks are allocated for assignments (as specified by the subject teacher concerned). The first assignment should be submitted before the conduct of the first mid-examination, and the second assignment should be submitted before the conduct of the second mid-examination. The total marks secured by the student in each mid-term examination are evaluated for 25 marks, and the average of the two mid-term examinations shall be taken as the final marks secured by each student in internals/sessionals. If any student is absent from any subject of a mid-term examination, an on-line test will be conducted for him by the university. The details of the question paper pattern are as follows,

- The end semester examinations will be conducted for 75 marks consisting of two parts viz. i) **Part- A** for 25 marks, ii) **Part - B** for 50 marks.
- Part-A is compulsory question which consists of ten sub-questions. The first five sub-questions are from each unit and carry 2 marks each. The next five sub-questions are one from each unit and carry 3 marks each.
- Part-B consists of five questions (numbered from 2 to 6) carrying 10 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

8.3 For practical subjects there shall be a continuous internal evaluation during the semester for 25 sessional marks and 75 semester end examination marks. Out of the 25 marks for internal evaluation, day-to-day work in the laboratory shall be evaluated for 15 marks and internal practical examination shall be evaluated for 10 marks conducted by the laboratory teacher concerned. The semester end examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the clusters of colleges which are decided by the examination branch of the university.

8.4 For the subject having design and/or drawing, (such as engineering graphics, engineering drawing, machine drawing) and estimation, the distribution shall be 25 marks for continuous internal evaluation (15 marks for day-to-day work and 10 marks for internal tests) and 75 marks for semester end examination. There shall be two internal tests in a semester and the average of the two shall be considered for the award of marks for internal tests.

8.5 There shall be an UG mini-project, in collaboration with an industry of their specialization. Students will register for this immediately after III year II semester examinations and pursue it during summer vacation. The UG mini-project shall be submitted in a report form and presented before the committee in IV year I semester. It shall be evaluated for 100 marks. The committee consists of an external examiner, Head of the Department, supervisor of the UG mini-project and a senior faculty member of the department. There shall be no internal marks for UG mini-project.

8.6 There shall be a seminar presentation in IV year I semester. For the seminar, the student shall collect the information on a specialized topic, prepare a technical report, and submit it to the department. It shall be evaluated by the departmental committee consisting of Head of the Department, seminar supervisor and a senior faculty member. The seminar report shall be evaluated for 100 marks. There shall be no semester end examination for the seminar.

8.7 Out of a total of 100 marks for the UG major Project, 25 marks shall be allotted for internal evaluation and 75 marks for the end semester examination (viva voce). The end semester examination of the UG major Project shall be conducted by the same committee as appointed for the UG mini-project. In addition, the UG major Project supervisor shall also be included in the committee. The topics for UG mini project, seminar and UG major Project shall be different from one another. The evaluation of UG major Project shall be made at the end of IV year II semester. The internal evaluation shall be on the basis of two seminars given by each student on the topic of UG major Project.

8.8 The laboratory marks and the sessional marks awarded by the college are subject to scrutiny and scaling by the university wherever necessary. In such cases, the sessional and laboratory marks awarded by the college will be referred to a committee. The committee will arrive at a scaling factor and the marks will be scaled accordingly. The recommendations of the committee are final and binding. The laboratory records and internal test papers shall be preserved in the respective institutions as per the university rules and produced before the committees of the university as and when asked for.

8.9 For mandatory courses Environmental Science, Professional Ethics and gender sensitization lab, a student has to secure 40 marks out of 100 marks (i.e. 40% of the marks allotted) in the continuous internal evaluation for passing the subject/course.

8.10 For mandatory courses NCC/ NSO and NSS, a ‘satisfactory participation certificate’ shall be issued to the student from the authorities concerned, only after securing ≥ 65% attendance in such a course.

8.11 No marks or letter grade shall be allotted for all mandatory/non-credit courses.

9.0 Grading procedure

9.1 Marks will be awarded to indicate the performance of student in each theory subject, labaratory / practicals, seminar, UG mini project, UG major project. Based on the percentage of marks obtained (Continuous Internal Evaluation plus Semester End Examination, both taken together) as specified in item 8 above, a corresponding letter grade shall be given.

9.2 As a measure of the performance of student, a 10-point absolute grading system using the following letter grades (as per UGC/AICTE guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured in a Subject/Course (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
Greater than or equal to 90%	O (Outstanding)	10
80 and less than 90%	A^+ (Excellent)	9

70 and less than 80%	**A (Very Good)**	**8**
60 and less than 70%	**B^+ (Good)**	**7**
50 and less than 60%	**B (Average)**	**6**
40 and less than 50%	**C (Pass)**	**5**
Below 40%	**F (FAIL)**	**0**
Absent	**Ab**	**0**

9.3 A student obtaining '**F'** grade in any subject shall be deemed to have '**failed'** and is required to reappear as a 'supplementary student' in the semester end examination, as and when offered. In such cases, internal marks in those subjects will remain the same as those obtained earlier.

9.4 A student who has not appeared for examination in any subject, '**Ab'** grade will be allocated in that subject, and student shall be considered '**failed'**. Student will be required to reappear as a 'supplementary student' in the semester end examination, as and when offered.

9.5 A letter grade does not indicate any specific percentage of marks secured by the student, but it indicates only the range of percentage of marks.

9.6 A student earns grade point (GP) in each subject/ course, on the basis of the letter grade secured in that subject/ course. The corresponding 'credit points' (CP) are computed by multiplying the grade point with credits for that particular subject/ course.

Credit points (CP) = grade point (GP) x credits …. For a course

9.7 The student passes the subject/ course only when **GP ≥ 5 ('C' grade or above)**

9.8 The semester grade point average (SGPA) is calculated by dividing the sum of credit points (ΣCP) secured from all subjects/ courses registered in a semester, by the total number of credits registered during that semester. SGPA is rounded off to **two** decimal places. SGPA is thus computed as

SGPA = $\{ \sum_{i=1}^{N} C_i \, G_i \} / \{ \sum_{i=1}^{N} C_i \}$ …. For each semester,

where 'i' is the subject indicator index (takes into account all subjects in a semester), 'N' is the no. of subjects '**registered'** for the semester (as specifically required and listed under the course structure of the parent department), C_i is the no. of credits allotted to the i^{th} subject, and G_i represents the grade points (GP) corresponding to the letter grade awarded for that i^{th} subject.

9.9 The cumulative grade point average (CGPA) is a measure of the overall cumulative performance of a student in all semesters considered for registration. The CGPA is the ratio of the total credit points secured by a student in **all** registered courses in **all** semesters, and the total number of credits registered in **all** the semesters. CGPA is rounded off to **two** decimal places. CGPA is thus computed from the I year II semester onwards at the end of each semester as per the formula

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

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

where '**M**' is the **total** no. of subjects (as specifically required and listed under the course structure of the parent department) the student has '**registered**' i.e., from the 1st semester onwards up to and inclusive of the 8th semester, 'j' is the subject indicator index (takes into account all subjects from 1 to 8 semesters), C_j is the no. of credits allotted to the j^{th} subject, and G_j represents the grade points (GP) corresponding to the letter grade awarded for that j^{th} subject. After registration and completion of I year I semester, the SGPA of that semester itself may be taken as the CGPA, as there are no cumulative effects.

Illustration of calculation of SGPA

Course/Subject	Credits	Letter Grade	Grade Points	Credit Points
Course 1	4	A	8	4 x 8 = 32
Course 2	4	O	10	4 x 10 = 40
Course 3	4	C	5	4 x 5 = 20
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	C	5	3 x 5 = 15
	21			152

SGPA = 152/21 = 7.23

Illustration of calculation of CGPA:

Semester	Credits	SGPA	Credits x SGPA
Semester I	24	7	24 x 7 = 168
Semester II	24	6	24 x 6 = 144
Semester III	24	6.5	24 x 6.5 = 156
Semester IV	24	6	24 x 6 = 144

Semester V	24	7.5	24 x 7.5 = 180
Semester VI	24	8	24 x 8 = 192
Semester VII	24	8.5	24 x 8.5 = 204
Semester VIII	24	8	24 x 8 = 192
	192		1380

CGPA = 1380/192 = 7.18

9.10 For merit ranking or comparison purposes or any other listing, **only** the '**rounded off'** values of the CGPAs will be used.

9.11 For calculations listed in regulations 9.6 to 9.9, performance in failed subjects/ courses (securing **F** grade) will also be taken into account, and the credits of such subjects/ courses will also be included in the multiplications and summations. After passing the failed subject(s) newly secured letter grades will be taken into account for calculation of SGPA and CGPA. However, mandatory courses will not be taken into consideration.

10.0 Passing standards

10.1 A student shall be declared successful or 'passed' in a semester, if student secures a GP ≥ 5 ('C' grade or above) in every subject/course in that semester (i.e. when student gets an SGPA ≥ 5.00 at the end of that particular semester); and a student shall be declared successful or 'passed' in the entire under graduate programme, only when gets a CGPA ≥ 5.00 for the award of the degree as required.

10.2 After the completion of each semester, a grade card or grade sheet (or transcript) shall be issued to all the registered students of that semester, indicating the letter grades and credits earned. It will show the details of the courses registered (course code, title, no. of credits, and grade earned etc.), credits earned, SGPA, and CGPA.

11.0 Declaration of results

11.1 Computation of SGPA and CGPA are done using the procedure listed in 9.6 to 9.9.

11.2 For final percentage of marks equivalent to the computed final CGPA, the following formula may be used.

% of Marks = (final CGPA – 0.5) x 10

12.0 Award of degree

12.1 A student who registers for all the specified subjects/ courses as listed in the course structure and secures the required number of 192 credits (with CGPA ≥ 5.0), within 8 academic years from the date of commencement of the first academic year, shall be declared to have '**qualified'** for the award of the B.Tech. degree in the chosen branch of Engineering as selected at the time of admission.

12.2 A student who qualifies for the award of the degree as listed in item 12.1 shall be placed in the following classes.

12.3 Students with final CGPA (at the end of the under graduate programme) ≥ 8.00, and fulfilling the following conditions -

(i) Should have passed all the subjects/courses in '**first appearance'** within the first 4 academic years (or 8 sequential semesters) from the date of commencement of first year first semester.

(ii) Should have secured a CGPA ≥ 8.00, at the end of each of the 8 sequential semesters, starting from I year I semester onwards.

(iii) Should not have been detained or prevented from writing the end semester examinations in any semester due to shortage of attendance or any other reason, shall be placed in '**first class with distinction'**.

12.4 Students with final CGPA (at the end of the under graduate programme) ≥ 6.50 but < 8.00, shall be placed in '**first class'**.

12.5 Students with final CGPA (at the end of the under graduate programme) ≥ 5.50 but < 6.50, shall be placed in '**second class'**.

12.6 All other students who qualify for the award of the degree (as per item 12.1), with final CGPA (at the end of the under graduate programme) ≥ 5.00 but < 5.50, shall be placed in '**pass class**'.

12.7 A student with final CGPA (at the end of the under graduate programme) < 5.00 will not be eligible for the award of the degree.

12.8 Students fulfilling the conditions listed under item 12.3 alone will be eligible for award of '**university rank**' and '**gold medal**'.

13.0 Withholding of results

13.1 If the student has not paid the fees to the university/ college at any stage, or has dues pending due to any reason whatsoever, or if any case of indiscipline is pending, the result of the student may be withheld, and student will not be allowed to go into the next higher semester. The award or issue of the degree may also be withheld in such cases.

14.0 Transitory regulations

A. **For students detained due to shortage of attendance**:

1. A Student who has been detained in I year of R09/R13/R15 Regulations due to lack of attendance, shall be permitted to join I year I Semester of R16 Regulations and he is required to complete the study of B.Tech./B. Pharmacy programme within the stipulated period of eight academic years from the date of first admission in I Year.
2. A student who has been detained in any semester of II, III and IV years of R09/R13/R15 regulations for want of attendance, shall be permitted to join the corresponding semester of R16 regulations and is required to complete the study of

B.Tech./B. Pharmacy within the stipulated period of eight academic years from the date of first admission in I Year. The R16 Academic Regulations under which a student has been readmitted shall be applicable to that student from that semester.

See rule (C) for further Transitory Regulations.

B. **For students detained due to shortage of credits**:

3. A student of R09/R13/R15 Regulations who has been detained due to lack of credits, shall be promoted to the next semester of R16 Regulations only after acquiring the required credits as per the corresponding regulations of his/her first admission. The student is required to complete the study of B.Tech./B. Pharmacy within the stipulated period of eight academic years from the year of first admission. The R16 Academic Regulations are applicable to a student from the year of readmission onwards.

See rule (C) for further Transitory Regulations.

C. **For readmitted students in R16 Regulations**:

4. A student who has failed in any subject under any regulation has to pass those subjects in the same regulations.
5. The maximum credits that a student acquires for the award of degree, shall be the sum of the total number of credits secured in all the regulations of his/her study including R16 Regulations. The performance evaluation of the student will be done after the exemption of two subjects if total credits acquired are ≤ 206, three subjects if total credits acquired are > 206 (see R16 Regulations for exemption details).
6. If a student readmitted to R16 Regulations, has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in R16 Regulations will be substituted by another subject to be suggested by the University.

Note: If a student readmitted to R16 Regulations, has not studied any subjects/topics in his/her earlier regulations of study which is prerequisite for further subjects in R16 Regulations, the College Principals concerned shall conduct remedial classes to cover those subjects/topics for the benefit of the students.

15.0 Student transfers

15.1 There shall be no branch transfers after the completion of admission process.

15.2 There shall be no transfers from one college/stream to another within the constituent colleges and units of Jawaharlal Nehru Technological University Hyderabad.

15.3 The students seeking transfer to colleges affiliated to JNTUH from various other Universities/institutions have to pass the failed subjects which are equivalent to the subjects of JNTUH, and also pass the subjects of JNTUH which the students have not studied at the earlier institution. Further, though the students have passed some of the subjects at the earlier institutions, if the same subjects are prescribed in different semesters of JNTUH, the students have to study those subjects in JNTUH in spite of the fact that those subjects are repeated.

15.4 The transferred students from other Universities/institutions to JNTUH affiliated colleges who are on rolls to be provide one chance to write the CBT (internal marks) in the **failed subjects and/or subjects not studied** as per the clearance letter issued by the university.

15.5 The autonomous affiliated colleges have to provide one chance to write the internal examinations in the **failed subjects and/or subjects not studied,** to the students transferred from other universities/institutions to JNTUH autonomous affiliated colleges who are on rolls, as per the clearance (equivalence) letter issued by the University.

16.0 Scope

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

16.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the vice-chancellor is final.

16.3 The university may change or amend the academic regulations, course structure or syllabi at any time, and the changes or amendments made shall be applicable to all students with effect from the dates notified by the university authorities.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

(Established by State Act No. 30 of 2008)

Kukatpally, Hyderabad, Telangana (India).

Academic Regulations for B.Tech. (Lateral Entry Scheme) from the AY 2017-18

1. **Eligibility for award of B. Tech. Degree (LES)**

   The LES students after securing admission shall pursue a course of study for not less than three academic years and not more than six academic years.

2. The student shall register for 144 credits and secure 144 credits with CGPA ≥ 5 from II year to IV year B.Tech. programme (LES) for the award of B.Tech. degree. **Out of the 144 credits secured, the student can avail exemption up to 6 credits**, that is, one open elective subject and one professional elective subject or two professional elective subjects resulting in 138 credits for B.Tech programme performance evaluation**.**

3. The students, who fail to fulfil the requirement for the award of the degree in six academic years from the year of admission, shall forfeit their seat in B.Tech.

4. The attendance requirements of B. Tech. (Regular) shall be applicable to B.Tech. (LES).

5. **Promotion rule**

S. No	Promotion	Conditions to be fulfilled
1	**Second year first semester to second year second semester**	**Regular course of study of second year first semester.**
2	**Second year second semester to third year first semester**	**(i) Regular course of study of second year second semester.** **(ii) Must have secured at least 29 credits out of 48 credits i.e., 60% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.**
3	**Third year first semester to third year second semester**	**Regular course of study of third year first semester.**
4	**Third year second semester to fourth year first semester**	**(i) Regular course of study of third year second semester.** **(ii) Must have secured at least 58 credits out of 96 credits i.e., 60% credits up to third year second semester from all the**

		relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	**Fourth year first semester to fourth year second semester**	**Regular course of study of fourth year first semester.**

6. All the other regulations as applicable to B. Tech. 4-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme).

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/Improper conduct	**Punishment**
	If the student:	
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 student is appearing but has not made use of (material shall include any marks on the body of the student 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 student orally or by any other body language methods or communicates through cell phones with any student 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 students 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 student is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student 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 student is to be cancelled and sent to the university.
3.	Impersonates any other student in connection with the examination.	The student who has impersonated shall be expelled from examination hall. The student is also debarred and forfeits the seat. The performance of the original student 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 examinations of the remaining subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the chief superintendent/assistant – superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the student(s) has (have) already appeared and shall not be permitted to appear for the remaining

	others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	examinations of the subjects of that semester/year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student 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 student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat.
9.	If student of the college, who is not a student for the particular examination or any person not connected with the	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other

	college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat.Person(s) who do not belong to the college will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student 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 student has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the university for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

1. Punishments to the students as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
    a. A show cause notice shall be issued to the college.
    b. Impose a suitable fine on the college.
    c. Shifting the examination centre from the college to another college for a specific period of not less than one year.

* * * * *

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS (R16)
(Common for Civil, ME, AE, ME (M), MME, AU, Mining, Petroleum, CEE, ME (Nanotech))

Applicable From 2017-18 Admitted Batch

I YEAR I SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	MA101BS	Mathematics-I	3	1	0	3
2	MA102BS	Mathematics-II	4	1	0	4
3	PH103BS	Engineering Physics	3	0	0	3
4	CS104ES	Computer Programming in C	3	0	0	3
5	ME105ES	Engineering Mechanics	3	0	0	3
6	ME106ES	Engineering Graphics	2	0	4	4
7	PH107BS	Engineering Physics Lab	0	0	3	2
8	CS108ES	Computer Programming in C Lab	0	0	3	2
9	*EA109MC	NSS	0	0	0	0
		Total Credits	**18**	**2**	**10**	**24**

I YEAR II SEMESTER

S. No	Course Code	Course Title	L	T	P	Credits
1	AP201BS	Applied Physics	3	0	0	3
2	CH202BS	Engineering Chemistry	4	0	0	4
3	MA203BS	Mathematics-III	4	1	0	4
4	EN204HS	Professional Communication in English	3	0	0	3
5	EE205ES	Basic Electrical and Electronics Engineering	4	0	0	4
6	CH206BS	Engineering Chemistry Lab	0	0	3	2
7	EN207HS	English Language Communication Skills Lab	0	0	3	2
8	ME208ES	Engineering Workshop	0	0	3	2
9	*EA209MC	NCC/NSO	0	0	0	0
		Total Credits	**18**	**1**	**9**	**24**

***Mandatory Course- Satisfactory/Unsatisfactory**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. TECH. AERONAUTICAL ENGINEERING
II, III, IV YEARS COURSE STRUCTURE & SYLLABUS (R16)

Applicable From 2016-17 Admitted Batch

II YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	MA301BS	Mathematics – IV	4	1	0	4
2	ME301ES	Fluid Mechanics and Hydraulic Machines	4	1	0	4
3	AE302ES	Aircraft Production Technology	3	0	0	3
4	ME303ES	Mechanics of Solids	3	0	0	3
5	ME304ES	Thermodynamics	4	1	0	4
6	AE305ES	Aircraft Production Technology Lab	0	0	3	2
7	ME307ES	Mechanics of Solids Lab	0	0	3	2
8	ME310ES	Fluid Mechanics and Hydraulic Machines Lab	0	0	3	2
9	*MC300HS	Gender Sensitization Lab	0	0	3	0
		Total Credits	**18**	**3**	**12**	**24**

II YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	AE401ES	Low Speed Aerodynamics	4	1	0	4
2	AE402ES	Fundamentals of Structural Analysis	4	1	0	4
3	AE403ES	Aircraft Performance	4	1	0	4
4	AE404ES	Control Theory	3	1	0	3
5	SM405MS	Business Economics and Financial Analysis	3	0	0	3
6	AE406ES	Electrical and Electronics Engineering Lab	0	0	3	2
7	AE407ES	Numerical Simulation with MATLAB	0	0	3	2
8	AE408ES	Aircraft Engineering Drawing with CAD	0	0	3	2
9	*MC400ES	Environmental Science and Technology	3	0	0	0
		Total Credits	**21**	**4**	**9**	**24**

III YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	AE501PC	High Speed Aerodynamics	4	1	0	4
2	AE502PC	Air Breathing Propulsion	4	0	0	4
3	AE503PC	Aircraft Structural Analysis	4	1	0	4
4	SM504MS	Fundamentals of Management	3	0	0	3
5		Open Elective – I	3	0	0	3
6	AE505PC	Aerodynamics and Propulsion Lab	0	0	3	2
7	AE506PC	Aerospace Structures Lab	0	0	3	2
8	AE507PC	Aero Modeling Lab	0	0	3	2
9	*MC500HS	Professional Ethics	3	0	0	0
		Total Credits	**21**	**2**	**9**	**24**

III YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	AE601PC	Aircraft Systems	4	1	0	4
2	AE602PC	Aircraft Stability and Control	4	1	0	4
3	AE603PC	Rocket and Spacecraft Propulsion	4	0	0	4
4		Professional Elective-I	3	0	0	3
5		Open Elective-II	3	0	0	3
6	AE604PC	Computational Structures Lab	0	0	3	2
7	AE605PC	Flight Dynamics and Control Lab	0	0	3	2
8	EN606HS	Advanced English Communication Skills Lab	0	0	3	2
		Total Credits	**18**	**2**	**9**	**24**

During Summer Vacation between III and IV Years: Industry Oriented Mini Project

IV YEAR I SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1	AE701PC	Flight Vehicle Design	4	1	0	4
2	AE702PC	Mechanical Vibration and Structural Dynamics	4	1	0	4
3		Professional Elective - II	3	0	0	3
4		Professional Elective - III	3	0	0	3
5		Professional Elective - IV	3	0	0	3
6	AE703PC	Flight Vehicle Design and Instrumentation Lab	0	0	3	2
7	AE704PC	Computational Fluid Dynamics Lab	0	0	3	2
8	AE705PC	Industry Oriented Mini Project	0	0	3	2
9	AE706PC	Seminar	0	0	2	1
		Total Credits	**17**	**2**	**11**	**24**

IV YEAR II SEMESTER

S. No.	Course Code	Course Title	L	T	P	Credits
1		Open Elective – III	3	0	0	3
2		Professional Elective - V	3	0	0	3
3		Professional Elective - VI	3	0	0	3
4	AE801PC	Major Project	0	0	30	15
		Total Credits	**9**	**0**	**30**	**24**

Professional Elective - I

ME611PE	Finite Element Methods
AE612PE	Experimental Aerodynamics
AE613PE	Mechanisms and Mechanical Design
AE614PE	Unmanned Air Vehicle (UAV) Systems

Professional Elective - II

AE721PE	CAD/CAM
AE722PE	Aircraft Maintenance Engineering
AE723PE	Material Science and Composites
ME724PE	Operations Research

Professional Elective - III

AE731PE	Aircraft Structural Design
ME732PE	Computational Fluid Dynamics
AE733PE	Airport Planning and Management
AE734PE	System Modeling and Simulation

Professional Elective - IV

AE741PE	Advanced Manufacturing Techniques
AE742PE	Air Traffic Control

AE743PE	Space Mechanics
AE744PE	Mechanics of Composite Structures

Professional Elective - V

AE851PE	Helicopter Engineering
AE852PE	Fabrication and Machining of Composite Structures
AE853PE	Airlines Planning, Scheduling and Operations
AE854PE	Hypersonic Aerodynamics

Professional Elective -VI

AE861PE	Aeroelasticity
AE862PE	Wind Engineering and Industrial Aerodynamics
AE863PE	Heat Transfer
AE864PE	Ground Vehicle Aerodynamics

***Open Elective** subjects' syllabus is provided in a separate document.

***Open Elective –** Students should take Open Electives from the List of Open Electives Offered by Other Departments/Branches Only.

Ex: - A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

LIST OF OPEN ELECTIVES OFFERED BY VARIOUS DEPARTMENTS FOR B.TECH. III AND IV YEARS

S. No.	Name of the Department Offering Open Electives	Open Elective – I (Semester – V)	Open Elective – II (Semester – VI)
1	Aeronautical Engg.	AE511OE: Introduction to Space Technology	AE621OE: Introduction to Aerospace Engineering
2	Automobile Engg.	CE511OE: Disaster Management MT512OE: Intellectual Property Rights	MT621OE: Data Structures MT622OE: Artificial Neural Networks
3	Biomedical Engg.	BM511OE: Reliability Engineering	BM621OE: Medical Electronics
4	Civil Engg.	CE511OE: Disaster Management.	CE621OE: Remote Sensing and GIS CE622OE: Geo-Informatics CE623OE: Intellectual Property Rights
5	Civil and Environmental Engg.	CE511OE: Disaster Management	CN621OE: Environmental Impact Assessment CE623OE: Intellectual Property Rights
6	Computer Science and Engg. / Information Technology	CS511OE: Operating Systems CS512OE: Database Management Systems	CS621OE: Java Programming CS622OE: Software Testing Methodologies CS623OE: Cyber Security
7	Electronics and Communication Engg. / Electronics and Telematics Engg.	EC511OE: Principles of Electronic Communications	EC621OE: Principles of Computer Communications and Networks
8	Electronics and Computer Engg.	EM511OE: Scripting Languages	EM621OE: Soft Computing Techniques
9	Electrical and Electronics Engg.	EE511OE: Non-Conventional Power Generation EE512OE: Electrical Engineering Materials EE513OE: Nanotechnology	EE621OE: Design Estimation and Costing of Electrical Systems EE622OE: Energy Storage Systems EE623OE: Introduction to Mechatronics
10	Electronics and Instrumentation Engg.	EI511OE: Electronic Measurements and Instrumentation	EI621OE: Industrial Electronics
11	Mechanical Engg.	ME511OE: Optimization Techniques ME512OE: Computer Graphics ME513OE: Introduction to Mechatronics ME514OE: Fundamentals of Mechanical Engineering	ME621OE: World Class Manufacturing ME622OE: Fundamentals of Robotics ME623OE: Fabrication Processes
12	Mechanical Engg. (Material Science and Nanotechnology)	NT511OE: Fabrication Processes NT512OE: Non destructive	NT621OE: Introduction to Material Handling NT622OE: Non-Conventional

		Testing Methods NT513OE: Fundamentals of Engineering Materials	Energy Sources NT623OE: Robotics
13	Mechanical Engg. (mechatronics)	MT511OE: Analog and Digital I.C. Applications MT512OE: Intellectual Property Rights MT513OE: Computer Organization	MT621OE: Data Structures MT622OE: Artificial Neural Networks MT623OE: Industrial Management
14	Metallurgical and Materials Engg.	MM511OE: Materials Characterization Techniques	MM621OE: Science and Technology of Nano Materials MM622OE: Metallurgy of Non Metallurgists
15	Mining Engg.	MN511OE: Introduction to Mining Technology	MN621OE: Coal Gasification, Coal Bed Methane and Shale Gas
16	Petroleum Engg.	PE511OE: Materials Science and Engineering PE512OE: Renewable Energy Sources PE513OE: Environmental Engineering	PE621OE: Energy Management and Conservation PE622OE: Optimization Techniques PE623OE: Entrepreneurship and Small Business Enterprises

S. No.	Name of the Department Offering Open Electives	Open Elective –III (Semester – VIII)
1	Aeronautical Engg.	AE831OE: Air Transportation Systems AE832OE: Rockets and Missiles
2	Automobile Engg.	AM831OE: Introduction to Mechatronics AM832OE: Microprocessors and Microcontrollers
3	Biomedical Engg.	BM831OE: Telemetry and Telecontrol BM832OE: Electromagnetic Interference and Compatibility
4	Civil Engg.	CE831OE: Environmental Impact Assessment CE832OE: Optimization Techniques in Engineering CE833OE: Entrepreneurship and Small Business Enterprises
5	Civil and Environmental Engg.	CN831OE: Remote Sensing and GIS CE833OE: Entrepreneurship and Small Business Enterprises
6	Computer Science and Engg. / Information Technology	CS831OE: Linux Programming CS832OE: R Programming CS833OE: PHP Programming
7	Electronics and Communication Engg. / Electronics and Telematics Engg.	EC831OE: Electronic Measuring Instruments
8	Electronics and Computer Engg.	EM831OE: Data Analytics
9	Electrical and Electronics Engg.	EE831OE: Entrepreneur Resource Planning EE832OE: Management Information Systems EE833OE: Organizational Behaviour
10	Electronics and Instrumentation Engg.	EI831OE: Sensors and Transducers, EI832OE: PC Based Instrumentation

11	Mechanical Engg.	ME831OE: Total Quality Management ME832OE: Industrial Safety, Health, and Environmental Engineering ME833OE: Basics of Thermodynamics ME834OE: Reliability Engineering
12	Mechanical Engg. (Material Science and Nanotechnology)	NT831OE: Concepts of Nano Science And Technology NT832OE: Synthesis of Nanomaterials NT833OE: Characterization of Nanomaterials
13	Mechanical Engg. (mechatronics)	MT831OE: Renewable Energy Sources MT832OE: Production Planning and Control CE833OE: Entrepreneurship and Small Business Enterprises
14	Metallurgical and Materials Engg.	MM831OE: Design and Selection of Engineering Materials
15	Mining Engg.	MN831OE: Solid Fuel Technology MN832OE: Health & Safety in Mines
16	Petroleum Engg.	PE831OE: Disaster Management PE832OE: Fundamentals of Liquefied Natural Gas PE833OE: Health, Safety and Environment in Petroleum Industry

***Open Elective –** Students should take Open Electives from List of Open Electives Offered by Other Departments/Branches Only.

Ex: - A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

MATHEMATICS - I
(Linear Algebra and Differential Equations)

B.Tech. I Year I Sem.	**L T/P/D C**
Course Code: **MA101BS**	**3 1/0/0 3**

Prerequisites: Foundation course (No prerequisites).

Course Objectives: To learn

- types of matrices and their properties
- the concept of rank of a matrix and applying the same to understand the consistency
- solving the linear systems
- the concepts of eigen values and eigen vectors and reducing the quadratic forms into their canonical forms
- partial differentiation, concept of total derivative
- finding maxima and minima of functions of two variables
- methods of solving the linear differential equations of first and higher order
- the applications of the differential equations
- formation of the partial differential equations and solving the first order equations.

Course Outcomes: After learning the contents of this paper the student must be able to

- write the matrix representation of a set of linear equations and to analyze the solution of the system of equations
- find the Eigen values and Eigen vectors which come across under linear transformations
- find the extreme values of functions of two variables with/ without constraints.
- identify whether the given first order DE is exact or not
- solve higher order DE's and apply them for solving some real world problems

UNIT–I

Initial Value Problems and Applications

Exact differential equations - Reducible to exact.

Linear differential equations of higher order with constant coefficients: Non homogeneous terms with RHS term of the type e^{ax}, sin ax, cos ax, polynomials in x, e^{ax} V(x), xV(x)- Operator form of the differential equation, finding particular integral using inverse operator, Wronskian of functions, method of variation of parameters.

Applications: Newton's law of cooling, law of natural growth and decay, orthogonal trajectories, Electrical circuits.

UNIT–II

Linear Systems of Equations

Types of real matrices and complex matrices, rank, echelon form, normal form, consistency and solution of linear systems (homogeneous and Non-homogeneous) - Gauss elimination, Gauss Jordon and LU decomposition methods- Applications: Finding current in the electrical circuits.

UNIT–III

Eigen values, Eigen Vectors and Quadratic Forms

Eigen values, Eigen vectors and their properties, Cayley - Hamilton theorem (without proof), Inverse and powers of a matrix using Cayley - Hamilton theorem, Diagonalization, Quadratic forms, Reduction of Quadratic forms into their canonical form, rank and nature of the Quadratic forms – Index and signature.

UNIT–IV

Partial Differentiation

Introduction of partial differentiation, homogeneous function, Euler's theorem, total derivative, Chain rule, Taylor's and Mclaurin's series expansion of functions of two variables, functional dependence, Jacobian.

Applications: maxima and minima of functions of two variables without constraints and Lagrange's method (with constraints)

UNIT-V

First Order Partial Differential Equations

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions, Lagranges method to solve the first order linear equations and the standard type methods to solve the non linear equations.

Text Books:

1. A first course in differential equations with modeling applications by Dennis G. Zill, Cengage Learning publishers.
2. Higher Engineering Mathematics by Dr. B. S. Grewal, Khanna Publishers.

References:

1. Advanced Engineering Mathematics by E. Kreyszig, John Wiley and Sons Publisher.
2. Engineering Mathematics by N. P. Bali, Lakshmi Publications.

MATHEMATICS- II
(Advanced Calculus)

B.Tech. I Year I Sem.	**L T/P/D C**
Course Code: **MA102BS/MA202BS**	**4 1/0/0 4**

Prerequisites: Foundation course (No prerequisites)**.**

Course Objectives: To learn

- concepts & properties of Laplace Transforms
- solving differential equations using Laplace transform techniques
- evaluation of integrals using Beta and Gamma Functions
- evaluation of multiple integrals and applying them to compute the volume and areas of regions
- the physical quantities involved in engineering field related to the vector valued functions.
- the basic properties of vector valued functions and their applications to line, surface and volume integrals.

Course Outcomes: After learning the contents of this course the student must be able to

- use Laplace transform techniques for solving DE's
- evaluate integrals using Beta and Gamma functions
- evaluate the multiple integrals and can apply these concepts to find areas, volumes, moment of inertia etc of regions on a plane or in space
- evaluate the line, surface and volume integrals and converting them from one to another

UNIT–I

Laplace Transforms: Laplace transforms of standard functions, Shifting theorems, derivatives and integrals, properties- Unit step function, Dirac's delta function, Periodic function, Inverse Laplace transforms, Convolution theorem (without proof).
Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.

UNIT-II

Beta and Gamma Functions: Beta and Gamma functions, properties, relation between Beta and Gamma functions, evaluation of integrals using Beta and Gamma functions.
Applications: Evaluation of integrals.

UNIT–III

Multiple Integrals: Double and triple integrals, Change of variables, Change of order of integration.

Applications: Finding areas, volumes& Center of gravity (evaluation using Beta and Gamma functions).

UNIT–IV

Vector Differentiation: Scalar and vector point functions, Gradient, Divergence, Curl and their physical and geometrical interpretation, Laplacian operator, Vector identities.

UNIT–V

Vector Integration: Line Integral, Work done, Potential function, area, surface and volume integrals, Vector integral theorems: Greens, Stokes and Gauss divergence theorems (without proof) and related problems.

Text Books:

1. Advanced Engineering Mathematics by R K Jain & S R K Iyengar, Narosa Publishers
2. Engineering Mathematics by Srimanthapal and Subodh C. Bhunia, Oxford Publishers

References:

1. Advanced Engineering Mathematics by Peter V. O. Neil, Cengage Learning Publishers.
2. Advanced Engineering Mathematics by Lawrence Turyn, CRC Press

ENGINEERING PHYSICS/ENGINEERING PHYSICS - I

B.Tech. I Year I Sem. **L T/P/D C**
Course Code: **PH103BS** **3 0/0/0 3**

Course Objectives:

- To understand interaction of light with matter through interference, diffraction and polarization.
- To able to distinguish ordinary light with a laser light and to realize propagation of light through optical fibers.
- To understand various crystal systems and there structures elaborately.
- To study various crystal imperfections and probing methods like X-RD.

Course outcomes: after completion of this course the student is able to

- Realize the importance of light phenomena in thin films and resolution.
- Learn principle, working of various laser systems and light propagation through optical fibers.
- Distinguish various crystal systems and understand atomic packing factor.
- Know the various defects in crystals.

UNIT-I
Interference: Coherence, division of amplitude and division of wave front, interference in thin films (transmitted and reflected light), Newton's rings experiment.
Diffraction: Distinction between Fresnel and Fraunhoffer diffraction, diffraction due to single slit, N-slits, Diffraction grating experiment.

UNIT-II
Polarization: Introduction, Malus's law, double refraction, Nicol prism, Quarter wave and half wave plates.
Lasers: Characteristics of lasers, spontaneous and stimulated emission of radiation, Einstein coefficients, population inversion, ruby laser, helium – neon laser, semi conductor laser, applications of lasers

UNIT-III
Fiber Optics: Principle of optical fiber, construction of fiber, acceptance angle and acceptance cone, numerical aperture, types of optical fibers: step index and graded index fibers, attenuation in optical fibers, applications of optical fibers in medicine and sensors**.**

UNIT-IV
Crystallography: Space lattice, unit cell and lattice parameters, crystal systems, Bravais lattices, atomic radius, co-ordination number and packing factor of SC, BCC, FCC, HCP and diamond, Miller indices, crystal planes and directions, inter planar spacing of orthogonal crystal systems.

UNIT-V

X-ray Diffraction and Defects in Crystals: Bragg's law, X-ray diffraction methods: Laue method, powder method; point defects: vacancies, substitutional, interstitial, Frenkel and Schottky defects, line defects (qualitative) and Burger's vector, surface defects: stacking faults, twin, tilt and grain boundaries.

Text Books:

1. Physics Vol. 2, Halliday, Resnick and Kramer John wiley and Sons, Edition 4.
2. Modern Engineering Physics, K. Vijaya Kumar and S. Chandra Lingam, S. Chand and Co. Pvt. Ltd.
3. Introduction to Solid State Physics, Charles Kittel, Wiley Student edition.

Reference Books:

1. X-Ray Crystallography, Phillips, John Wiley publishers.
2. Waves, Frank S Crawford Jr, Berkeley Physics course, Volume 3.
3. Solid State Physics, AJ Dekker, MacMilan Publishers.
4. Introduction to Crystallography, Phillips, John Wiley publishers.

COMPUTER PROGRAMMING IN C

B.Tech. I Year I Sem.	**L T/P/D C**
Course Code: **CS104ES/CS204ES**	**3 0/0/0 3**

Course Objectives:

- To learn the fundamentals of computers.
- To understand the various steps in Program development.
- To learn the syntax and semantics of C Programming Language.
- To learn how to write modular and readable C Programs.
- To learn to write programs using structured programming approach in C to solve problems.

Course Outcomes:

- Demonstrate the basic knowledge of computer hardware and software.
- Ability to write algorithms for solving problems.
- Ability to draw flowcharts for solving problems.
- Ability to code a given logic in C programming language.
- Gain knowledge in using C language for solving problems.

UNIT - I

Introduction to Computers – Computer Systems, Computing Environments, Computer Languages, Creating and running programs, Program Development, algorithms and flowcharts , Number systems-Binary, Decimal, Hexadecimal and Conversions, storing integers and real numbers.

Introduction to C Language – Background, C Programs, Identifiers, Types, Variables, Constants, Input / Output, Operators(Arithmetic, relational, logical, bitwise etc.), Expressions, Precedence and Associativity, Expression Evaluation, Type conversions, Statements- Selection Statements(making decisions) – if and switch statements, Repetition statements (loops)-while, for, do-while statements, Loop examples, other statements related to looping – break, continue, goto, Simple C Program examples.

UNIT - II

Functions-Designing Structured Programs, Functions, user defined functions, inter function communication, Standard functions, Scope, Storage classes-auto, register, static, extern, scope rules, type qualifiers, recursion- recursive functions, Limitations of recursion, example C programs.

Arrays – Concepts, using arrays in C, inter function communication, array applications- linear search, binary search and bubble sort, two – dimensional arrays, multidimensional arrays, C program examples.

UNIT - III

Pointers – Introduction (Basic Concepts), Pointers for inter function communication, pointers to pointers, compatibility, Pointer Applications-Arrays and Pointers, Pointer Arithmetic and arrays,

Passing an array to a function, memory allocation functions, array of pointers, programming applications, pointers to void, pointers to functions.
Strings – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions, string / data conversion, C program examples.

UNIT - IV
Enumerated, Structure ,and Union Types– The Type Definition (typedef), Enumerated types, Structures –Declaration, initialization, accessing structures, operations on structures, Complex structures-Nested structures, structures containing arrays, structures containing pointers, arrays of structures, structures and functions, Passing structures through pointers, self referential structures, unions, bit fields, C programming examples, command–line arguments, Preprocessor commands.

UNIT – V
Input and Output – Concept of a file, streams, text files and binary files, Differences between text and binary files, State of a file, Opening and Closing files, file input / output functions (standard library input / output functions for files), file status functions (error handling), Positioning functions (fseek ,rewind and ftell), C program examples.

Text books:

1. Computer Science: A Structured Programming Approach Using C, B.A. Forouzan and R. F. Gilberg, Third Edition, Cengage Learning.
2. Programming in C. P. Dey and M Ghosh , Second Edition, Oxford University Press.

Reference books:

1. The C Programming Language, B.W. Kernighan and Dennis M. Ritchie, Second Edition, Pearson education.
2. Programming with C, B. Gottfried, 3rd edition, Schaum's outlines, McGraw Hill Education (India) Pvt Ltd.
3. C From Theory to Practice, G S. Tselikis and N D. Tselikas, CRC Press.
4. Basic computation and Programming with C, Subrata Saha and S. Mukherjee, Cambridge University Press.

ENGINEERING MECHANICS

B.Tech. I Year I Sem.	**L T/P/D C**
Course Code: **ME105ES**	**3 0/0/0 3**

Pre Requisites: None

Course Objectives:

- To understand the resolving forces and moments for a given force system
- To analyze the types of friction for moving bodies and problems related to friction.
- To determine the centroid and second moment of area

UNIT-I

Introduction to Mechanics: Basic Concepts, system of Forces Coplanar Concurrent Forces - Components in Space Resultant -Moment of Forces and its Application - Couples and Resultant of Force Systems. Equilibrium of system of Forces: Free body diagrams, Equations of Equilibrium of Coplanar Systems.

UNIT-II

Friction: Types of friction -Limiting friction -Laws of Friction -static and Dynamic Frictions -Motion of Bodies – Wedge & Screw, Screw-jack.

UNIT-III

Centroid and Center of Gravity: Introduction – Centroids of lines – Centroids of area - Centroids of Composite figures - Theorem of Pappus - Centre of Gravity of Bodies – Centroids of Volumes – Center of gravity of composite bodies.

Area moments of Inertia: Introduction – Definition of Moment of Inertia -Polar Moment of Inertia – Radius of gyration. Transfer Theorem for moment of inertia – Moments of inertia by integration - Moments of Inertia of Composite Figures.

UNIT-IV

Mass Moment of Inertia: Introduction - Moment of Inertia of Masses – Radius of gyration - Transfer Formula for Mass Moments of Inertia – Mass moments of inertia by integration - Mass moment of inertia of composite bodies.

UNIT-V

Kinetics: Kinetics of a particle-D'Alemberts principle. Work-energy and power. Principle of conservation of energy- Kinetics of rigid body in translation, rotation-work done-Principle of work-energy.

TEXT BOOKS:

1. Singer's Engineering Mechanics Statics and Dynamics/ K. Vijaya Kumar Reddy, J. Suresh Kumar/ BSP
2. Engineering Mechanics/ Irving Shames, G. Krishna Mohan Rao / Prentice Hall
3. Foundations and applications of Engineering Mechanics by HD Ram and AK Chouhan, Cambridge publications.
4. A Text Book of Engineering Mechanics/S.S. Bhavikatti/New Age International (P) Limited Publications, New Delhi.
5. Engineering Mechanics Statics and Dynamics/N.H. Dubey/ McGraw Hill Education (India) Private Limited, New Delhi.

REFERENCES:

1. A Text of Engineering Mechanics /YVD Rao/ K. Govinda Rajulu/ M. Manzoor Hussain / Academic Publishing Company
2. Engineering Mechanics / Bhattacharyya/ Oxford.

ENGINEERING GRAPHICS

B.Tech. I Year I Sem. **L T/P/D C**
Course Code: **ME106ES/ME205ES** **2 0/0/4 4**

Pre-requisites: None

Course objectives:

- To provide basic concepts in engineering drawing.
- To impart knowledge about standard principles of orthographic projection of objects.
- To draw sectional views and pictorial views of solids.

Course Outcomes:

- Ability to prepare working drawings to communicate the ideas and information.
- Ability to read, understand and interpret engineering drawings.

UNIT – I

Introduction to Engineering Drawing: Principles of Engineering Graphics and their Significance, Conic Sections. Involute, Cycloid, Epicycloid and Hypocycloid Scales – Plain & Diagonal.

UNIT - II

Orthographic Projections: Principles of Orthographic Projections – Conventions – Projections of Points and Straight Lines. Projections of Plane regular geometric figures.— Auxiliary Planes.

UNIT – III

Projections of Regular Solids – Auxiliary Views.

UNIT – IV

Sections and Developments: Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views. Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid, and Cone.

UNIT – V

Isometric & Orthographic Projections: Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple Solids – Conversion of Isometric Views to Orthographic Views.

Text Books:

1. Engineering Drawing N.D. Bhatt / Charotar
2. Engineering Drawing / Basant Agrawal and McAgrawal/ McGraw Hill
3. Engineering Drawing/ M. B. Shah, B.C. Rane / Pearson.
4. Engineering Drawing / N. S. Parthasarathy and Vela Murali/ Oxford

ENGINEERING PHYSICS LAB

B.Tech. I Year I Sem. **L T/P/D C**
Course Code: **PH107BS/PH207BS** **0 0/3/0 2**

(Any TEN experiments compulsory)

1. Dispersive power of the material of a prism – Spectrometer.
2. Determination of wavelengths of white source – Diffraction grating.
3. Newton's Rings – Radius of curvature of Plano convex lens.
4. Melde's experiment – Transverse and longitudinal modes.
5. Charging, discharging and time constant of an R-C circuit.
6. L-C-R circuit – Resonance & Q-factor.
7. Magnetic field along the axis of current carrying coil – Stewart and Gees method and to verify Biot – Savart's law.
8. Study the characteristics of LED and LASER diode.
9. Bending losses of fibres & Evaluation of numerical aperture of a given fibre.
10. Energy gap of a material of p-n junction.
11. Torsional pendulum – Rigidity modulus.
12. Wavelength of light, resolving power and dispersive power of a diffraction grating using laser.
13. V-I characteristics of a solar cell.

COMPUTER PROGRAMMING IN C LAB

B.Tech. I Year I Sem. — **L T/P/D C**

Course Code: **CS108ES/CS208ES** — **0 0/3/0 2**

Course Objective:

- To write programs in C using structured programming approach to solve the problems.

Course Outcomes

- Ability to design and test programs to solve mathematical and scientific problems.
- Ability to write structured programs using control structures and functions.

Recommended Systems/Software Requirements:

- Intel based desktop PC
- GNU C Compiler

1. a) Write a C program to find the factorial of a positive integer.

b) Write a C program to find the roots of a quadratic equation.

2. a) Write a C program to determine if the given number is a prime number or not.

b) A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1.Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.

3. a) Write a C program to construct a pyramid of numbers.

b) Write a C program to calculate the following Sum:

$Sum=1-x^2/2! +x^4/4!-x^6/6!+x^8/8!-x^{10}/10!$

4. a) The least common multiple (lcm) of two positive integers a and b is the smallest integer that is evenly divisible by both a and b. Write a C program that reads two integers and calls lcm (a, b) function that takes two integer arguments and returns their lcm. The lcm (a, b) function should calculate the least common multiple by calling the gcd (a, b) function and using the following relation:

LCM (a,b) = ab / gcd (a,b)

b) Write a C program that reads two integers n and r to compute the ncr value using the following relation:

ncr (n,r) = n! / r! (n-r)! . Use a function for computing the factorial value of an integer.

5. a) Write C program that reads two integers x and n and calls a recursive function to compute x^n

b) Write a C program that uses a recursive function to solve the Towers of Hanoi problem.

c) Write a C program that reads two integers and calls a recursive function to compute ncr value.

6. a) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user using Sieve of Eratosthenes algorithm.

b) Write a C program that uses non recursive function to search for a Key value in a given list of integers. Use linear search method.

7. a) Write a menu-driven C program that allows a user to enter n numbers and then choose between finding the smallest, largest, sum, or average. The menu and all the choices are to be functions. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.

b) Write a C program that uses non recursive function to search for a Key value in a given sorted list of integers. Use binary search method.

8 a) Write a C program that implements the Bubble sort method to sort a given list of integers in ascending order.

b) Write a C program that reads two matrices and uses functions to perform the following:

i) Addition of two matrices

ii) Multiplication of two matrices

9. a) Write a C program that uses functions to perform the following operations:

i) to insert a sub-string into a given main string from a given position.

ii) to delete n characters from a given position in a given string.

b) Write a C program that uses a non recursive function to determine if the given string is a palindrome or not.

10. a) Write a C program to replace a substring with another in a given line of text.

b) Write a C program that reads 15 names each of up to 30 characters, stores them in an array, and uses an array of pointers to display them in ascending (ie. alphabetical) order.

11. a) 2's complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2's complement of 11100 is 00100. Write a C program to find the 2's complement of a binary number.

b) Write a C program to convert a positive integer to a roman numeral. Ex. 11 is converted to XI.

12. a) Write a C program to display the contents of a file to standard output device.

b) Write a C program which copies one file to another, replacing all lowercase characters with their uppercase equivalents.

13. a) Writ**e a C** program to count the number of times a character occurs in a text file. The file name and the character are supplied as command-line arguments.

b) Write a C program to compare two files, printing the first line where they differ.

14. a) Write a C program to change the nth character (byte) in a text file. Use fseek function.

b) Write a C program to reverse the first n characters in a file. The file name and n are specified on the command line. Use fseek function.

15. a) Write a C program to merge two files into a third file (i.e., the contents of the firs t file followed by those of the second are put in the third file).

b) Define a macro that finds the maximum of two numbers. Write a C program that uses the macro and prints the maximum of two numbers.

Reference Books:

1. Mastering C, K.R. Venugopal and S.R. Prasad, TMH Publishers.
2. Computer Programming in C, V. Rajaraman, PHI.
3. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
4. C++: The complete reference, H. Schildt, TMH Publishers.

AP201BS: APPLIED PHYSICS

I Year II Sem. B.Tech.

L	T/P/D	C
3	0/0/0	3

Course Objectives:

- To understand the elastic behavior of materials.
- To understand basic principles of acoustics and architecture of buildings.
- To study production and applications of ultrasonics.
- To understand magnetic, dielectric and superconducting properties.

Course Outcomes: after completion of this course the student is able to

- Realize the importance of elastic behavior of materials.
- Learn Sabine's formula for reverberation time and apply in architecture of buildings.
- Learn various methods of producing ultrasonics and their uses.
- Learn magnetic, dielectric and superconducting properties of materials and their applications.

UNIT - I

Elastic properties: stress and strain, Hooke's law, elastic behaviour of a material, factors affecting elasticity, three modulii of elasticity, work done for unit volume in deforming a body, relation between three modulii of elasticity, determination of rigidity modulus – torsional pendulum.

UNIT - II

Acoustics of buildings and acoustic quieting: Introduction, basic requirement for the acoustically good halls, reverberation and time of reverberation, transmission of sound and transmission loss, factors affecting the architectural acoustics and their remedy, sound absorbing materials, sabine formulae, absorption coefficients, stadium seating, movie theater, acoustic quieting,

UNIT - III

Ultrasonics: Introduction, production of ultrasonic waves, magnetostriction method, piezo electric method, detection of ultrasonic waves, properties of ultrasonic waves, use of ultrasonics for nondestructive testing, applications of ultrasonics.

UNIT - IV

Dielectric Properties: Electric dipole, dipole moment, dielectric constant, polarizability, electric susceptibility, displacement vector, electronic, ionic and orientation polarizations and calculation of their polarizabilitites, internal field, Clausius-Mossotti relation, Piezoelectricity, pyroelectricity and ferroelectricity-$BaTiO_3$ structure.

UNIT - V

Magnetic Properties: Permeability, field intensity, magnetic field induction, magnetization, magnetic susceptibility, origin of magnetic moment, Bohr magneton, classification of dia, para and ferro magnetic materials on the basis of magnetic moment, hysteresis curve based on domain theory, soft and hard magnetic materials, properties of anti-ferro and ferri magnetic materials.

Superconductivity: Superconductivity phenomenon, Meissner effect, applications of superconductivity.

Text books:

1. Solid State Physics, A. J. Dekkar, MacMillan publishers
2. Fundamentals of Physics, Alan Giambattisa, BM Richardson and Robert C Richardson, Tata Mcgrahill Publishers
3. Fundamentals of Acoustics, Kinster and Frey, John Wiley and Sons.

Reference Books:

1. Solid state physics, Charles Kittel, Wiley student edition
2. University Physics, Francis W. Sears, Hugh D. Young, Marle Zeemansky and Roger A Freedman, Pearson Education.
3. Introduction to Magnetic Materials, B.D. Cullity, C.D.Graham, A John Wiley & Sons, Inc., Publication.
4. Elastic and Inelastic Stress Analysis, Irving H. Shames, Francis A. Cozzarelli, Taylor & Francis Group.

CH102BS/CH202BS: ENGINEERING CHEMISTRY

I Year II Sem. B.Tech. **L T/P/D C**
4 0/0/0 4

Course Objectives:

- To bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.
- To include the importance of water in industrial usage, significance of corrosion control to protect the structures, polymers and their controlled usage.
- To acquire knowledge of engineering materials and about fuels and batteries.
- To acquire required knowledge about engineering materials like cement, refractories and composites..

Course Outcomes: Students will gain the basic knowledge of electrochemical procedures related to corrosion and its control. They can understand the basic properties of water and its usage in domestic and industrial purposes. They learn the use of fundamental principles to make predictions about the general properties of materials. They can predict potential applications of chemistry and practical utility in order to become good engineers and entrepreneurs

UNIT - I

Water and its treatment: Introduction – hardness of water – causes of hardness – types of hardness: temporary and permanent – expression and units of hardness – Estimation of hardness of water by complexometric method. Numerical problems. Potable water and its specifications- Steps involved in the treatment of potable water - Disinfection of potable water by chlorination and Ozonization. Defluoridation – Nalgonda technique - Determination of F^- ion by ion-selective electrode method.

Boiler troubles: sludges, scales and Caustic embrittlement. Internal treatment of Boiler feed water – Calgon conditioning – Phosphate conditioning - Colloidal conditioning – Softening of water by ion-exchange processes. Desalination of water – Reverse osmosis. Numerical problems – Sewage water - Steps involved in treatment of sewage.

UNIT - II

Electrochemistry: Electrode- electrode potential, standard electrode potential, types of electrodes – Construction and functioning of Standard hydrogen electrode, calomel and glass electrode. Nernst equation - electrochemical series and its applications. Electrochemical cells: Daniel cell – cell notation, cell reaction and cell emf -– Concept of concentration cells – Electrolyte concentration cell –Numerical problems.

Batteries: Cell and battery - Primary battery (dry cell, alkaline cell and Lithium cell) and Secondary battery (lead acid, Ni-Cd and lithium ion cell),**Fuel cells:** Hydrogen –oxygen and methanol-oxygen fuel cells – Applications.

UNIT – III

Polymers: Definition – Classification of polymers with examples – Types of polymerization – addition (free radical addition) and condensation polymerization with examples.

Plastics: Definition and characteristics- thermoplastic and thermosetting plastics, compounding and fabrication of plastics (compression and injection moulding). Preparation, Properties and engineering applications of PVC and Bakelite.

Fibers: Characteristics of fibers – preparation, properties and applications of Nylon-6,6 and Dacron. Fiber reinforced plastics (FRP) – Applications.

Rubbers: Natural rubber and its vulcanization - compounding of rubber.

Elastomers: Characteristics –preparation – properties and applications of Buna-S, Butyl and Thiokol rubber.

Conducting polymers: Characteristics and Classification with examples-mechanism of conduction in trans-polyacetylene and applications of conducting polymers.

Biodegradable polymers: Concept and advantages - Polylactic acid and poly vinyl alcohol and their applications.

UNIT - IV

Fuels & Combustion: Classification- solid fuels: coal – analysis of coal – proximate and ultimate analysis and their significance. Liquid fuels – petroleum and its refining, cracking – types – moving bed catalytic cracking. Knocking – octane and cetane rating, synthetic petrol - Fischer-Tropsch's process; Gaseous fuels – composition and uses of natural gas, LPG and CNG.

Combustion: Definition, Calorific value of fuel – HCV, LCV; Calculation of air quantity required for combustion of a fuel.

UNIT - V

Cement: Portland cement, its composition, setting and hardening of Portland cement.

Special cements: White cement, water proof cement, High alumina cement and Acid resistant cement.

Refractories: Classification, characteristics of good refractories, Refractoriness, refractoriness under load, porosity and chemical inertness – applications of refractories.

Lubricants: Classification of lubricants with examples-characteristics of a good lubricants - mechanism of lubrication (thick film, thin film and extreme pressure)- properties of lubricants: viscosity, cloud point, pour point, flash point and fire point.

Composites: Introduction- Constituents of composites – advantages, classification and constituents of composites. Applications of composites.

Text books:

1. Engineering Chemistry by P.C. Jain & M. Jain, Dhanpatrai Publishing Company, New Delhi (2010)
2. Engineering Chemistry by Rama Devi, Venkata Ramana Reddy and Rath, Cengage learning, New Delhi. (2016)

Reference Books:

1. Engineering Chemistry by Shashi Chawla, Dhanpatrai & Company (P) Ltd. Delhi (2011)
2. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi (2015)
3. Engineering Chemistry by Thirumala Chary and Laxminarayana, Scitech Publishers, Chennai (2016).

MA203BS: Mathematics - III
(Statistical and Numerical Methods)

I Year II Sem. B.Tech. **L T/P/D C**
4 1/0/0 4

Prerequisites: Foundation course (No prerequisites).

Course Objectives: To learn
- random variables that describe randomness or an uncertainty in certain realistic situation
- binomial geometric and normal distributions
- sampling distribution of mean, variance, point estimation and interval estimation
- the testing of hypothesis and ANOVA
- the topics those deals with methods to find roots of an equation
- to fit a desired curve by the method of least squares for the given data
- solving ordinary differential equations using numerical techniques

Course Outcomes: After learning the contents of this course the student must be able to
- differentiate among random variables involved in the probability models which are usefull for all branches of engineering
- calculate mean, proportions and variances of sampling distributions and to make important decisions s for few samples which are taken from a large data
- solve the tests of ANOVA for classified data
- find the root of a given equation and solution of a system of equations
- fit a curve for a given data
- find the numerical solutions for a given first order initial value problem

UNIT – I
Random variables and Distributions:
Introduction, Random variables, Discrete random variable, Continuous random variable, Distribution function, Expectation, Moment generating function, Moments and properties.
Discrete distributions: Binomial and geometric distributions. Continuous distribution: Normal distributions.

UNIT – II
Sampling Theory: Introduction, Population and samples, Sampling distribution of means (σ Known)-Central limit theorem, t-distribution, Sampling distribution of means (σunknown)- Sampling distribution of variances – χ^2 and F- distributions, Point estimation, Maximum error of estimate, Interval estimation.

UNIT – III
Tests of Hypothesis: Introduction, Hypothesis, Null and Alternative Hypothesis, Type I and Type II errors, Level of significance, One tail and two-tail tests, Tests concerning one mean

and proportion, two means-proportions and their differences-ANOVA for one-way classified data.

UNIT – IV

Algebraic and Transcendental Equations & Curve Fitting: Introduction, Bisection Method, Method of False position, Iteration methods: fixed point iteration and Newton Raphson methods. Solving linear system of equations by Gauss-Jacobi and Gauss-Seidal Methods.

Curve Fitting: Fitting a linear, second degree, exponential, power curve by method of least squares.

UNIT – V

Numerical Integration and solution of Ordinary Differential equations: Trapezoidal rule- Simpson's $1/3^{rd}$ and $3/8^{th}$ rule- Solution of ordinary differential equations by Taylor's series, Picard's method of successive approximations, Euler's method, Runge-Kutta method (second and fourth order)

Text Books:

1. Probability and Statistics for Engineers by Richard Arnold Johnson, Irwin Miller and John E. Freund, New Delhi, Prentice Hall.
2. Probability and Statistics for Engineers and Sciences by Jay L. Devore, Cengage Learning.
3. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar and R. K. Jain, New Age International Publishers

References:

1. Fundamentals of Mathematical Statistics by S. C. Guptha & V. K. Kapoor, S. Chand
2. Introductory Methods of Numerical Analysis by S. S. Sastry, PHI Learning Pvt. Ltd

EN104HS/EN204HS: PROFESSIONAL COMMUNICATION IN ENGLISH

I Year II Sem. B.Tech.	**L T/P/D C**
	3 0/0/0 3

INTRODUCTION:

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop linguistic and communicative competencies of Engineering students.

In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts/poems silently leading to reading comprehension. Reading comprehension passages are given for practice in the class. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind. For example, from newspaper articles, advertisements, promotional material, etc. *The focus in this syllabus is on skill development, fostering ideas and practice of language skills.*

Course Objectives: The course will help students to:

- Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
- Equip students to study academic subjects more effectively using the theoretical and Practical components of English syllabus.
- Develop study skills and communication skills in formal and informal situations.

Course Outcomes: Students will be able to:

- Use English Language effectively in spoken and written forms.
- Comprehend the given texts and respond appropriately.
- Communicate confidently in formal and informal contexts.

SYLLABUS

Reading Skills
Objectives

1. To develop an awareness in students about the significance of silent reading and comprehension.
2. To develop students' ability to guess meanings of words from the context and grasp the overall message of the text, draw inferences, etc., by way of:
   - Skimming and Scanning the text
   - Intensive and Extensive Reading
   - Reading for Pleasure

- Identifying the topic sentence
- Inferring lexical and contextual meaning
- Recognizing Coherence/Sequencing of Sentences

NOTE: The students will be trained in reading skills using the prescribed texts for detailed study. They will be tested in reading comprehension of different 'unseen' passages which may be taken from authentic texts, such as magazines/newspaper articles.

Writing Skills
Objectives

1. To develop an awareness in the students about writing as an exact and formal skill
2. To create an awareness in students about the components of different forms of writing, beginning with the lower order ones through;
   - Writing of sentences
   - Use of appropriate vocabulary
   - Paragraph writing
   - Coherence and cohesiveness
   - Narration / description
   - Note Making
   - Formal and informal letter writing
   - Describing graphs using expressions of comparison

In order to improve the proficiency of the students in the acquisition of language skills mentioned above, the following text and course contents, divided into Five Units, are prescribed:
The course content / study material is divided into **Five Units.**
Note: ***Listening and speaking skills are covered in the syllabus of ELCS Lab.***

UNIT – I
Chapter entitled '***Presidential Address' by Dr. A.P.J. Kalam*** from ***"Fluency in English– A Course book for Engineering Students"*** published by Orient BlackSwan, Hyderabad.

Vocabulary: Word Formation -- Root Words --The Use of Prefixes and Suffixes– Collocations– Exercises for Practice.
Grammar: Punctuation – Parts of Speech- Articles -Exercises for Practice.
Reading: ***Double Angels*** by David Scott-Reading and Its Importance- Techniques for Effective Reading- Signal Words- Exercises for Practice
Writing: Writing Sentences- Techniques for Effective Writing-- Paragraph Writing-Types, Structure and Features of a Paragraph-Coherence and Cohesiveness: Logical, Lexical and Grammatical Devices - Exercises for Practice

UNIT – II

Chapter entitled ***Satya Nadella: Email to Employees on his First Day as CEO*** from ***"Fluency in English– A Course book for Engineering Students"*** Published by Orient BlackSwan, Hyderabad.

Vocabulary: Synonyms and Antonyms – Homonyms, Homophones, Homographs- Exercises for Practice (Chapter 17 ***'Technical Communication- Principles and Practice'. Third Edition*** published by Oxford University Press may also be followed.)

Grammar: Verbs-Transitive, Intransitive and Non-finite Verbs – Mood and Tense—Gerund – Words with Appropriate Prepositions – Phrasal Verbs - Exercises for Practice

Reading: Sub-skills of Reading- Skimming, Scanning, Extensive Reading and Intensive Reading - ***The Road Not Taken*** by **Robert Frost** -- Exercises for Practice

Writing: Letter Writing –Format, Styles, Parts, Language to be used in Formal Letters- Letter of Apology – Letter of Complaint-Letter of Inquiry with Reply – Letter of Requisition –- Exercises for Practice

UNIT – III

From the book entitled ***'Technical Communication- Principles and Practice'. Third Edition*** published by Oxford University Press.

Vocabulary: Introduction- A Brief History of Words – Using the Dictionary and Thesaurus– Changing Words from One Form to Another – Confusables (From Chapter 17 entitled '*Grammar and Vocabulary Development*')

Grammar: Tenses: Present Tense- Past Tense- Future Tense- Active Voice – Passive Voice- Conditional Sentences – Adjective and Degrees of Comparison. (From Chapter 17 entitled '*Grammar and Vocabulary Development*')

Reading: Improving Comprehension Skills – Techniques for Good Comprehension- Skimming and Scanning- Non-verbal Signals – Structure of the Text – Structure of Paragraphs – Punctuation – Author's viewpoint (Inference) – Reader Anticipation: Determining the Meaning of Words – Summarizing- Typical Reading Comprehension Questions. (From Chapter 10 entitled '*Reading Comprehension*')

Writing: Introduction- Letter Writing-Writing the Cover Letter- Cover Letters Accompanying Resumes- Emails. (From Chapter 15 entitled '*Formal Letters, Memos, and Email*')

UNIT – IV

Chapter entitled ***'Good Manners' by J.C. Hill*** from ***Fluency in English – A Course book for Engineering Students"*** published by Orient Blackswan, Hyderabad.

Vocabulary: Idiomatic Expressions –One- word Substitutes --- Exercises for Practice (Chapter 17 ***'Technical Communication- Principles and Practice'. Third Edition*** published by Oxford University Press may also be followed.)

Grammar: Sequence of Tenses- Concord (Subject in Agreement with the Verb) – Exercises for Practice

Reading: ***'If'*** poem by **Rudyard Kipling**--Tips for Writing a Review --- Author's Viewpoint – Reader's Anticipation-- Herein the Students will be required to Read and Submit a Review of a Book (Literary or Non-literary) of their choice – Exercises for Practice.
Writing: Information Transfer-Bar Charts-Flow Charts-Tree Diagrams etc., -- Exercises for Practice.

Introduction - Steps to Effective Precis Writing – Guidelines- Samples (Chapter 12 entitled '*The Art of Condensation*' from ***Technical Communication- Principles and Practice. Third Edition*** published by Oxford University Press)

UNIT – V
Chapter entitled ***'Father Dear Father'*** **by Raj Kinger** from ***Fluency in English – A Course book for Engineering Students"*** Published by Orient BlackSwan, Hyderabad

Vocabulary: Foreign Words—Words borrowed from other Languages- Exercises for Practice
Grammar: Direct and Indirect Speech- Question Tags- Exercises for Practice
Reading: Predicting the Content- Understanding the Gist – SQ3R Reading Technique- Study Skills – Note Making - Understanding Discourse Coherence – Sequencing Sentences. (From Chapter 10 entitled **'Reading Comprehension'** - ***Technical Communication- Principles and Practice. Third Edition*** published by Oxford University Press.)
Writing: Technical Reports- Introduction – Characteristics of a Report – Categories of Reports –Formats- Prewriting – Structure of Reports (Manuscript Format) - Types of Reports - Writing the Report. (From Chapter 13 entitled **'Technical Reports'** - ***Technical Communication- Principles and Practice. Third Edition*** published by Oxford University Press.)

- **Exercises from both the texts not prescribed shall be used for classroom tasks.**

Text Books:
1. ***"Fluency in English – A Course book for Engineering Students"*** by Board of Editors**: Hyderabad: Orient BlackSwan Pvt. Ltd. 2016. Print.**
2. Raman, Meenakshi & Sharma, Sangeeta**. *"Technical Communication- Principles and Practice"*. Third Edition. New Delhi: Oxford University Press. 2015. Print.**

References:

1. Green, David. *Contemporary English Grammar –Structures and Composition*. MacMillan India. 2014 (Print)
2. Rizvi, M. Ashraf. *Effective Technical Communication*. Tata Mc Graw –Hill. 2015 (Print).

EE106ES/EE205ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

I Year II Sem. B.Tech.	**L**	**T/P/D**	**C**
	4	**0/0/0**	**4**

Pre-requisite: None

Course Objectives:

- To introduce the concept of electrical circuits and its components
- To introduce the concepts of diodes & transistors, and
- To impart the knowledge of various configurations, characteristics and applications.

Course Outcomes: After this course, the student will be able

- To analyze and solve electrical circuits using network laws and theorems.
- To identify and characterize diodes and various types of transistors.

UNIT - I

Basic Concepts of Electrical Circuits and Single Phase AC Circuits

Electrical Circuits: R-L-C Parameters, Voltage and Current, Independent and Dependent Sources, Source Transformation – V-I relationship for passive elements, Kirchoff's Laws, Network reduction techniques – series, parallel, series-parallel, star-to-delta, delta-to-star transformation, Nodal Analysis,

Single Phase AC Circuits: R.M.S. and Average values, Form Factor, steady state analysis of series, parallel and series-parallel combinations of R, L and C with sinusoidal excitation, concept of reactance, impedance, susceptance and admittance – phase and phase difference, Concept of power factor, j-notation, complex and polar forms of representation.

UNIT - II

Resonance: Series resonance and Parallel resonance circuits, concept of bandwidth and Q factor.

Network Theorems: Thevenin's, Norton's, Maximum Power Transfer, Superposition and Reciprocity theorem for DC and AC excitations.

UNIT - III

P-N Junction and Zener Diode: Principle of Operation Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Load line analysis, Diffusion and Transition Capacitances.

Zener Diode: characteristics.

Rectifiers and Filters: P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters.

UNIT - IV

Bipolar Junction Transistor (BJT): Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations.

Transistor Biasing And Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, Emitter Feedback Bias, Collector to Emitter feedback bias, Voltage divider bias, Bias stability, Stabilization against variations in V_{BE} and β, Bias Compensation using Diodes and Transistors.

Transistor Configurations: Hybrid model, Determination of h-parameters from transistor characteristics, Analysis of CE, CB and CC configurations using h-parameters, Comparison of CE, CB and CC configurations.

UNIT- V

Junction Field Effect Transistor: Construction, Principle of Operation, Pinch-Off Voltage, Volt-Ampere Characteristic, Comparison of BJT and FET, Biasing FET.

TEXT BOOKS:

1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J NagarathMcGraw Hill Education

REFERENCES:

1. Electronic Devices and Circuits – R. L. Boylestead and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.
3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches)- 2nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.

CH206BS: ENGINEERING CHEMISTRY LAB

I Year II Sem. B.Tech.

L	T/P/D	C
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LIST OF EXPERIMENTS

Volumetric Analysis:

1. Estimation of Ferrous ion by Dichrometry.
2. Estimation of hardness of water by Complexometric method using EDTA.
3. Estimation of Ferrous and Ferric ions in a given mixture by Dichrometry.
4. Estimation Ferrous ion by Permanganometry.
5. Estimation of copper by Iodomery.
6. Estimation of percentage of purity of MnO_2 in pyrolusite
7. Determination of percentage of available chlorine in bleaching powder.
8. Determination of salt concentration by ion- exchange resin.

Instrumental methods of Analysis:

1. Estimation of HCl by Conductometry.
2. Estimation of Ferrous ion by Potentiometry.
3. Determination of Ferrous iron in cement by Colorimetric method.
4. Determination of viscosity of an oil by Redwood / Oswald's Viscometer.
5. Estimation of manganese in $KMnO_4$ by Colorimetric method.
6. Estimation o f HCl and Acetic acid in a given mixture by Conductometry.
7. Estimation of HCl by Potentiometry.

Preparation of Polymers:

1. Preparation of Bakelite and urea formaldehyde resin.

Text Books:

1. Vogel's Text Book of Quantitative Chemical Analysis, 5th Edition (2015) G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney.
2. A Text Book on experiments and calculations in Engineering Chemistry by S.S. Dara S. Chand & Company Ltd., Delhi (2003).

PCE107HS/PCE207HS: ENGLISH LANGUAGE COMMUNICATION SKILLS LAB

I Year II Sem. B.Tech.	**L**	**T/P/D**	**C**
	0	**0/3/0**	**2**

The **English Language Communication Skills (ELCS) Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Course Objectives:

- To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
- To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm
- To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency of students in spoken English and neutralize their mother tongue influence
- To train students to use language appropriately for public speaking, group discussions and interviews

Course Outcomes: Students will be able to attain:

- Better understanding of nuances of English language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills.

Syllabus: English Language Communication Skills Lab (ELCS) shall have two parts:

- **Computer Assisted Language Learning (CALL) Lab**
- **Interactive Communication Skills (ICS) Lab**

Listening Skills:
Objectives:

- To enable students develop their listening skills so that they may appreciate the role in the LSRW skills approach to language and improve their pronunciation
- To equip students with necessary training in listening, so that they can comprehend the speech of people of different backgrounds and regions.

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills:
Objectives
- To involve students in speaking activities in various contexts
- To enable students express themselves fluently and appropriately in social and professional contexts :
    - Oral practice
    - Describing objects/situations/people
    - Role play – Individual/Group activities
    - Just A Minute (JAM) Sessions.

The following course content is prescribed for the **English Language Communication Skills Lab**.

Exercise – I
CALL Lab:
Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers- Effective Listening.
Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants – Minimal Pairs- Consonant Clusters- Past Tense Marker and Plural Marker.
Testing Exercises
ICS Lab:
Understand: Spoken vs. Written language- Formal and Informal English.
Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

Exercise – II
CALL Lab:
Understand: Structure of Syllables – Word Stress– Weak Forms and Strong Forms – Sentence Stress – Intonation.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms- Sentence Stress – Intonation.
Testing Exercises
ICS Lab:
Understand: Features of Good Conversation – Strategies for Effective Communication.
Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

Exercise - III
CALL Lab:
Understand: Errors in Pronunciation-the Influence of Mother Tongue (MTI).
Practice: Common Indian Variants in Pronunciation – Differences between British and American Pronunciation.
Testing Exercises
ICS Lab:
Understand: Descriptions- Narrations- Giving Directions and Guidelines.
Practice: Giving Instructions – Seeking Clarifications – Asking for and Giving Directions – Thanking and Responding – Agreeing and Disagreeing – Seeking and Giving Advice – Making Suggestions.

Exercise – IV
CALL Lab:
Understand: Listening for General Details.
Practice: Listening Comprehension Tests.
Testing Exercises
ICS Lab:
Understand: Public Speaking – Exposure to Structured Talks - Non-verbal Communication- Presentation Skills.
Practice: Making a Short Speech – Extempore- Making a Presentation.

Exercise – V
CALL Lab:
Understand: Listening for Specific Details.
Practice: Listening Comprehension Tests.
Testing Exercises
ICS Lab:
Understand: Group Discussion- Interview Skills.
Practice: Group Discussion- Mock Interviews.

Minimum Requirement of infrastructural facilities for ELCS Lab:

1. Computer Assisted Language Learning (CALL) Lab:
The Computer Assisted Language Learning Lab has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.
System Requirement (Hardware component):
Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:
Computers with Suitable Configuration
High Fidelity Headphones

2. Interactive Communication Skills (ICS) Lab:

The Interactive Communication Skills Lab: A Spacious room with movable chairs and audio-visual aids with a Public Address System, a T. V. or LCD, a digital stereo –audio & video system and camcorder etc.

Prescribed Lab Manuals:

1. A book entitled "***ELCS Lab Manual – A Workbook for CALL and ICS Lab Activities***" by Board of Editors: Hyderabad: Orient BlackSwan Pvt. Ltd. 2016. Print.
2. Hart, Steve; Nair, Aravind R.; Bhambhani, Veena. ***"EMBARK- English for undergraduates"*** Delhi: Cambridge University Press. 2016. Print.

Suggested Software:

1. Cambridge Advanced Learners' English Dictionary with CD.
2. Grammar Made Easy by Darling Kindersley.
3. Punctuation Made Easy by Darling Kindersley.
4. Oxford Advanced Learner's Compass, 8th Edition.
5. English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
6. English Pronunciation in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
7. TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).

References:

1. Jayashree Mohanraj. *Let Us Hear Them Speak*. New Delhi: Sage Texts. 2015.Print.
2. Hancock, M. *English Pronunciation in Use. Intermediate Cambridge*: Cambridge University Press. 2009.Print.

ME108ES/ME208ES: ENGINEERING WORKSHOP

I Year II Sem. B.Tech.

L	T/P/D	C
0	0/3/0	2

Pre-requisites: Practical skill

Course Objectives:
- To Study of different hand operated power tools, uses and their demonstration.
- To gain a good basic working knowledge required for the production of various engineering products.
- To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the engineering field.
- To develop a right attitude, team working, precision and safety at work place.
- It explains the construction, function, use and application of different working tools, equipment and machines.
- To study commonly used carpentry joints.
- To have practical exposure to various welding and joining processes.
- Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.

Course Outcomes: At the end of the course, the student will be able to:
- Study and practice on machine tools and their operations
- Practice on manufacturing of components using workshop trades including pluming, fitting, carpentry, foundry, house wiring and welding.
- Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling.
- Apply basic electrical engineering knowledge for house wiring practice.

1. TRADES FOR EXERCISES:
At least two exercises from each trade:
- Carpentry
- Fitting
- Tin-Smithy and Development of jobs carried out and soldering.
- Black Smithy
- House-wiring
- Foundry
- Welding
- Power tools in construction, wood working, electrical engineering and mechanical
- Engineering.

2. TRADES FOR DEMONSTRATION & EXPOSURE:
- Plumbing, Machine Shop, Metal Cutting (Water Plasma)

Text Books:

1. Workshop Practice /B. L. Juneja / Cengage
2. Workshop Manual / K.Venugopal / Anuradha.

Reference Books:

1. Work shop Manual - P.Kannaiah/ K.L.Narayana/ Scitech
2. Workshop Manual / Venkat Reddy/ BSP

MA301BS: MATHEMATICS - IV
(Complex Variables and Fourier Analysis)

B.Tech. II Year I Sem.

L	T	P	C
4	1	0	4

Prerequisites: Foundation course (No Prerequisites)

Course Objectives: To learn

- differentiation and integration of complex valued functions
- evaluation of integrals using Cauchy's integral formula
- Laurent's series expansion of complex functions
- evaluation of integrals using Residue theorem
- express a periodic function by Fourier series and a non-periodic function by Fourier transform
- to analyze the displacements of one dimensional wave and distribution of one dimensional heat equation

Course Outcomes: After learning the contents of this paper the student must be able to

- analyze the complex functions with reference to their analyticity, integration using Cauchy's integral theorem
- find the Taylor's and Laurent's series expansion of complex functions
- the bilinear transformation
- express any periodic function in term of sines and cosines
- express a non-periodic function as integral representation
- analyze one dimensional wave and heat equation

UNIT – I

Functions of a complex variable: Introduction, Continuity, Differentiability, Analyticity, properties, Cauchy, Riemann equations in Cartesian and polar coordinates**.** Harmonic and conjugate harmonic functions-Milne-Thompson method

UNIT - II

Complex integration: Line integral, Cauchy's integral theorem, Cauchy's integral formula, and Generalized Cauchy's integral formula, Power series: Taylor's series- Laurent series, Singular points, isolated singular points, pole of order m – essential singularity, Residue, Cauchy Residue theorem (Without proof).

UNIT – III

Evaluation of Integrals: Types of real integrals:

(a) Improper real integrals $\int_{-\infty}^{\infty} f(x)dx$ (b) $\int_{c}^{c+2\pi} f(\cos\theta, \sin\theta)d\theta$

Bilinear transformation- fixed point- cross ratio- properties- invariance of circles.

UNIT – IV

Fourier series and Transforms: Introduction, Periodic functions, Fourier series of periodic function, Dirichlet's conditions, Even and odd functions, Change of interval, Half range sine and cosine series.

Fourier integral theorem (without proof), Fourier sine and cosine integrals, sine and cosine, transforms, properties, inverse transforms, Finite Fourier transforms.

UNIT – V

Applications of PDE: Classification of second order partial differential equations, method of separation of variables, Solution of one dimensional wave and heat equations.

TEXT BOOKS:

1. A first course in complex analysis with applications by Dennis G. Zill and Patrick Shanahan, Johns and Bartlett Publishers.
2. Higher Engineering Mathematics by Dr. B. S. Grewal, Khanna Publishers.
3. Advanced engineering Mathematics with MATLAB by Dean G. Duffy

REFERENCES:

1. Fundamentals of Complex Analysis by Saff, E. B. and A. D. Snider, Pearson.
2. Advanced Engineering Mathematics by Louis C. Barrett, McGraw Hill.

ME301ES: FLUID MECHANICS AND HYDRAULIC MACHINES

B.Tech. II Year I Sem. **L T P C**
4 1 0 4

Course Objectives: The objectives of the course are to enable the student;

1. To understand the basic principles of fluid mechanics
2. To identify various types of flows
3. To understand boundary layer concepts and flow through pipes
4. To evaluate the performance of hydraulic turbines
5. To understand the functioning and characteristic curves of pumps

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Course Outcomes:

1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation.
3. To analyze a variety of practical fluid flow and measuring devices and utilize fluid ~~1.~~ mechanics principles in design.
4. To select and analyze an appropriate turbine with reference to given situation in power plants.

~~4.~~5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.
~~5.~~6. Able to demonstrate boundary layer concepts.

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UNIT - I

Fluid statics: Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension - vapour pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

UNIT - II

Fluid kinematics: Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three dimensional flows.

Fluid dynamics: Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.

UNIT - III

Boundary Layer Concepts: Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line. Measurement of flow: Pitot tube, venturi meter, and orifice meter, Flow nozzle

UNIT - IV

Basics of turbo machinery : Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

Hydraulic Turbines : Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies , hydraulic design –draft tube theory- functions and efficiency.

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT - V

Centrifugal pumps: Classification, working, work done – barometric head- losses and efficiencies specific speed- performance characteristic curves, NPSH.

Reciprocating pumps: Working, Discharge, slip, indicator diagrams.

TEXT BOOKS:

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by Rajput.

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REFERENCES:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.

~~1.~~3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.

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AE302ES: AIRCRAFT PRODUCTION TECHNOLOGY

B.Tech. II Year I Sem. **L T P C**
3 0 0 3

UNIT – I

Casting and Welding: General principles of various Casting Processes: Sand casting, die-casting, centrifugal casting, investment casting; shell moulding types; Principles and equipment used in arc welding, gas welding, resistance welding, solid phase welding process, laser welding, Electron beam welding, Soldering and brazing techniques.

UNIT – II

Machining and Forming: General Principals (with schematic diagram only) of working and types: lathe, shaper, milling machines, grinding, drilling machine, CNC machining and general principles; Sheet metal operations: shearing, punching, super plastic forming; Automation in bend forming and different operations in bending like stretch forming spinning drawing etc.

UNIT – III

Unconventional Machining: Principles (with schematic diagram only) of working and applications of abrasive jet machining, ultrasonic machining.
Electric discharge machining and electro chemical machining, laser beam/electron beam/plasma arc machining.

UNIT – IV

Tooling, Assembly and NDT: Jigs, fixtures, and stages of assembly; Types of equipment for riveted joints, bolted joints, Aircraft tooling concepts; NDT and other Inspection techniques: Dye penetrant test, X-Ray, magnetic particle, and ultrasonic testing, Acoustic holography.

UNIT – V

Introduction to Additive Manufacturing: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Advantages of AM, Guidelines for process selection: Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control, AM applications, Future directions of AM.

TEXT BOOKS:

1. Kalpakajam, “Manufacturing Engineering and Technology”, Addison Wesley 5th Edn, 1991.

REFERENCE BOOKS:

1. Keshu S. C, Ganapathy K.K, “Air craft production techniques”, Interline Publishing House, Bangalore, 3rd Edition, 1993.
2. R. K Jain-Khanna, “Production technology”, Mc Graw Hill, 1st Edition, 2002.
3. O. P Khanna, Lal. M. Dhanpat Rai, “Production technology”, 5th Edition, 1997.

ME303ES: MECHANICS OF SOLIDS

B.Tech. II Year I Sem. **L T P C**
3 1 0 3

Course Objectives: The objective is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials is also of interest. Fundamentals of applying equilibrium, compatibility, and force-deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis. The course builds on the fundamental concepts of engineering mechanics course.
This course will advance the students' development of the following broad capabilities:

1. Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.

~~2.~~1. Students will be able to understand and know how to calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions.

~~3.~~2. Students will understand how to develop shear-moment diagrams of a beam and find the maximum moment/shear and their locations

~~4.~~3. Students will understand how to calculate normal and shear stresses

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Course Outcomes:

1. Analyze the behavior of the solid bodies subjected to various types of loading;
2. Apply knowledge of materials and structural elements to the analysis of simple structures;
3. Undertake problem identification, formulation and solution using a range of analytical methods;
4. Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams.
5. Expectation and capacity to undertake lifelong learning

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UNIT - I

Simple Stresses & Strains: Elasticity and plasticity – Types of stresses & strains–Hooke's law– stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT - II

Shear Force and Bending Moment : Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT - III

Flexural Stresses : Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT - IV

Principal Stresses and Strains: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses – Principal stresses and strains – Analytical and graphical solutions. **Theories of Failure**: Introduction – Various theories of failure - Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory (Von Mises Theory).

UNIT - V

Torsion of Circular Shafts : Theory of pure torsion – Derivation of Torsion equations : T/J = q/r = Nθ/L – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.

Thin Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells.

TEXT BOOKS:

1. Strength of materials – R.S. Kurmi and Gupta.
2. Solid Mechanics, by Popov
3. Strength of Materials – Ryder. G.H.; Macmillan Long Man Pub.
4. Strength of Materials – W.A. Nash, TMH

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REFERENCES:

1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani.
3. Mechanics of Structures Vol –I by H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd.
4. Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.
5. Strength of Materials by S. S. Rattan, Tata McGraw Hill Education Pvt. Ltd.
6. Fundamentals of Solid Mechanics by M. L. Gambhir, PHI Learning Pvt. Ltd

~~1.~~7. Strength of Materials by R.K Rajput, S. Chand & Company Ltd.

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ME304ES: THERMODYNAMICS

B.Tech. II Year I Sem.

L	T	P	C
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Pre-requisite: Engineering Chemistry and Physics

Course Objective: To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics to engineering applications

Course Outcomes: At the end of the course, the student should be able to Understand and differentiate between different thermodynamic systems and processes. Understand and apply the laws of Thermodynamics to different types of systems undergoing various processes and to perform thermodynamic analysis. Understand and analyze the Thermodynamic cycles and evaluate performance parameters.

Tables/Codes: Steam Tables and Mollier Chart, Refrigeration Tables

UNIT – I

Introduction: Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

UNIT - II

PMM I - Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation.

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump , Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics

UNIT – III

Pure Substances, p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes

UNIT - IV

Deviations from perfect Gas Model – Vader Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour, Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier's Equation – Psychrometric chart.

UNIT - V

Power Cycles : Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

Refrigeration Cycles:

Brayton and Rankine cycles – Performance Evaluation – combined cycles, Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

TEXT BOOKS:

1. Engineering Thermodynamics / PK Nag / Mc Graw Hill
2. Thermodynamics for Engineers / Kenneth A. Kroos ; Merle C. Potter/ Cengage

REFERENCE BOOKS:

1. Engineering Thermodynamics / Chattopadhyay/ Oxford
2. Engineering Thermodynamics / Rogers / Pearson

AE305ES: AIRCRAFT PRODUCTION TECHNOLOGY LAB

B.Tech. II Year I Sem.

L	T	P	C
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List of Experiments:

1. Introduction- lathe machine, plain turning, Step turning & grooving.
2. Taper turning-compound rest/offset method & Drilling using lathe.
3. External threading-Single start
4. Eccentric turning-Single axis
5. Shaping-V-Block.
6. Grinding-Cylindrical /Surface/Tool & cutter.
7. Slotting-Keyways.
8. Milling-Polygon /Spur gear
9. Gear hobbing-Helical gear
10. Drilling, reaming, counter boring.

REFERENCES:

1. Keshu S. C, Ganapathy K. K, "Air craft production techniques", Interline Publishing House, Bangalore, 3rd Edition, 1993.
2. R. K Jain-Khanna, "Production technology", McGraw Hill, 1st Edition, 2002.
3. O. P Khanna, Lal. M. Dhanpat Rai, "Production technology", 5th Edition, 1997.

ME307ES: MECHANICS OF SOLIDS LAB

B.Tech. II Year I Sem.

L	T	P	C
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Course Objectives:

The objective is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials is also of interest. Fundamentals of applying equilibrium, compatibility, and force-deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis. The course builds on the fundamental concepts of engineering mechanics course.

The students will advance the students' development of the following broad capabilities:

1. Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.
2. Students will be able to understand and know how to calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions.
3. Students will understand how to develop shear-moment diagrams of a beam and find the maximum moment/shear and their locations
4. Students will understand how to calculate normal and shear stresses on any cross-section of a beam. Different cross-sections (including I-beam) will be discussed and applied Continuous Assessment Test 10 marks Mid Semester Test 15 marks End

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Course Outcomes

1. Analyze the behavior of the solid bodies subjected to various types of loading.
2. Apply knowledge of materials and structural elements to the analysis of simple structures.
3. Undertake problem identification, formulation and solution using a range of analytical methods
4. Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams.
5. Expectation and capacity to undertake lifelong learning.

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Any 10 experiments from the following

1. Direct tension test
2. Bending test on Simple supported beam
3 Bending test on Cantilever beam
4. Torsion test
5. Brinell hardness test
6. Rockwell hardness test

7. Test on springs
8. Compression test on cube
9. Izod Impact test
10 .Charpy Impact test
11. Punch shear test

ME310ES: FLUID MECHANICS AND HYDRAULIC MACHINES LAB

	L	T	P	C
B.Tech. II Year I Sem.	**0**	**0**	**3**	**2**

Course Objectives:

~~3.~~1. To understand the basic principles of fluid mechanics.
~~4.~~2. To identify various types of flows.
~~5.~~3. To understand boundary layer concepts and flow through pipes.
~~6.~~4. To evaluate the performance of hydraulic turbines.
~~7.~~5. To understand the functioning and characteristic curves of pumps.

Course Outcomes:

~~•~~1. Able to explain the effect of fluid properties on a flow system.
~~•~~2. Able to identify type of fluid flow patterns and describe continuity equation.
~~•~~3. To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
~~•~~4. To select and analyze an appropriate turbine with reference to given situation in power plants.
~~•~~5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.
~~•~~6. Able to demonstrate boundary layer concepts

List of Experiments:

~~4.~~1. Impact of jets on Vanes.
~~5.~~2. Performance Test on Pelton Wheel.
~~6.~~3. Performance Test on Francis Turbine.
~~7.~~4. Performance Test on Kaplan Turbine.
~~8.~~5. Performance Test on Single Stage Centrifugal Pump.
~~9.~~6. Performance Test on Multi Stage Centrifugal Pump.
~~10.~~7. Performance Test on Reciprocating Pump.
~~11.~~8. Calibration of Venturimeter.
~~12.~~9. Calibration of Orifice meter.
~~13.~~10. Determination of friction factor for a given pipe line.
~~14.~~11. Determination of loss of head due to sudden contraction in a pipeline.
~~15.~~12. Verification of Bernoulli's Theorems

Note: Any 10 of the above 12 experiments are to be conducted.

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MC300HS: GENDER SENSITIZATION LAB

B.Tech. II Year I Sem.

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Course Objectives:

- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- To introduce students to information about some key biological aspects of genders.
- To expose the students to debates on the politics and economics of work.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women.

Course Outcomes:

- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature, and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students will acquire insight into the gendered division of labour and its relation to politics and economics.
- Men and women students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life.
- Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

UNIT-I
UNDERSTANDING GENDER

Gender: Why Should We Study It? (*Towards a World of Equals*: Unit -1)

Socialization: Making Women, Making Men (*Towards a World of Equals*: Unit -2)

Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT-II
GENDER AND BIOLOGY

Missing Women: Sex Selection and Its Consequences (*Towards a World of Equals*: Unit -4)

Declining Sex Ratio. Demographic Consequences.

Gender Spectrum: Beyond the Binary (*Towards a World of Equals*: Unit -10)

Two or Many? Struggles with Discrimination.

UNIT-III
GENDER AND LABOUR

Housework: the Invisible Labour (*Towards a World of Equals*: Unit -3)

"My Mother doesn't Work." "Share the Load."
Women's Work: Its Politics and Economics (*Towards a World of Equals*: Unit -7)
Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

UNIT-IV
ISSUES OF VIOLENCE
Sexual Harassment: Say No! (*Towards a World of Equals*: Unit -6)
Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "*Chupulu"*.
Domestic Violence: Speaking Out (*Towards a World of Equals*: Unit -8)
Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading: New Forums for Justice.
Thinking about Sexual Violence (*Towards a World of Equals*: Unit -11)
Blaming the Victim-"I Fought for my Life…." - Additional Reading: The Caste Face of Violence.

UNIT-V
GENDER: CO - EXISTENCE
Just Relationships: Being Together as Equals (*Towards a World of Equals*: Unit -12)
Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Additional Reading: Rosa Parks-The Brave Heart.

TEXTBOOK
All the five Units in the Textbook**, *"Towards a World of Equals: A Bilingual Textbook on Gender"*** written by A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu and published by **Telugu Akademi, Hyderabad**,Telangana State in the year **2015**.

Note: Since it is an Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

REFERENCE BOOKS:

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. Abdulali Sohaila. "*I Fought For My Life…and Won*."Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

AE401ES: LOW SPEED AERODYNAMICS

B.Tech. II Year II Sem.

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UNIT – I

Review of Fluid Mechanics: Importance of Aerodynamics, Fundamental aerodynamics variables and dimensional analysis (statement of Buckingham π – theorem) leading to force & moment coefficient and dimensionless similarity parameters such as Reynolds number, Mach number, incompressible flow, compressible flow and Mach number- Continuity & momentum equations in differential form. Euler equation, viscosity, Navier – Stokes equation, Reynolds number as an order- of-magnitude messure of ratio of Inertia forces to viscous forces.

UNIT – II

Inviscid Incompressible Flows: Large Reynolds number flows, Prandtl’s Boundary Layer Hypothesis, viscous boundary layer flow and inviscid external flow. Justification of inviscid flow analysis. Angular Velocity, Vorticity and circulation, Kelvin Theorem and irrotational flow velocity potential, Stream function, Laplace equiation, boundary condition at infinity and wall, Elementary flows and their combinations, flow past circular cylinder – non lifting case, lifting case & Magnus effect, the spinning tennis ball, D’Alembert’s Paradox, Kutta – Joukowsky theorem – circular cyclinder with vortex, airfoil as an arbitrary cylinder with a sharp trailing edge, Kutta condition. Kelvin’s circulation theorem & starting vortex, concept of small perturbation & thin airfoil theory – linearization of the boundary condition, resolution of thin airfoil problem into lifting & nonlifting cases, their solutions by method of singularity distribution, the aerodynamic center, the center of pressure, load representation.

UNIT – III

Viscous Flow And Boundary Layer: Role of viscosity in fluid flow. boundary layer growth along a flat plate and nearly flat surface, displacement thickness and patching of inviscid external flow to viscous boundary layer flow, laminar boundary layer, transition and turbulent boundary layer, skin friction drag by integration of tangential stress & pressure drag by integration of normal stress, factors influencing boundary layer separation – adverse pressure gradient and sharp bending / turning of surface. Real (Viscous) flow and variation of drag coefficient with Reynolds number for circular cylinder. Real (viscous) flow and importance of skin friction drag for airfoils. Effect of transition and surface roughness on airfoils, N – S equation, Boundary layer approximation, Blasius solution for the flat plate problem. Definition of momentum thickness & derivation of Von Karman’s momentum equation.

UNIT – IV

Invicid Flow Over Wings & Panel Methods: Vortex filament statement of Helmholtz’s vortex theorems, Biot – Savart Law, starting, bound & trailing vortices of wings, Lanchester’s experiment, Prandtl’s Lifting line theory – downwash and induced drag, Elliptic loading & wings of elliptic plantforms, expression for induced drag, minimum induced drag for Elliptic planform. Source and vortex panel methods for airfoils. Replacement of an air foil by a concentrated vortex at quarter – chord point, importance of three – quarter chord point for discretization, use of quarter chord and three- quarter chord points in vortex panel method for wings.

UNIT – V

Applied Aerodynamics & Introduction To Propellers: Critical Mach number & Drag Divergence, drag reduction & lift augmentation – Sweep, winglets, Flaps, slats and vortex generators. Propellers : Concept of slip stream with only axial velocity, Actuator disk theory due to Rankine & Froude ; power& thrust coefficients, why the propeller is twisted by blade element analysis , blade angle, advance ratio and Torque coefficient, efficiency , how to read propeller chart.

TEXT BOOKS:

1. Bertin, J.J., Aerodynamics for Engineers, fourth edition, Pearson Education, 2002, ISBN: 81-297-0486-2
2. Anderson, Jr., J.D., Fundamentals of Aerodynamics, International edition, McGraw-Hill, 2001, ISBN: 0-07-118146-6.
3. Kuethe, A.M., and Chow, C., Foundations of Aerodynamics, 5^{th} Edn., Wiley, 1998, ISBN: 0-471-12919-4.
4. Karamcheti Krishnamurthy, Principles of Ideal- fluid Aerodynamics, Wiley, 1966

REFERENCES:

1. Kuchemann, D., the Aerodynamic Design of Aircraft, Pergamum, 1978.
2. Shevell, R.S., Fundamentals of Flight, Indian reprint, Pearson Education, 2004, ISBN: 81-297-0514-1.
3. McCormick, B.W., Aerodynamics, Aeronautics, & Flight Mechanics, second edition, John Wiley, 1995, ISBN: 0-471-57506-2.

AE402ES: FUNDAMENTALS OF STRUCTURAL ANALYSIS

B.Tech. II Year II Sem.	**L**	**T**	**P**	**C**
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UNIT- I

Introduction to Theory of Elasticity: Equilibrium and Compatibility conditions for elastic solids, 2D elasticity equations for plane stress, plane strain and generalized plane strain cases Airy's stress function. Simple problems in plane stress / plane strain Stresses and Strains on arbitrary planes and transformations. Concept of principal planes, stress and Strains, Construction of Mohr's circle.

UNIT- II

Redundant Structures: Indeterminate structures and order of redundancy, Introduction to redundant analysis, - Clapeyrons method, Moment distribution method Use of free body diagrams to explain compatibility and redundant analysis principles. Singularity method for uniform beams with various boundary and support conditions (props, hinges and fixities) subjected to distributed / discrete loads (including moments).

UNIT- III

Beams with Elastic Supports and Initial Curvature: Direct solution of beams on elastic foundation, Deflection of beams with discrete elastic supports using singularity methods and modeling concepts. Equation of equilibrium for curved beam stress and deflections of a typical curved beam (Bulk Head segments on fuselages).

UNIT -IV

Stability: Stability of Structural systems, Modes of instability of columns. Euler's formula for critical loads of column. Slenderness ratio, Effect of boundary conditions on mode shapes and critical loads. Column with initial curvature, effect of eccentricity. Long, medium and short column ranges. Rankine and Jhonson's formulae. Eigen values and Eigen modes. Effect of intermediate supports. Concept of beam column.

UNIT - V

Energy Principles And shear Flow In Closed Sections: Introduction to energy principles and methods. Principles of Virtual Displacement and Principle of Virtual Force Castigliano's theorems, Maxwell's reciprocal theorem and Unit load method.The displacement method (Rayleigh Ritz method). Direct application of energy principles to beams and trusses. Bredt-Batho formula. Single and multi-cell closed box structures. Semi monocoque and moncoque structures. Shear flow in single and multi cell monocoque and semi monocoque box beams subject to torsion.

TEXT BOOKS:

1. Megson THG, "Aircraft Structures for Engineering students", Edward Arnold Publication.
2. David J. Peery" Aircraft Structures" McGraw-HILL Book Company

REFRENCES:

1. Aircraft structures by G. Lakshmi Narasaiah, B. S. Publications.
2. B. C. Punmia, “Theory of Structures”, Laxmi Publication.
3. Timoshenko S. P. and J.N. Goodier, “Theory of Elasticity McGraw Hill Book Co.
4. Structural Analysis by OA. Bauchauji, Craig - Springer Publications.
5. David J. Peery” Aircraft Structures” McGraw-HILL Book Company
6. Argyris J. H. and Kelsey S. Energy theorems and structural analysis, Butterworth’s Scientific Publications. 1960
7. Donaldson, B. K. Analysis of Aircraft Structures-An introduction “McGraw Hill.
8. David H. Allen, and Walter E. Haiseler Introduction to Aeronautical Structure Analysis, John Wiley & Son, 1985.

AE403ES: AIRCRAFT PERFORMANCE

B.Tech. II Year II Sem.

L	T	P	C
4	1	0	4

UNIT- I

Introduction To Airplane Performance: The role and design mission of an Aircraft, Specification of the Performance requirements and mission profile, Importance of performance analysis, estimation, measurement, operational safety and economy, Scheduled performance and operational performance of the Aircraft, The standard atmosphere, Off-standard and design atmosphere, Measurements of air data, Air data computers.

UNIT- II

Basic Aerodynamic And Propulsion Characteristics: Source of aerodynamic forces, Aerodynamic lift, drag and moment, Aerodynamic coefficients, Variation of lift, drag, moment co-efficient, Aerodynamic centre, Lift and drag build up-Lift for the finite wing, Wing body combinations, Drag, Drag polar, Side force, Drag reduction methods, Aerodynamic relationships for a parabolic drag polar, Thrust and efficiency, Types of engines, Reciprocating engines, Turbojet engines, Turbofan, Turboprop, Variation of power, thrust, specific fuel consumption with velocity and altitude, Afterburning.

UNIT- III

Airplane Performance-Steady Flight: Equations of motion for steady level flight, Thrust required-graphical and analytical approach, Fundamental parameters-Thrust to Weight ratio, Wing loading, Lift to Drag ratio, Thrust available, Maximum velocity of the airplane, Power required, Power available and Maximum velocity, Drag divergence mach number, Effect of drag divergence on maximum velocity, Minimum velocity, Stall and High lift devices. Gliding flight-Glide angle and Sinking speed, Glide range and Endurance, Climbing flight, Rate of climb, Climb angle, Time to climb, Service and Absolute ceiling, Range-Range for a propeller driven airplane, Range for a jet propelled airplane, Endurance- Endurance for a propeller driven airplane, Endurance for a jet propelled airplane.

UNIT - IV

Maneuvering Flight: Accelerated motion of aircraft-Equations of motions-The maneuver envelope, Longitudinal maneuvers-The Pull-up or Push over maneuver and Pull down maneuver, Lateral maneuvers-Turn performance-Turn rates, Turn radius, Limiting factors, Instantaneous and Sustained turns, Specific excess power, Energy turns, Maneuvers boundaries, Maneuver performance of Military aircraft, Transport aircraft.

UNIT - V

Take-Off And Landing Performance: Take-off performance-Estimation of Take-off distances, Effect on the take-off distance of weight, wind, runway conditions, ground effect, Take off performance safety factors, Landing Performance-Estimation of Landing distances, Effect on the landing distance, The discontinued landing, Baulked landing, Air safety procedures and Requirements on Landing performance, Flight safety criteria, Performance classification of Civil aircraft, Flight planning-Performance planning and Fuel planning-Fuel requirements, Trip fuel, Environmental effects, Reserves, Tankering.

TEXTBOOKS:

1. Anderson, J.D. Jr., Aircraft Performance and Design McGraw Hill Publishing Co., 1st Edition, 1998.
2. Eshelby, M.E., Aircraft performance: Theory and Practice, Elsevier, 1st Edition, 2000.
3. Brandt, S.A. et.al., Introduction to Aeronautics : A Design Perspective, American Institute of Aeronautics & Astronautics; 3rd Edition, 2015.
4. Edward Lewis Houghton, N. B. Carruthers, Aerodynamics for Engineering Students, Butterworth - Heineman, 5th Edition, 2003.

REFRENCES:

1. Dole, C.E., Flight Theory and Aerodynamics: A Practical Guide for Operational Safety, 2nd Edition, Wiley, 2000.
2. McCormick, B.W, Aerodynamics, Aeronautics and Flight Mechanics, 2nd Edition, Wiley, 1995.
3. Raymer, D.P., Aircraft Design: A Conceptual Approach, 2nd Edition, AIAA, 1992.
4. Yechout, T.R. et al., Introduction to Aircraft Flight Mechanics, AIAA Eduction Series, AIAA, 1st Edition, 2003.

AE404ES: CONTROL THEORY

B.Tech. II Year II Sem.

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UNIT- I

Introduction to Control Systems and Modeling of Dynamic Systems: Examples of Control Systems, Closed-Loop Control versus Open-loop Control; Transfer Function and Impulse-Response Function, Automatic Control Systems, Modelling in State Space, State-Space Representation of Dynamic Systems, Mechanical Systems, Electrical and Electronic Systems, Signal Flow Graphs, Linearization of Non-Linear Mathematical Models

UNIT- II

Transient and Steady-State Response Analysis: Introduction, First-Order Systems, Second-Order Systems, Higher-Order Systems, Transient-Response Analysis with MATLAB, Routh's Stability Criterion, Effects of Integral and Derivative Control Actions on System Performance, Steady-State Errors in Unity-Feedback Control Systems

UNIT- III

Root-Locus Analysis: Root-Locus Analysis: Introduction, Root-Locus Plots, General Rules for Constructing Root Loci, Root-Locus Plots with MATLAB, Positive Feedback Systems, Conditionally Stable Systems, Root Loci for Systems with Transport Lag

UNIT- IV

Frequency Response Analysis: Introduction, Bode Diagrams, Plotting Bode Diagrams with MATLAB, Polar Plots, Drawing Nyquist Plots with MATLAB, Log-Magnitude-versus-Phase Plots, Nyquist Stability Criterion, Stability Analysis, Relative Stability, Closed-Loop Frequency Response of Unity-Feedback Systems

UNIT- V

Control Systems Design by Root-Locus Method and Frequency Response: Root-Locus Method - Introduction, Preliminary design considerations, lead compensation, lag compensation, lead-lag compensation, parallel compensation; Frequency Response Method- Introduction, lead compensation, lag compensation, lead-lag compensation.

TEXT-BOOKS:

1. Modern Control Engineering, Katsuhiko Ogata, 4th edition, Pearson Education International, 2002

REFERENCES:

1. Automatic Control Systems, Farid Golnargh and Benjamin C. Kuo, 9th edition, John Wiley & Sons, Inc, 2019
2. Control Systems Engineering, J. Nagarath and M.Gopal, New Age International (P) Limited, 4th edition, 2005.

SM405MS: BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Course Objective: To learn the basic Business types, impact of the Economy on Business and Firms specifically. To analyze the Business from the Financial Perspective.

Course Outcome: The students will understand the various Forms of Business and the impact of economic variables on the Business. The Demand, Supply, Production, Cost, Market Structure, Pricing aspects are learnt. The Students can study the firm's financial position by analysing the Financial Statements of a Company.

UNIT – I
Introduction to Business and Economics:
Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance.
Economics: Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply in Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT – II
Demand and Supply Analysis:
Elasticity of Demand: Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting.
Supply Analysis: Determinants of Supply, Supply Function & Law of Supply.

UNIT - III
Production, Cost, Market Structures & Pricing:
Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.
Cost analysis: Types of Costs, Short run and Long run Cost Functions.
Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, and Monopolistic Competition.
Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, and Cost Volume Profit Analysis.

UNIT - IV

Financial Accounting: Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, and Preparation of Final Accounts.

UNIT -V

Financial Analysis through Ratios: Concept of Ratio Analysis, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios (simple problems). Introduction to Fund Flow and Cash Flow Analysis (simple problems).

TEXT BOOKS:

1. D. D. Chaturvedi, S. L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, Financial Accounting, Tata McGraw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.

REFERENCES:

1. Paresh Shah, Financial Accounting for Management 2e, Oxford Press, 2015.
2. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.

AE406ES: ELECTRICAL AND ELECTRONICS ENGINEERING LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	3	2

SECTION A: ELECTRICAL ENGINEERING:

1. Verification of KCL and KVL.
2. Magnetization characteristics of D.C. Shunt generator.
3. Speed control of DC motor.
4. Swinburne’s Test on DC shunt machine.
5. Brake test on DC shunt motor.
6. OC and SC tests on Single-phase transformer.
7. Brake test on 3-phase Induction motor.
8. Regulation by an alternator by synchronous impedance method.

SECTION B: ELECTRONICS ENGINEERING:

1. PN Junction Diode Characteristics (Forward bias, Reverse bias)
2. Transistor CE Characteristics (Input and Output)
3. Study of CRO.
4. Zener Diode Characteristics
5. Transistor CE Characteristics
6. Rectifier without Filters (Full wave & Half wave)
7. Rectifier with Filters (Full wave & half wave).

Note: Total 12 experiments are to be conducted.
(Six experiments from PART-A, Six experiments from PART-B)

AE407ES: NUMERICAL SIMULATION WITH MATLAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	3	2

List of Experiments

1. Introduction to MATLAB and basic operations
2. Basic plotting, multiple plotting with Arrays.
3. Performing operations by using different types of loops in MATLAB.
4. (a)if else (b)if-elseif (c)while (d)for loops
5. Computation of drag force using loops
6. Computation of differential equations of motions using Euler integration.
7. Computation of drag force using differential equations at different altitudes using Euler integration
8. Computation for deflection of different types of Beams
9. Computation of ‘g’ loads on reentry vehicle.

REFERENCES

1. “Getting Started with Matlab” by Rudra Prathap
2. “Introduction to Matlab for Engineering Students” by David Hacque
3. “Computational Methods in Aerospace engineering” by David L Darmofal

AE408ES: AIRCRAFT ENGINEERING DRAWING WITH CAD

B.Tech. II Year II Sem. **L T P C**
0 0 3 2

UNIT - I

Introduction to Auto-Cad, Sections And Sectional Views, Development Of Surfaces: Introduction to Auto-CAD: Geometrical construction. Sections and sectional views Sections of right regular solids-prisms, pyramids, cylinders and cones , auxiliary views, Development of surfaces Development of surfaces of right regular solids prisms, pyramids, cylinders and cones.

UNIT - II

Intersection of Solids: Intersection of solids: Intersection of prism vs prism, cylinder vs prism, cylinder vs cylinder and cylinder vs cone.

UNIT - III

Isometric Projections: Isometric projections: Principles of isometric projections, isometric scale, isometric views, conventions.
Isometric views of lines, planes, simple and compound solids, isometric views of objects having spherical parts.

UNIT - IV

Transformation of Projections: Transformation of projections: Conversion of isometric views to orthographic views -conventions for simple objects. Construction of orthographic projections for given isometric projections**.**

UNIT -V

Perspective Projections: Perspective projections: Perspective view of points, lines, plane figures and simple solids, vanishing point method and visual ray method.

TEXT BOOKS:

1. N. D. Bhatt, “Elementary Engineering Drawing”, Charotar Publishing House, 55th Edition, 2015.
2. K. L. Narayana and P. Kannaiah, “Engineering Drawing”, Scitech Publications, 23rd Edition, 2010.
3. K. C. John, “Engineering Graphics”, Prentice Hall of India, 1st Edition, 2009.

REFERENCES:

1. Venugopal, “Engineering Drawing and Graphics, New Age, 2nd Edition, 2010.
2. Dhananjay. A. Johle, “Engineering Drawing”, Tata Mc Graw Hill, 1st Edition, 2008.
3. Trymbaka Murthy, “Computer Aided Engineering Drawing”, I.K. International Publishers, 3rd Edition, 2011.
4. A. K. Sarkar A. P. Rastogi, “Engineering graphics with Auto CAD”, Phi Learning, 1st Edition, 2010.

MC400ES: ENVIRONMENTAL SCIENCE & TECHNOLOGY

B.Tech. II Year II Sem.	**L**	**T**	**P**	**C**
Course Code:	**3**	**0**	**0**	**0**

Course Objectives:

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures
- Understanding the environmental policies and regulations

Course Outcomes:

Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which inturn helps in sustainable development

UNIT - I

Ecosystems: Definition, Scope and Importance of ecosystem. Classification, structure and function of an ecosystem, Food chains, food webs and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

UNIT - II

Natural Resources: Classification of Resources: Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

UNIT - III

Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

UNIT - IV

Environmental Pollution and Control Technologies: Environmental Pollution: Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics

of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.
Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Problems and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol and Montréal Protocol.

UNIT - V

Environmental Policy, Legislation & EIA: Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela . 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4^{th} Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

HIGH SPEED AERODYNAMICS

B.Tech. III Year I Sem. **L T P C**
Course Code: AE501PC **4 1 0 4**

UNIT – I

One Dimensional Flows: Compressibility, Review of Fundamentals: Concepts from Fluid Mechanics, Basic Thermodynamic Relations. Velocity of sound. Mach number, flow regimes. Governing equations of inviscid compressible flow. Continuity, Momentum and Energy equations in Integral and Differential form. Stagnation conditions.

UNIT – II

Flow through Nozzles: Flow Through a nozzle: Convergent Nozzles, CD Nozzles, Exit Pressure variation vs Stagnation pressure variation. Chocked flow conditions. Normal shock. Under and over expansion conditions. Flow through diffusers, wave reflections from a free boundary. Description of supersonic wind tunnels and rocket engine. Flow with Friction, Friction choking, Flow with heat addition, Thermal choking.

UNIT - III

Oblique Shocks And Expansion Waves: Oblique shock relations. Supersonic, Mach number relations strong and weak shock solutions / Shock flow over a wedge polar. Regular reflection from a solid boundary. Intersections of shock wave. Expansion waves. Prandtl – Meyer Expansion. **Subsonic Compressible Flow Over Airfoil:** Introduction, Velocity potential equation, Transonic small perturbation equation, Prandtl-Glauert compressibility corrections, Critical Mach number, Drag divergence Mach number, Area rule, Supercritical airfoil.

UNIT – IV

Supersonic Flow: Linearized supersonic flow, Linearized supersonic flow over airfoil and wings. Shock Expansion theory. Detached shock. Axi-symmetrical flows, flow past slender bodies of revolution, conical flows, Numerical integration procedure. **HYPERSONIC FLOWS:** Qualitative aspects of hypersonic flow. Newtonian theory. Flat plate at an angle of attack. Hypersonic shock wave relations. Lift and drag of wings at hypersonic speeds. Recent advances in hypersonic flows and testing techniques.

UNIT – V

Flow Measurements and Model Testing: Non dimensional parameters and II numbers Similarity of flows. Model testing in wind tunnels. Pressure, Velocity measurements, **Force Measurements Wind Tunnel Balances:** Force measurements, Wind tunnel balances. Scale effects and corrections, wall interferences, induced drag and other computations/corrections. Experimental Methods, Shock Tube, Supersonic Wind tunnel, Flow visualization, Supersonic Probes., Methods of characteristics. Design of nozzles, External flow around bodies, Experimental characteristics of airfoils in compressible flow.

TEXT BOOKS:

1. Anderson J. D (2004), Modern Compressible Fluid Flow, 3rd Edition, McGraw-Hill International Edition, New York
2. Rathakrishnan E.E. (2010), Gas Dynamics, 3rd Edition, Prentice Hall of India, New Delhi.

RFFERENCE BOOKS:

1. Anderson J .D. (2011), Fundamental of Aerodynamics, 5th edition, McGraw-Hill, New Delhi. Hodge B. K, Koenig K (1995), Compressible Fluid Dynamics with Computer Application, 1st edition, Prentice Hall, New York.
2. Clancy L. J. (2006), *Aerodynamics*, Sterling Publishers, New Delhi.

AIRBREATHING PROPULSION

B.Tech. III Year I Sem.	**L T P C**
Course Code: AE502PC	**4 0 0 4**

UNIT - I

Gas Turbine Theories: Impulse and reaction balding of gas turbines, Velocity triangles and power output, Elementary theory, Vortex theory. Choice of blade profile, pitch and chord, Estimation of stage performance.

Design Consilretions: Limiting factors in gas turbine design, Overall turbine performance. Methods of blade cooling, matching of turbine and compressor, Numerical problems.

UNIT - II

Thrust Control: Thrust Augmentation through after burning, thrust vector control methods.

RAMJET Propulsion: Operating principle Subcritical, critical and supercritical operation. Combustion in ramjet engine, Ramjet performance, Sample ramjet design calculations. Introduction to SCRAMJET, Preliminary concepts in supersonic combustion, Integral ram, Rocket, Numerical problems.

UNIT - III

Chemical Rockets: *Solid Propellant:* Solid propellant rockets, Selection criteria of solid propellants, important hardware components of solid rockets, Propellant grain design considerations.

Liquid Propellant: Liquid propellant rockets, cooling in liquid rockets. Limitations of hybrid rockets, Relative advantages of liquid rockets over solid rockets.

UNIT - IV

Fundamentals of Rocket Propulsion: Operating principle, Specific impulse of a rocket, internal ballistics, Rocket nozzle classifications. Rocket performance considerations, Numerical problems.

UNIT - V

Advanced Propulsion Techniques: Electric rocket propulsion, Ion propulsion techniques, nuclear rocket - Types, Solar sail, and Preliminary concepts in nozzle less propulsion.

TEXT BOOKS:

1. Sutton G. P. (2010), *Rocket Propulsion Elements*, 8th edition, John Wiley & Sons Inc, USA.
2. Philipa Hill, Carl Peterson (2010), *Mechanics and Thermodynamics of Propulsion*, 2nd edition, Addison Wesley Longman Inc, USA.

REFERENCE BOOKS:

1. Oates G. C (1986), *Aero Thermodyanamics of Aircraft Engine Components*, AIAA Educational Series, USA.

2. Rolls- Royce (2005), *Jet Engine*, 6th edition, Rolls - Royce Ltd, USA.
3. Ganesan V (2010), *Gas Turbines*, Tata McGraw- Hill, New Delhi.
4. S. M. Yahya(2010), *Fundamentals of Compressible Flow with Aircraft and Rocket propulsion*, 4th Edition, New Age International Publications, New Delhi.

AIRCRAFT STRUCTURAL ANALYSIS

B.Tech. III Year I Sem. **L T P C**
Course Code: AE503PC **4 1 0 4**

UNIT - I

Thin Plate Theory, Structural Instability: Analysis of thin rectangular plates subject to bending, twisting, distributed transverse load, combined bending and in-plane loading- thin plates having small initial curvature, energy methods of analysis. Buckling of thin plates-elastic, inelastic, experimental determination of critical load for a flat plate, local instability, Tension field beams- complete diagonal tension, incomplete diagonal tension.

UNIT - II

Bending, Shear and Torsion of Thin Walled Beams: Unsymmetrical bending- resolution of bending moments, direct stress distribution, position of neutral axis. Deflections due to bending- approximations for thin walled sections, temperature effects. Shear loaded thin walled beams- general stress, strain and displacement relationships- direct stress - shear centre, twist and warping. Torsion of beams of closed section- displacements associated with Bredt-Batho shear flow. Torsion of open section beams. Warping of cross section- conditions for zero warping. Bending, shear, torsion of combined open and closed section beams.

UNIT - III

Structural Idealisation of Thin Walled Beams: Structural idealization- principal assumptions, idealization of panel, effect on the analysis of thin walled beams under bending, shear, torsion loading- application to determining deflection.

UNIT - IV

Structural and Loading Discontinuities in Thin Walled Beams: Closed section beams-shear stress distribution of a closed section beam built in at one end under bending, shear and torsion loads.

Open section beams- I section beam subjected to torsion, torsion of beam of arbitrary section, torsion bending constant, distributed torque loading- extension of theory for general systems of loading. Shear lag- effect of shearing strains in beams- redistribution of bending stresses due to restraining of warping, limitation of elementary bending theory, effect of accounting for shear lag on the estimated strength.

UNIT - V

Stress Analysis of Aircraft Components- Wing, Fuselage: Wing spars and box beams-tapered wing spar, open and closed section beams, beams having variable stringer areas. Wings- Three-boom shell in bending, torsion, shear, tapered wings, deflections, cut-outs in wings. Bending, shear, torsion, cut-outs in fuselages. Fuselage frames and wing ribs-principles of stiffener/ web construction, fuselage frames, wing ribs.

TEXT BOOKS:

1. Megson, T.H.G., Aircraft Structures for Engineering Students, 4th edn., Elsevier, 2007, ISBN 0-750-667397.
2. Peery, D.J. and Azar, J.J., Aircraft Structures, 2nd edn., McGra-Hill, 1982, ISBN 0-07-049196-8.

REFERENCES:

1. Allen, D.H. and Haisler, W.E., *Introduction to Aerospace Structural Analysis*, John Wiley, 2010.
2. Bruhn. E.H, *Analysis and Design of Flight Vehicles Structures*, Tri-state Off-set Company, USA, 1965.
3. Lakshmi Narasaiah, G., *Aircraft Structures*, BS Publications, 2010.
4. Sechler.E.E. and Dunn, L.G., *Airplane Structural Analysis and Design*, John Wiley & Sons, 1942

FUNDAMENTALS OF MANAGEMENT

B.Tech. III Year I Sem.	**L T P C**
Course Code: SM504MS	**3 0 0 3**

Course Objectives: To understand the Management Concepts, applications of Concepts in Practical aspects of business and development of Managerial Skills.

Course Outcomes: The students understand the significance of Management in their Profession. The various Management Functions like Planning, Organizing, Staffing, Leading, Motivation, and Control aspects are learnt in this course. The students can explore the Management Practices in their domain area.

UNIT - I

Introduction to Management: Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management- Classical Approach- Scientific and Administrative Management; The Behavioral approach; The Quantitative approach; The Systems Approach; Contingency Approach, IT Approach.

UNIT – II

Planning and Decision Making: General Framework for Planning - Planning Process, Types of Plans, Management by Objectives; Development of Business Strategy. Decision making and Problem Solving - Programmed and Non Programmed Decisions, Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making; Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.

UNIT - III

Organization and HRM: Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization; Organizational Culture; Organizational Climate and Organizational Change.

Human Resource Management & Business Strategy: Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

UNIT - IV

Leading and Motivation: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Complaints, Team Leadership.

Motivation - Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

UNIT - V

Controlling: Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls, Establishing control systems, Control frequency, and Methods.

TEXT BOOKS:

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
2. Fundamentals of Management, Stephen P.Robbins, Pearson Education, 2009.

REFERENCES:

1. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.
2. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.

AERODYNAMICS AND PROPULSION LAB

	L	T	P	C
B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: AE505PC	**0**	**0**	**3**	**2**

LIST OF EXPERIMENTS:

1. Calibration of subsonic wind tunnel.
2. Pressure distribution over smooth and rough cylinder.
3. Pressure distribution over symmetric airfoil.
4. Pressure distribution over cambered airfoils.
5. Pressure distribution over thin airfoils.
6. Force measurement using wind tunnel balance.
7. Flow over a flat plate at various angles of incidence.
8. Flow visualization studies in low speed over cylinder.
9. Flow visualization studies in low speed over wedge.
10. Flow visualization studies in low speed over airfoil at different angles of incidence.

REFERENCES:

~~5.~~1.Clancy. L. J, “Aerodynamics”, Pitman, 1st Edition, 1986.
~~6.~~2.Milne L.H, Thomoson, “Theoretical Aerodynamics”, Dover, 2nd Edition, 1985.
~~7.~~3.N. M. Komerath, “Low Speed Aerodynamics”, Extrovert, 1st Edition, 2012.

AEROSPACE STRUCTURES LAB

B.Tech. III Year I Sem.	**L T P C**
Course Code: AE506PC	**0 0 3 2**

LIST OF EXPERIMENTS:

1. Study of construction and use of Universal Testing Machine, mechanical and optical
2. Extensometers- application to determine stress-strain curves and tensile and compressive
3. Strength of various engineering materials.
4. 2. Bending tests- deflection of slender and short beams for various loading and end conditions determination of influence coefficients- verification of Maxwell's and Castiglione’s theorems.
5. Compression tests on long and short columns- determination of buckling loads- South well plot.
6. Determination of the strength and deformation of riveted and bolted joints.
7. Methods of inspection and non-destructive testing (NDT) of aircraft structural components.
8. Strain gauge techniques- measurement of strain in beams, thin and thick walled cylinders
9. Subjected to internal pressure, shaft subjected to combined loading.
10. Shear Centers of open and closed sections- determination of the elastic axis of beams.
11. Post buckling behaviour of shear panels- measurements on semi-tension field webs of beams.
12. Determination of elastic constants of composite materials- flexural test on composites.
13. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
14. Study and use of seismic pickups for the measurement of amplitude and frequency of vibration of structural components.
15. Determination of critical fracture toughness of aerospace materials.

REFERENCE BOOKS:

1. Megson, T.H.G., Aircraft Structures for Engineering Students, 4th edn., Elsevier, 2007, ISBN 0-750-667397.
2. Bruhn. E.H, Analysis and Design of Flight Vehicles Structures, Tri-state of Off-set Company, USA, 1965.

AEROMODELING LAB

B.Tech. III Year I Sem. **L T P C**
Course Code: AE507PC **0 0 3 2**

Design and Modelling of Aircraft Components Using CATIA:

1. Design of airfoils and wings
2. Design of fuselage with seating arrangement
3. Design of propeller shaft and blades
4. Design of landing gear
5. Design of horizontal and vertical stabilizer
6. Design of nose cone
7. Design of door of aircraft

Assembly and Modelling of the Aircraft Components Using PRO-E:

1. Assemble the wings to fuselage
2. Assemble the seating arrangement in fuselage
3. Assemble the engine along with propeller shaft and blades in fuselage
4. Assemble the landing gears to fuselage
5. Assemble the horizontal and vertical to fuselage
6. Assemble the door to fuselage

PROFESSIONAL ETHICS

B.Tech. III Year I Sem. **L T P C**
Course Code: MC500HS **3 0 0 0**

Course Objective: To enable the students to imbibe and internalize the Values and Ethical Behavior in the personal and Professional lives.

Course Outcome: The students will understand the importance of Values and Ethics in their personal lives and professional careers. The students will learn the rights and responsibilities as an employee, team member and a global citizen.

UNIT - I
Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT - II
Basic Theories: Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

UNIT - III
Professional Practices in Engineering: Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession.
Central Responsibilities of Engineers - The Centrality of Responsibilities of Professional Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walk away Collapse.

UNIT - IV
Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation.
Ethics in changing domains of research - The US government wide definition of research misconduct, research misconduct distinguished from mistakes and errors, recent history of attention to research misconduct, the emerging emphasis on understanding and fostering responsible conduct, responsible authorship, reviewing & editing.

UNIT - V

Global issues in Professional Ethics: Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; War Ethics; Bio Ethics, Intellectual Property Rights.

TEXT BOOKS:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.

REFERENCES

1. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, 4e , Cengage learning, 2015.
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

AIRCRAFT SYSTEMS

B.Tech. III Year II Sem.	**L T P C**
Course Code: AE601PC	**4 1 0 4**

UNIT – I

Introduction to Aircraft Systems: System concepts, everyday examples of systems, sub-systems; Generic system definition, inputs, outputs, feedback, external influence; Aircraft systems- airframe systems, vehicle systems, avionics systems, mission systems and their sub-systems; Specification of requirements- mission requirements, performance requirements; Operating environment conditions.

UNIT - II

Electrical Systems and Flight Control Systems: Electrical loads in aircraft; Electrical power generation and control- DC, AC- types. Power distribution: primary, secondary, Power conversion and energy storage, Load protection, electrical load management systems, variable speed constant frequency (VSCS) cyclo converter and 270 V DC systems.

Flight control systems: primary and secondary flight control, control linkages, actuation-types, description, and redundancy; Fly-by-wire control- control laws, implementation.

UNIT - III

Hydraulic Systems: Aircraft hydraulic systems: function, merits, application, system loads, design requirements, Principal components; Flight control actuation- importance, need for redundancy, types, description, and applications.

Hydraulic fluid: Required properties, operating fluid pressures, temperatures, and flow rates; Hydraulic piping, pumps, reservoir, accumulator; Landing gear and brake management systems.

UNIT - IV

Pneumatic and Environmental Control Systems: Engine as source of high pressure air-engine bleed air- user systems, environment control, windscreen, wing and engine anti-ice, engine start, hydraulic, Pitot-static systems; Bleed air control- structure, components, operation; Need for controlled cabin environment; Principal heat sources in aircraft; Methods of cooling- ram air, engine bleed air, fuel cooling; Cooling systems: air cycle refrigeration, types, turbo fan, bootstrap, reverse bootstrap systems; Vapor cycle refrigeration. Humidity control; Air distribution systems, cabin pressurization, molecular-sieve oxygen concentrators, g-tolerance and protection.

UNIT – V

Engine Control and Fuel Systems: Principle of operation of aircraft gas turbine engines. Engine- airframe interfaces, Control of fuel flow, air flow, exhaust gas flow: need, means, system parameters, basic inputs and outputs; Limited authority control systems, full authority control systems- examples. Engine monitoring- sensors, indicators; Power off takes: need, types, effect on engine performance; Fuel systems: characteristics, components, operating modes. Fuel tank safety, fuel inserting system.

TEXT BOOKS:

1. David A Lombaro, “Aircraft systems”, Tata Mc Graw Hill, 2nd Edition, 2009.
2. Moir I. Sea bridge, “Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration”, 3rd Edition, John Wiley, 2008.
3. Moir I. Sea bridge, “Design and Development of Aircraft Systems- an Introduction”, AIAA Education Series, AIAA, 2nd Edition, 2004.

REFERENCES:

1. Pallett, E.H.J, “Aircraft Instruments and Integrated Systems”, Longman Scientific and Technical, 10th Edition, 1992.
2. Harris D, “Flight Instruments and Automatic Flight Control Systems”, Ground Studies for Pilots, Blackwell Science, 6th Edition, 2004.
3. Bolton W, “Pneumatic and Hydraulic Systems”, Butterworth-Heinemann, 1st Edition, 1997.

AIRCRAFT STABILITY AND CONTROL

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE602PC	**4**	**1**	**0**	**4**

UNIT - I

INTRODUCTION: Degree Of Freedom Of A System, Static And Dynamic Stability. Need For Stability In An Airplanes. Purpose Of Controls, Inherently And Marginally Stable Airplanes.

EQUATIONS OF MOTION: Equations Of Motion Of A Rigid Body. Inertial Forces And Moments. Equations Of Motion Of Flight Vehicles. Aerodynamic Forces And Moments. Decoupling Of Longitudinal And Lateral-Directional Equations. Linearization Of Equations.

UNIT - II

AERODYNAMIC STABILITY DERIVATIVES: Aerodynamic Stability And Control Derivatives. Relation To Geometry, Flight Configuration. Effects Of Power, Compressibility, And Flexibility.

UNIT - III

STATIC LONGITUDINAL STABILITY - CONTROL FREE: Effects Of Releasing The Elevator. Hinge Moment Coefficients, Control Forces To Trim. Control Free Neutral Point - Trim Tabs. Aerodynamic Balancing Of Control Surfaces. Means Of Augmentation Of Control.

MANEUVER STABILITY: Contribution Of Pitch Damping To Pitching Moment Of Flight Vehicle, Effect On Trim And Stability. Control Deflections And Control Forces For Trim In Symmetric Maneuvers And Coordinated Turns. Control Deflection And Force Gradients. Control Fixed And Control Free Maneuver Stability. Maneuver Points. Maneuver Margins.

UNIT - IV

STATIC LONGITUDINAL STABILITY AND CONTROL - CONTROL FIXED: STICK FIXED: Basic Equilibrium Equation, Stability Criterion, Contribution Of Wing And Tail And Elevator To Pitching Moments. Effect Of Fuselage And Nacelles, Effects Of Center Of Gravity Location, Power Effects Stabilizer Setting And Center Of Gravity Location, Elevator Power, Elevator To Trim . Trim Gradients. Control Fixed Static Stability, Control Fixed Neutral Point. Stability Margins.

UNIT - V

STATIC LATERAL AND DIRECTIONAL STABILITY AND CONTROL: Dihedral Effect, Coupling Between Rolling And Yawing Moment, Adverse Yaw, Aileron Power, Aileron Reversal. Weather Cocking Effects, Rudder Power. Lateral And Directional Stability- Definition. Control Surface Deflections In Steady Sideslips, Rolls And Turns One Engine Inoperative
Conditions, Rudder Lock.

DYNAMIC STABILITY AND RESPONSE TO CONTROL: Solutions To The Stability Quadratic Of The Linearised Equations Of Motion. The Principal Modes. Phugoid , Short Period Dutch Roll And Spiral Modes, Further Approximations. Restricted Degrees Of Motion. Solutions. Response To Controls. Auto Rotation And Spin.

TEXT BOOKS:

1. Houghton E. L, Carruthers N. B. (2010), *Aerodynamics For Engineering Students*, 5th Edition, Elsevier, USA.
2. Mc. Cormic B. W. (2010), *Aerodynamics, Aeronautics And Flight Mechanics*, Wiley India Pvt. Ltd, USA.

REFERENCE BOOKS:

1. Perkins C. D, Robert Hage E (2003), *Airplane Performance, Stability And Control*, Wiley Toppan, USA.
2. Nelson R. C (2007), *Flight Stability And Automatic Control*, Sie Edition, MCGRAW Hill, New York.
3. T. R. Yechout, S. L. Morns (2003), *Introduction To Aircraft Flight Mechanics*, Aiaa Publishers, USA.

ROCKET AND SPACECRAFT PROPULSION

B.Tech. III Year II Sem.	**L T P C**
Course Code: AE603PC	**4 0 0 4**

UNIT – I

ROCKET SYSTEMS: Ignition System In Rockets, Types Of Igniters, Igniter Design Considerations; Design Consideration Of Liquid Rocket Combustion Chamber, Injector Propellant Feed Lines, Valves, Propellant Tanks And Their Outlets; Pressurized And Turbine Feed Systems; Propellant Slosh And Propellant Hammer; Elimination Of Geysering Effect In Missiles; Combustion System Of Solid Rockets.

UNIT - II

AERODYNAMICS OF ROCKET AND MISSILES: Airframe Components Of Rockets And Missiles; Forces Acting On A Missile While Passing Through Atmosphere; Classification Of Missiles; Method Of Describing Aerodynamic Forces And Moments; Lateral Aerodynamic Moment; Lateral Damping Moment And Longitudinal Moment Of A Rocket; Lift And Drag Forces; Drag Estimation; Body Upwash And Downwash In Missiles; Rocket Dispersion; Numerical Problems.

UNIT - III

ROCKET MOTION IN FREE SPACE AND GRAVITATIONAL FIELD: One Dimensional And Two Dimensional Rocket Motions In Free Space And Homogeneous Gravitational Fields; Description Of Vertical, Inclined And Gravity Turn Trajectories; Determination Of Range And Altitude; Simple Approximations To Burnout Velocity.

UNIT - IV

STAGING AND CONTROL OF ROCKET AND MISSILES: Rocket Vector Control, Methods, Thrust Termination; Secondary Injection Thrust Vector Control System; Multistaging Of Rockets; Vehicle Optimization; Stage Separation Dynamics; Separation Techniques.

UNIT – V

MATERIALS FOR ROCKET AND MISSILES: Selection Of Materials; Special Requirements Of Materials To Perform Under Adverse Conditions.

TEXT BOOKS:

~~6.~~1. Sutton, G. P., And Biblarz, O., “Rocket Propulsion Elements”, John Wiley & Sons Inc., New York, 8th Edition, 2010.
~~7.~~2. M.J. L. Turner, “Rocket And Spacecraft Propulsion”, Praxis Publishing, 2nd Edition, 2006.
~~8.~~3. Mathur, M., And Sharma, R.P., “Gas Turbines And Jet And Rocket Propulsion”, Standard Publishers, New Delhi, 4th Edition, 2005.P.G Hill, C.R. Peterson

~~9.~~4. "Mechanics & Thermodynamics Of Propulsion" Addison Wesley Longman Inc, 3rd Edition, 1991.

REFERENCES

~~2.~~1. Leissa, A.W., Vibration Of Continuous System, The Mcgraw-Hill Company, 2011.
~~3.~~2. Inman, D.J., Vibration Engineering, Third Edition, Prentice Hall Int., Inc., 2001,
~~4.~~3. Kelly, S.G., Schaum's Outline Of The Theory And Problems Of Mechanical Vibrations, Schaum's Outline Series, Mcgraw-Hill, 1996.

FINITE ELEMENT METHODS
(PROFESSIONAL ELECTIVE – I)

B. Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: NT603PC/ME611PE	**3**	**0**	**0**	**3**

Pre-requisites: Mechanics of Solids

Course Objective: The aim of the course is to provide the participants an overview on Finite Element Method, Material models, and Applications in Civil Engineering. At the end of the course, the participants are expected to have fair understanding of:

- Basics of Finite Element Analysis.
- Available material models for structural materials, soils and interfaces/joints.
- Modeling of engineering systems and Soil–Structure Interaction (SSI).
- Importance of interfaces and joints on the behavior of engineering systems.
- Implementation of material model in finite element method and applications

Course Outcomes: At the end of the course, the student will be able to, Apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer. Formulate and solve problems in one dimensional structures including trusses, beams and frames. Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi-symmetric and plate bending problems. Implement and solve the finite element formulations using MATLAB.

UNIT – I

Introduction to Finite Element Method for solving field problems. Stress and Equilibrium. Boundary conditions. Strain – Displacement relations. Stress – strain relations for 2-D and 3-D Elastic problems.

One Dimensional Problems: Finite element modeling coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT – II

Analysis of Trusses: Stiffness Matrix for Plane Truss Elements, Stress Calculations and problems. **Analysis of Beams**: Element stiffness matrix for two nodded, two degrees of freedom per node beam element and simple problems.

UNIT – III

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of Load Vector, Stresses.

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four nodded Isoperimetric elements and numerical integration.

UNIT – IV

Steady State Heat Transfer Analysis: one dimensional analysis of Slab, fin and two dimensional analysis of thin plate. Analysis of a uniform shaft subjected to torsion.

UNIT – V

Dynamic Analysis: Formulation of finite element model, element - Mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar, truss. Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation, techniques such as semi automatic and fully Automatic use of software's such as ANSYS, NISA, NASTRAN, etc.

TEXT BOOKS:

1. Finite Element Methods: Basic Concepts and applications/Alavala/PHI
2. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu/Pearson

REFERENCE BOOKS:

1. An Introduction to the Finite Element Method / J.N.Reddy/ Mc Graw Hill
2. Finite Element Analysis / SS Bhavikatti / New Age
3. Finite Element Method/ Dixit/Cengage

EXPERIMENTAL AERODYNAMICS
(PROFESSIONAL ELECTIVE – I)

	L	T	P	C
B.Tech. III Year II Sem.				
Course Code: AE612PE	**3**	**0**	**0**	**3**

UNIT – I

Aerodynamic Experiments - History, Model Testing & Wind Tunnels - Types, Application: Forms of aerodynamic experiments- observation, measurement- objectives. History means. Model testing- wind tunnel- principles - scaling laws, scale parameters- significance. Wind tunnels- low speed- types, description. High speed tunnels- transonic, supersonic, hypersonic, shock tubes, special tunnels- low turbulence, high Re, environmental, automobile- function, distinctive features, application. Major wind tunnel facilities- description, details.

UNIT - II

Low Speed Wind Tunnels - Construction, Components, Performance & Wind Tunnel Corrections: Low speed wind tunnel- principal components- working section, diffuser, corners, turning vanes, fan, straighteners, honeycombs, screens, contraction cone, fan, motor- function, description, design requirements, constraints, construction, performance- loss coefficients. Wind tunnel performance- flow quality, power losses.

Wind tunnel corrections. Sources of inaccuracies- buoyancy, solid blockage, wake blockage, streamline curvature- causes, estimation, and correction. Total correction on airspeed, dynamic pressure, and zero lift drag.

UNIT - III

Load Measurements - Wind Tunnel Balances & Flow Measurements – Instrumentation: Load measurements - wind tunnel balances, types, description, application. Steady and unsteady pressure measurements and various types of pressure probes and transducers, errors in pressure measurements; measurement of temperature using thermocouples, resistance thermometers, temperature sensitive paints and liquid crystals; measurement of airspeed, flow direction, boundary layer profile using Pitot static tubes, 5 hole probes, total head rake- function, working principle, types, details of design and construction.

UNIT - IV

Flow Visualisation Techniques: Flow visualisation- need, types- tufts, china clay, oil film, smoke- working principle, description, setting up, operation, observation, recording, interpretation of imagery, relative merits, applications. High speed flows- optical methods- shadowgraphy, Schleiren, interferometry.

UNIT – V

Measurement of Velocity - Hotwire Anemometry, Laser Doppler Anemometry, Particle Image Velocimetry- Overview: Hot Wire Anemometry, Laser Doppler Anemometry, Particle Image Velocimetry- working principles, description of equipment, experimental setup, settings, calibration, measurement, data processing, applications.

TEXT BOOKS:

1. Low Speed Wind Tunnel Testing, Barlow, J.B., Rae, W.H., Pope, A., Wiley 1999.
2. High Speed Wind Tunnel Testing, Pope, A. and Goin, K.L., Wiley, 1965.
3. Yang, W.J., Handbook of Flow Visualization, 2nd edition, Taylor and Francis, 2001.

REFERENCES

1. 1. Bradshaw, P., Experimental Fluid Mechanics, Pergamon Press, 1970.
2. Goldstein, R.J., (Ed.) Fluid Mechanics Measurements, Taylor Francis, Washington 1996. 84.
3. Tropea, C., Yarin, A. L., Foss, J. F., Handbook of Experimental Fluid Mechanics, Springer, 2007

MECHANISMS AND MECHANICAL DESIGN
(PROFESSIONAL ELECTIVE – I)

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE613PE	**3**	**0**	**0**	**3**

UNIT – I

Mechanisms & Machines: Elements of links – classification – rigid link, flexible and fluid link. Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs. Lower and higher pairs, closed and open pairs. Constrained motion – Completely, partially or successfully constrained, and incompletely constrained. Mechanism and machines – classification. Kinematic chain, inversion of mechanism, inversion of quadratic cycle. Chain – single and double slider crank chains. Exact and approximate straight line mechanisms - Peaucellier, Hart T. Chibichef, Pantograph.

UNIT - II

Kinematic Analysis of Mechanisms: Velocity and acceleration. Motion of link in machine – determination of velocity and acceleration diagrams – graphical method. Application of relative velocity method for four bar chain. Analysis of slider crank chain for displacement, Velocity and acceleration of sliding – Acceleration diagram for a given mechanism, Kleins construction, Coriolis acceleration, Determination of Coriolis component of acceleration.

UNIT - III

Plane Motion of Body & Gyroscopic Motion - Precession: Instantaneous centre of rotation, centroids and axodes – Relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links. The gyroscope- free and restrained- working principle- the free gyro, rate gyro, integrating gyro as motion measuring instruments. Effect of precession on the stability of vehicles- motorbikes, automobiles, airplanes and ships. Static and dynamic forces generated due to in precession in rotating mechanisms.

UNIT - IV

Cams and Followers & Steering Gears: Cams and followers- definition uses – types– terminology. Types of follower motion- uniform velocity, simple harmonic motion and uniform acceleration. Maximum velocity and acceleration during outward and return strokes. Roller follower, circular cam with straight, concave and convex flanks. Condition for correct steering – Davis steering gear, Ackerman's steering gear– Velocity ratio, Hook's Joint– single and double Hooks joint– universal coupling– applications.

UNIT – V

Gears and Gear Trains & Design of Four Bar Mechanisms: Introduction to gears- types, law of gearing. Tooth profiles- specifications, classification- helical, bevel and worm gears, simple and reverted gear train, epicyclic gear trains- velocity ratio or train value. Four bar mechanism, Freudenstein equation. Precession point synthesis, Chebyshev's method, structural error.

TEXT BOOKS:

1. Theory of Machines, Dr Jagdish Lal, JM Shaw.
2. Theory of Machines, Abdulla Sharif, Dhanpat Rai, 1987.
3. Theory of Machines, PL Ballaney, Khanna Publishers, 2003.

REFERENCES:

~~5.~~1. Theory of Machines Through Solved Problems, JS Rao / New Age – 1996
~~6.~~2. Mechanical engineering and design, J.E.Shigley and Charles.R.Mischke, TMH, 2003.

UNMANNED AIR VEHICLE (UAV) SYSTEMS
(PROFESSIONAL ELECTIVE – I)

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE614PE	**3**	**0**	**0**	**3**

UNIT - I
Introduction to Unmanned Aircraft Systems: Applications of UAS, categories of UAS systems, roles of unmanned aircraft, composition of UAV system

UNIT - II
Design of UAV Systems-I: Introduction to design and selection of the systems-conceptual phase, preliminary design, detailed design; Aerodynamics and airframe configurations-Lift-induced Drag, Parasitic Drag, Rotary-wing Aerodynamics, Response to Air Turbulence, Airframe Configurations; Medium-range, Tactical Aircraft, Characteristics of Aircraft Types-Long-endurance, Long-range Role Aircraft, Medium-range, Tactical Aircraft, Close-range/Battlefield Aircraft, MUAV Types, MAV and NAV Types, UCAV, Novel Hybrid Aircraft Configurations, Aspects of Airframe Design: Scale Effects, Packaging Density, Aerodynamics, Structures and Mechanisms, Selection of power- plants, Modular Construction, Ancillary Equipment, Design for Stealth: Acoustic Signature, Visual Signature, Thermal Signature, Radio/Radar Signature, Payload Types: Non-dispensable and dispensable payloads

UNIT - III
Design of UAV Systems-II: Communications-Communication Media, Radio Communication, Mid-air Collision (MAC) Avoidance, Communications Data Rate and Bandwidth Usage, Antenna Type; Control and Stability: HTOL Aircraft, Convertible Rotor Aircraft, Payload Control, Sensors, Autonomy; Navigation: NAVSTAR Global Positioning System (GPS), TACAN, LORAN C, Inertial Navigation, Radio Tracking, Way-point Navigation; Launch and Recovery; Design for Reliability: Determination of the Required Level of Reliability, Achieving Reliability, Reliability Data Presentation, Multiplexed Systems, Reliability by Design, Design for Ease of Maintenance; Design for Manufacture and Development

UNIT - IV
The Development of UAV Systems: System Development and Certification-System Development, Certification, Establishing Reliability; System Ground Testing: UAV Component Testing, UAV Sub-assembly and Sub-system Testing, Testing Complete UAV, Control Station Testing , Catapult Launch System Tests, Documentation; System In-flight Testing: Test Sites, Preparation for In-flight Testing, In-flight Testing, System Certification;

UNIT - V
Deployment and Future of UAV Systems: Operational trials and full certification; UAV System Deployment- Network-centric Operations (NCO), Teaming with Manned and Other

Unmanned System; Naval, arm and air force roles, civilian, paramilitary and commercial roles

TEXTBOOK:

1. Unmanned Aircraft Systems: UAVS Design, Development and Deployment, Reg Austin, Wiley, 2010.

REFERENCE BOOK:

1. Introduction to Unmanned Aircraft Systems, Richard K. Barnhart, Stephen B. Hottman, Douglas M. Marshall, Eric Shappee, (eds.), CRC Press, 2012.

COMPUTATIONAL STRUCTURES LAB

B.Tech. III Year II Sem. **L T P C**
Course Code: AE604PC **0 0 3 2**

1, 2. Introduction to the features and application of any one of the professional software employed in modelling and analysis of aircraft structures.

Modeling, Analysis (Maximum Stresses, Deflections) and Code Development, Of Structural Elements under Arbitrary Static Loading - Validation of Solutions with Professional Software

3. Bending of uniform cantilever beams.

4. Compressive strength of rectangular stiffened plane panels of uniform cross-section.

5. Shear and torsion of stiffened thin walled open and closed sections.

6. Statically indeterminate trusses.

7. Free vibrations of uniform cantilever beams- determination of natural frequencies and mode shapes.

Modeling and Analysis of Simple Aircraft Components Using Professional Software

8. 3 dimensional landing gear trusses.

9. Tapered wing box beams.

10. Fuselage bulkheads.

Suggested software:

ANSYS

NASTRAN

PATRAN

FLIGHT DYNAMICS AND CONTROL LAB

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE605PC	**0**	**0**	**3**	**2**

1. BASIC ANATOMY OF AN AIRCRAFT: The main aim of this experiment is to have a control over all the control surfaces of an aircraft.

2. HELICOPTER FLIGHT: The main aim of this experiment is to understand the mechanism involved in helicopter flight. The helicopter control mechanism is not exactly the same as that of an aircraft control mechanism, one need to study the controls mechanism of helicopter in order to obtain pitch, roll, and yaw maneuver.

3. FLIGHT SIMULATOR: The main aim of this experiment is to understand the mechanism involved in an aircraft and helicopter using flying software. Analysis of different mission segments of an aircraft and helicopter will be done.

4. ANALYSIS OF A STEADY LEVEL MANEUVERS AND INSTANTANEOUS MANEUVERS USING 2-D ACCELEROMETER: The main of this experiment is to analyze the data given by accelerometer for Pull-up, Pull- down maneuvers and Steady level turn.

5. FLIGHT MECHANISMS OF AN AIRCRAFT USING AURDINO: The main aim of this experiment is to analyze the actuation mechanisms of an aircraft and helicopter using Aurdnio with the help of mission planner software.

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

B.TECH. III YEAR II SEM.	**L T P C**
Course Code: EN606HS	**0 0 3 2**

Introduction:
A course on *Advanced English Communication Skills (AECS) Lab* is considered essential at the third year level of B.Tech and B.Pharmacy courses. At this stage, the students need to prepare themselves for their career which requires them to listen to, read, speak and write in English both for their professional and interpersonal communication. The main purpose of this course is to prepare the students of Engineering for their placements.

Course Objectives: This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve students' fluency in spoken English
- To enable them to listen to English spoken at normal conversational speed
- To help students develop their vocabulary
- To read and comprehend texts in different contexts
- To communicate their ideas relevantly and coherently in writing
- To make students industry-ready
- To help students acquire behavioral skills for their personal and professional life
- To respond appropriately in different socio-cultural and professional contexts

Course Outcomes: Students will be able to:

- Acquire vocabulary and use it contextually
- Listen and speak effectively
- Develop proficiency in academic reading and writing
- Increase possibilities of job prospects
- Communicate confidently in formal and informal contexts

Syllabus
The following course activities will be conducted as part of the Advanced English Communication Skills (AECS) Lab:

1. **Inter-personal Communication and Building Vocabulary** - Starting a Conversation – Responding Appropriately and Relevantly – Using Appropriate Body Language – Role Play in Different Situations - Synonyms and Antonyms, One-word Substitutes, Prefixes and Suffixes, Idioms and Phrases and Collocations.
2. **Reading Comprehension** –General Vs Local Comprehension, Reading for Facts, Guessing Meanings from Context, , Skimming, Scanning, Inferring Meaning.
3. **Writing Skills** – Structure and Presentation of Different Types of Writing – Letter Writing/Resume Writing/ e-correspondence/ Technical Report Writing.
4. **Presentation Skills** – Oral Presentations (individual or group) through JAM Sessions/Seminars/PPTs and Written Presentations through Posters/Projects/Reports/ e-mails/Assignments… etc.,
5. **Group Discussion and Interview Skills** – Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas and Rubrics of Evaluation- Concept and Process,

Pre-interview Planning, Opening Strategies, Answering Strategies, Interview through Tele-conference & Video-conference and Mock Interviews.

Minimum Hardware Requirement
Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- **Spacious room with appropriate acoustics**
- **Eight round tables with five movable chairs for each table.**
- **Audio-visual aids**
- **LCD Projector**
- **Public Address system**
- **Computer with suitable configuration**

Suggested Software: The software consisting of the prescribed topics elaborated above should be procured and used.

- **Oxford Advanced Learner's Compass**, 8th Edition
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**

REFERENCES:

1. Kumar, Sanjay and Pushp Lata. English for Effective Communication, Oxford University Press, 2015.
2. Konar, Nira. English Language Laboratories – A Comprehensive Manual, PHI Learning Pvt. Ltd., 2011.

FLIGHT VEHICLE DESIGN

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: AE701PC	**4**	**1**	**0**	**4**

UNIT – I

Overview of the Design Process, Sizing From a Conceptual Sketch: Phases of aircraft design. Aircraft conceptual design process, project brief / request for proposal, problem definition, information retrieval, aircraft requirements, configuration options. Integrated product development and aircraft design. The initial conceptual sketches, L / D estimation. Initial takeoff weight build-up, empty weight estimation, historical trends, fuel fraction estimation, mission profiles, mission segment weight fractions.

UNIT – II

Airfoil and Geometry Selection, Thrust to Weight Ratio, Wing Loading: Airfoil selection, airfoil design, design lift coefficient, stall, airfoil thickness ratio and other airfoil considerations. Wing geometry and wing vertical location, wing tip shapes. Tail geometry and arrangements. Thrust to weight ratio, statistical estimation, thrust matching. Wing loading performance constraints. Selection of thrust-to-weight ratio and wing loading.

Initial Sizing and Configuration Layout, Crew Station, Passengers And Payload: Sizing with fixed engine and with rubber engine. Geometry sizing of fuselage, wing, tail, control surfaces. Development of configuration lay out from conceptual sketch. The inboard profile drawing, wetted area, volume distribution and fuel volume plots. Lofting- definition, significance and methods, flat wrap lofting. Special consideration in configuration lay out. Isobar tailoring, Sears-Haack volume distribution, structural load paths. Radar, IR, visual detectability, aural signature. Considerations of vulnerability, crashworthiness, producibility, maintainability. Fuselage design, crew station, passenger compartment, cargo provisions, weapons carriage, gun installation.

UNIT – III

Propulsion and Fuel System Integration, Landing Gear and Subsystems: Propulsion selection, jet engine integration, engine dimensions, inlet geometry, inlet location, capture area calculation, boundary layer diverters, nozzle integration, engine cooling provisions, engine size estimation. Fuel system design and integration. Landing gear arrangements, guidelines for lay out. Shock absorbers–types, sizing, stroke determination, gear load factors. Gear retraction geometry. Aircraft subsystems, significance to configuration lay out. The baseline design layout and report of initial specifications.

Baseline Design Analysis - Aerodynamics & Propulsion, Structures & Weight and Balance: Estimation of lift curve slope, maximum lift coefficient, complete drag build up. Installed performance of an engine, installed thrust methodology, net propulsive force, part power operation. Aircraft loads, categories: manoeuvre, gust, inertial, power plant, landing gear loads. Limit loads, the V, n diagram. Air load distribution on lifting surfaces. Review of methods of structural analysis. Material selection. Weights and moments statistical group estimation method, centre of gravity excursion control.

UNIT – IV

Baseline Design - Stability and Control, Performance and Constraint Analysis: Estimation of static pitch stability, velocity stability and trim. Estimation of stability and control derivatives. Static lateral, directional stability and trim. Estimation of aircraft dynamical characteristics, handling qualities. Cooper – Harper scale, relation to aircraft dynamic characteristics. Performance analysis and constraint analysis– steady level flight, minimum thrust required for level flight, range and loiter endurance. Steady climbing and descending flight, best angle and rate of climb, time to climb and fuel to climb. Level turning flight, instantaneous turn rate, sustained turn rate. Energy maneuverability methods of optimal climb trajectories and turns. The aircraft operating envelope. Take off analysis, Balanced field length. Landing analysis. Fighter performance measures of merit. Effects of wind on aircraft performance. Initial technical report of baseline design analysis and evaluation. Refined baseline design and report of specifications.

Cost Estimation, Parametric Analysis, Optimisation, Refined Sizing and Trade Studies: Elements of life cycle cost, cost estimating method, RDT&E and production costs, operation and maintenance costs, fuel and oil costs, crew salaries, maintenance expenses, depreciation. Cost measures of merit. Aircraft and airline economics, DOC and IOC, airline revenue, breakeven analysis, investment cost analysis. Parametric analysis and optimisation. Refined conceptual sizing methods. Sizing matrix plot and carpet plot. Trade studies, design trades, requirement trades, growth sensitivities. Multivariable design optimization methods. Measures of merit. Determination of final baseline design configuration, preparation of type specification report.

UNIT - V

Case Studies and Design of Unique Aircraft Concepts: Design of the DC – 1, DC – 2, DC-3 aircraft, Boeing B-47 and 707, General Dynamics F-16, SR-71 Blackbird, Northrop-Grumman B-2 Stealth Bomber. A survey of the Indian aircraft design effort. Design of VTOL aircraft, helicopters, hypersonic vehicles, delta and double delta wings, forward swept wings, uninhabited air vehicles.

TEXT BOOKS:

1. Raymer, Daniel P. (2006), Aircraft Design: A Conceptual Approach, 4th edition, AIAA Educational Series, USA.
2. J. F. Marchman, L. R. Jenkinson (2003), Aircraft Design Projects for Engineering students, AIAA Publishers, USA.
3. Ajoy Kumar Kunda (2010), Aircraft Design, Cambridge University Press, UK.

REFERENCE BOOKS

1. Torenbeek E. (1986), Synthesis of Subsonic Airplane Design, Delft University Press, New York.

2. Bruhn. E. H (1973), Analysis and Design of Flight Vehicles Structures, New Edition, Jacobs Publishing House, USA.
3. Scheler E. E, Dunn L.G (1963), Airplane Structural Analysis and Design, John Wiley & Sons, USA.
4. D. Howe (2005), Aircraft conceptual Design Synthesis, John Wiley & Sons Publishers, USA.

MECHANICAL VIBRATIONS AND STRUCTURAL DYNAMICS

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: AE702PC	**4**	**1**	**0**	**4**

UNIT – I

Free Vibration of Single-Degree-of-Freedom-System: Importance of the Study of Vibration; Basic Concepts of Vibration - Elementary Parts of Vibrating Systems, Number of Degrees of Freedom, Discrete and Continuous Systems; Classification of Vibration - Free and Forced Vibration, Undamped and Damped Vibration, Linear and Nonlinear Vibration, Deterministic and Random Vibration; Vibration Analysis Procedure, Spring Elements, Mass or Inertia Elements, Damping Elements, Harmonic Motion, Harmonic Analysis. Introduction, Free Vibration of an Undamped Translational System, Free Vibration of an Undamped Torsional System, Response of First Order Systems and Time Constant, Rayleigh s Energy Method, Free Vibration with Viscous Damping, Graphical Representation of Characteristic Roots and Corresponding Solutions, Parameter Variations and Root Locus Representations, Free Vibration with Coulomb Damping, Free Vibration with Hysteretic Damping, Stability of Systems

UNIT - II

Vibration Under Harmonic Forcing Conditions: Introduction, Equation of Motion, Response of an Undamped System Under Harmonic Force, Response of a Damped System Under Harmonic Force, Response of a Damped System Under F(t)=F0eit , Response of a Damped System Under the Harmonic Motion of the Base, Response of a Damped System Under Rotating Unbalance, Forced Vibration with Coulomb Damping, Forced Vibration with Hysteresis Damping, Forced Motion with Other Types of Damping, Self-Excitation and Stability Analysis, Transfer-Function Approach.

UNIT - III

Vibration Under General Forcing Conditions: Introduction, Response Under a General Periodic Force, Response Under a Periodic Force of Irregular Form, Response Under a No periodic Force, Convolution Integral, Response Spectrum, Laplace Transform, Numerical Methods, Response to Irregular Forcing Conditions Using Numerical Methods

UNIT - IV

Two-Degree - and Multi-Degree-of-Freedom Systems: Introduction, Equations of Motion for Forced Vibration, Free Vibration Analysis of an Undamped System, Torsional System, Coordinate Coupling and Principal Coordinates, Forced-Vibration Analysis, Semi-definite Systems, Self-Excitation and Stability Analysis Modeling of Continuous Systems as Multi-degree-of-Freedom Systems, Using Newton s Second Law to Derive Equations of Motion, Influence Coefficients - Stiffness Influence Coefficients, Flexibility influence Coefficients, Inertia Influence Coefficients; Potential and Kinetic Energy Expressions in Matrix Form, Generalized Coordinates and Generalized Forces, Using Lagrange s Equations to Derive Equations of Motion, Equations of Motion of Undamped Systems in Matrix Form, Eigen value Problem, Solution of the Eigen value Problem, Expansion Theorem, Unrestrained Systems, Free Vibration of Undamped Systems, Forced Vibration of Undamped Systems Using Modal Analysis, Forced Vibration of Viscously Damped Systems, Self-Excitation and Stability Analysis

UNIT – V

Continuous Systems: Introduction, Transverse Vibration of a String or Cable, Longitudinal Vibration of a Bar or Rod, Torsional Vibration of a Shaft or Rod, Lateral Vibration of Beams, The Rayleigh-Ritz Method.

TEXT BOOKS:

1. Rao, S.S., Mechanical Vibrations, Fifth Edition, Prentice-Hall, 2011.
2. Thomson, W.T., Theory of vibrations with applications, CBS Publishers, Delhi.
3. Meirovitch, L., Fundamentals of vibrations, McGraw Hill International Edition, 2001.

REFERENCES:

1. Leissa, A.W., Vibration of continuous system, The McGraw-Hill Company, 2011.
2. Inman, D.J., Vibration Engineering, Third Edition, Prentice Hall Int., Inc., 2001,
3. Kelly, S.G., Schaum's Outline of The Theory and Problems of Mechanical Vibrations, Schaum's Outline Series, McGraw-Hill, 1996.

CAD/CAM
(PROFESSIONAL ELECTIVE – II)

B.Tech. IV Year I Sem. **L T P C**
Course Code: AE721PE **3 0 0 3**

Pre-requisites: To learn the importance and use of computer in design and manufacture

Course objectives: To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture. To understand the need for integration of CAD and CAM

Course Outcomes: Understand geometric transformation techniques in CAD. Develop mathematical models to represent curves and surfaces .Model engineering components using solid modeling techniques. Develop programs for CNC to manufacture industrial components. To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT – I
Fundamentals of CAD, CAM, Automation , design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD, Design workstation, Graphic terminal, CAD software- definition of system software and application software ,CAD database and structure.
Geometric Modeling: 3-D wire frame modeling, wire frame entities and their definitions, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

UNIT - II
Surface modeling: Algebraic and geometric form, Parametric space of surface, Blending functions, parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.
Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT – III
NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

UNIT – IV

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

UNIT – V

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Computer Integrated Manufacturing: CIM system, Benefits of CIM

TEXT BOOKS:

1. CAD/CAM Concepts and Applications / Alavala / PHI
2. CAD/CAM Principles and Applications / P.N.Rao / Mc Graw Hill

REFERENCE BOOKS:

1. CAD/CAM/ Groover M.P/ Pearson
2. CAD/CAM/CIM/ Radhakrishnan and Subramanian / New Age

AIRCRAFT MAINTENANCE ENGINEERING
(PROFESSIONAL ELECTIVE – II)

B.Tech. IV Year I Sem.	**L T P C**
Course Code: AE722PE	**3 0 0 3**

UNIT- I

Philosophy of Aircraft Maintenance: Definition of maintenance, Objectives of a maintenance program, Outline of aviation maintenance program, summary of FAA requirements, additional maintenance program requirements; Organization of maintenance and engineering, organization structure, M&E organization chart, general groupings, Managerial Level Functions-technical services, aircraft maintenance, overhaul shops, material, maintenance program evaluation directorates, summary of management levels, organization structure and TPPM, variations from the typical organization role of the engineer, role of the mechanic, two types of maintenance, reliability, redesign, failure rate patterns, other maintenance considerations, establishing a maintenance program. Goals and objectives of maintenance, Discussion of the five objectives

UNIT- II

Development of Maintenance Programs, Certification and Maintenance Documentation: Maintenance Steering Group(MSG) Approach, Process-Oriented maintenance, Task-oriented maintenance, Current MSG process-MSG-3, Maintenance program documents, maintenance intervals defined, changing basic maintenance intervals, maintenance program content; Aircraft certification, delivery inspection, operator certification, certification of personnel, aviation industry interaction; Types of documentation, manufacturer's documentation, regulatory documentation, airline generated documentation, ATA document standards, closer look of TPPM

UNIT- III

Technical Services: Engineering: makeup of engineering, mechanics and engineers, engineering department functions, engineering order preparation; Production Planning & Control-forecasting, production planning, production control, feedback for planning, organization of PP&C; Technical Publications-functions of technical publications, airline libraries, control of publications, document distribution; Technical Training-organization, training for aviation maintenance, airframe manufacturer's training courses, other airline training courses; Computer support-airlines uses of computers

UNIT- IV

Maintenance and Material Support: Line Maintenance(on-aircraft)-makeup of line maintenance, functions that control maintenance, maintenance control centre responsibilities, general line maintenance operations, aircraft logbook, ramp and terminal operations, other line maintenance activities, line station activities, maintenance crew requirements, morning meeting; Hangar Maintenance(on-aircraft)-organization of hangar maintenance, problem areas in hangar maintenance, maintenance support shops, ground support equipment, typical

C-check; Maintenance overhaul shops(off-aircraft)-organization, types and operation of overhaul shops,
Shop data collection; Material support-organization and function of material, material directorate, M&E support functions

UNIT- V

Oversight Functions: Quality Assurance-requirements for QA, quality audits, ISO 9000 quality standard, technical records, other functions of QA; Quality Control-quality control organization, FAA and JAA differences, QC inspector qualifications, basic inspection policies, other QC activities; Reliability-definition and types of reliability, elements of a reliability program; Maintenance Safety-industry safety, safety regulations, maintenance safety program, general responsibilities for safety, general safety rules, accident and injury reporting; Troubleshooting- three levels of troubleshooting, knowledge of malfunctions, knowledge is power, building your own knowledge base, understanding the sequence of events, eight basic concepts of troubleshooting

TEXT BOOKS:

~~6.~~1. Kinnison, H.A., Aviation Maintenance Management, Second Edition, McGraw-Hill, 2013.
~~7.~~2. McKinley, J. L., Bent, R.D., Maintenance and Repair of Aerospace Vehicles, Northrop Institute of Technology, McGraw Hill, 1967

REFERENCES:

1. Friend, C.H., Aircraft Maintenance Management, Longman, 1992.
2. Kroes, M., Watkins, W., and Delp, F. Aircraft Maintenance and Repair, Tata McGraw-Hill, 2010.
3. Patankar, M.S. And Taylor, J.C., Risk Management and Error Reduction in Aviation Maintenance, Ashgate, 2004, ISBN 0-7546-1941-9.

MATERIAL SCIENCE AND COMPOSITES
(PROFESSIONAL ELECTIVE – II)

B.Tech. IV Year I Sem.	**L T P C**
Course Code: AE723PE	**3 0 0 3**

UNIT - I

Introduction: Definition, Classification of Composite materials based on structure based on matrix. Advantages of composites, application of composites, functional requirements of reinforcement and matrix.

UNIT - II

Fibers: Preparation, properties and applications of glass fibers, carbon fibers, Kevlar fibers and metal fibers, properties and applications of whiskers, particle reinforcements.

UNIT - III

Manufacturing of Advanced Composites: Polymer matrix composites: Preparation of Moulding compounds and prepregs, hand layup method, Autoclave method. Filament winding method, Compression moulding, Reaction injection moulding.

UNIT - IV

Manufacturing of Metal Matrix Composites: Casting, Solid State diffusion technique, Cladding - Hot isostatic pressing. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration, Liquid phase sintering.

Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving.

UNIT - V

Response of Composites to Stress: (a) Iso Strain condition (b) Iso Stress condition (c) Load friction shared by the fibers.

TEXT BOOKS:

1. V. C. H. Cahn (2007), Material Science and Technology, Vol. 13, 3rd edition, Wiley WCH, West Germany.
2. K. K. Chawla (2010), Composite Materials, 2nd edition, Springer, USA.

REFERENCE BOOKS:

1. E. D. Lubin (2003), Hand Book of Composite Materials, 3rd edition, Tata McGraw-Hill, New Delhi, India.
2. Muhammad M. Rafique (2009), Composite Materials: Processing and Technology, 2nd edition, Academy Press,Lap Lambert.
3. P. K. Sinha (2006), Composite Materials and structure, IIT Kharagpur, India

OPERATIONS RESEARCH
(PROFESSIONAL ELECTIVE – II)

B.Tech. IV Year I Sem.	**L T P C**
Course Code: ME724PE/MT734PE/AM743PE	**3 0 0 3**

Course Objectives: Understanding the mathematical importance of development of model in a particular optimization model for the issue and solving it.

Course Outcome: Understanding the problem, identifying variables & constants, formulas of optimization model and applying appropriate optimization Tech

UNIT – I

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

Allocation: Linear Programming Problem - Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method; Duality Principle.

UNIT – II

Transportation Problem – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

UNIT – III

Sequencing – Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines-graphical model. **Replacement:** Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

UNIT – IV

Theory of Games: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games –m x 2 & 2 x n games - graphical method – m x n games - dominance principle.

Inventory: Introduction – Single item, Deterministic models – Types - Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand discrete variable or continuous variable – Single Period model with no setup cost.

UNIT – V

Waiting Lines: Introduction–Terminology-Single Channel–Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

Dynamic Programming: Introduction – Terminology- Bellman's Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem.

TEXT BOOKS:

1. Operations Research / N.V.S. Raju / SMS
2. Operations Research / ACS Kumar / Yes Dee

REFERENCE BOOKS:

1. Operations Research /J. K. Sharma / MacMilan.
2. Operations Research /A. M. Natarajan, P. Balasubramaniam, A. Tamilarasi / Pearson.

AIRCRAFT STRUCTURAL DESIGN
(PROFESSIONAL ELECTIVE – III)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: AE731PE	**3**	**0**	**0**	**3**

UNIT-I

Introduction and Airworthiness Requirements: Structural design and sizing stages, Principal Structural components of aircraft Design requirements- structural integrity, stiffness, service life, Constraints- baseline aerodynamic configuration, external loading, weight, operating conditions, conformity to government regulations. Design for durability, damage tolerance. Airworthiness requirements - loads, safety margins, material properties, methods of estimation construction, operation, maintenance, training-procedures. Critical load conditions. Limit and ultimate loads- definition, significance. Aircraft materials-mechanical properties- design data-allowable, allowable bases. Failure theory. Flight loads-atmospheric, manoeuvre - construction of flight envelope.

UNIT-II

External Loads – Estimation, Fasteners and Structural Joints: Wing loads- air load span wise distribution, effect of fuselage, engine nacelle, wing stores, control surfaces, landing, taxi, dynamic gust loads, wing weight distribution. Empennage loads- gust, manoeuvre, control surface. Fuselage loads- distribution of weight, fore body loads, after body loads, internal pressure, propulsion loads. Landing gear loads- landing conditions, ground handling loads, retraction loads. Miscellaneous loads. Airplane weight data, stiffness data. Theories of Failure. Fasteners and fittings- role, significance, general design considerations, criteria for allowable strength. Margins of safety. Fastener systems, types, fastener information, dimensions, material, allowable strength- tensile, shear, bending, bearing, Rivets, bolts and screws, nuts- detail design considerations. Fastener selection. Fittings- lugs, bushings and bearings- loading, design and analysis. Joints- spliced, eccentric, gusset, welded, brazed, bonded-types, methods of joining, failure modes. Fatigue design considerations. Stress concentration- causes, methods of reduction. Fastener load distribution and bypass load-severity factor, structural joint life prediction. Shim control and requirement.

UNIT- III

Design of Wing, Tail Unit Structures: The wing- role- summary of wing loads, structural Components- wing box, leading and trailing edges. Wing layout- location of spars, ailerons and flaps, rib spacing and direction, root rib bulkhead, span wise stiffeners, wing covers-skin-stringer panels, integrally stiffened panels, access holes, and attachment of leading edge and trailing edge panels. Spars- general rules of spar design. Ribs and bulkheads- rib spacing and arrangement. Wing root joints, carry through structure. Fighter wing design- problems with swept wings Wing box, root rib bulkhead- estimation of loads, stress analysis, design parameters, optimization, sizing, margins of safety. Leading and trailing edge assembly-control surfaces, flaps- structure.

UNIT-IV

Design of Fuselage, Landing Gear, Engine Mounts: Function of fuselage-loading, general requirements. Ultimate strength of stiffened cylindrical structure- review, Principal structural components- skin and stringers, frame and floor beam, pressure bulkhead, wing and fuselage intersection- lay out, loading, stress analysis, sizing. Forward fuselage, aft fuselage structures, fuselage openings- windows, doors- design considerations. Landing gear- purpose, types, general arrangement, loads- design considerations- ground handling, take-off, landing, braking, pavement loading, support structure. Stowage and retraction, gear lock kinematic design. Shock absorbers- function, types, components, operation, loads, materials, design. Wheels and brakes, tire selection Engine mounts- types-wing pod, rear fuselage, tail, fuselage mount, loads, design considerations.

UNIT- V

Fatigue Life, Damage Tolerance, Fail-Safe Design- Weight Control and Balance: Catastrophic effects of fatigue failure- examples- modes of failure-design criteria- fatigue stress, fatigue performance, fatigue life. Fatigue design philosophy- fail-safe, safe life. Service behaviour of aircraft structures- effect of physical and load environment design and of detail of fabrication Structural life methods of estimation- the scatter factor- significance Fail-safe design-the concept, requirements, damage tolerance- estimation of fatigue strength

TEXT BOOKS:

1. Niu, M.C., Airframe Structural Design, second edition, Hong kong Conmlit Press, 1988, ISBN: 962-7128- 09-0.
2. Niu, M.C., Airframe Stress Analysis, and Sizing, second edition, Hong kong Conmlit Press, 1997, ISBN: 962-7128-08-2.

REFERENCES:

1. Bruhn, E.H., Analysis and Design of Flight Vehicles Structures, Tri - state Offset Company, USA, 1965.
2. Peery, D.J, and Azar, J.J., Aircraft Structures, second edition, Mc Graw-Hill, N.Y., 1993.
3. Megson, T.H.G., Aircraft Structures for Engineering Students, Butterworth-Heinemann/
Elsevier, 2007.
4. Raymer, D.P., *Aircraft Design: A Conceptual Approach*, 3rd edn., AIAA Education Series, AIAA, 1999, ISBN: 1-56347- 281-0.
5. Fielding, J.P., Introduction to Aircraft Design, Cambridge University Press, 2005, ISBN: 0-521-657222-9.

COMPUTATIONAL FLUID DYNAMICS
(PROFESSIONAL ELECTIVE – III)

B.Tech. IV Year I Sem.	**L T P C**
Course Code: ME732PE/AM741PE	**3 0 0 3**

UNIT - I:
Basic Aspects of the Governing Equations – Physical Boundary Conditions – Methods of solutions of Physical Problems – Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM etc., - Main working principle - CFD as a research and design tool – Applications in various branches of Engineering
Mathematical behavior of Partial Differential Equations (Governing Equations): Classification of linear/ quasi linear PDE – Examples - Physical Processes: Wave Equations and Equations of Heat Transfer and Fluid Flow – Mathematical Behavior - General characteristics – Its significance in understanding the physical and numerical aspects of the PDE – One way and Two Way variables – Well posed problems – Initial and Boundary Conditions
Solution of Simultaneous Algebraic Equations: Direct Method – Gauss Elimination – LU Decomposition – Pivoting – Treatment of Banded Matrices – Thomas Algorithm
Iterative Method: Gauss Seidel and Jordan Methods - Stability Criterion

UNIT - II:
Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order and second order terms – Solution of physical problems with Elliptic type of Governing Equations for different boundary conditions - Numerical treatment of 1D and 2D problems in heat conduction, beams etc., - Solutions –Treatment of Curvelinear coordinates – Singularities – Finite Difference Discretization – Solution of 1D heat conduction problems in Heat conduction in curve linear coordinates

UNIT - III:
FDM: Solution of physical problems with Parabolic type of Governing Equations – Initial Condition –Explicit, implicit and semi implicit methods – Types of errors – Stability and Consistency – Von Neumann Stability criterion– Solution of simple physical problems in 1D and 2D – Transient Heat conduction problems- ADI scheme - Simple Hyperbolic type PDE - First order and Second order wave equations – Discretization using Explicit method - Stability criterion – Courant Number – CFL Condition - Its significance - Treatment of simple problems

UNIT - IV:
Finite Difference Solution of Unsteady Inviscid Flows: Lax – Wendroff Technique – Disadvantages – Maccormack's Technique
Fluid Flow Equations – Finite Difference Solutions of 2D Viscous Incompressible flow problems – Vorticity and Stream Function Formulation – Finite Difference treatment of Lid

Driven Cavity Problem - Application to Cylindrical Coordinates with example of flow over infinitely long cylinder and sphere – Obtaining Elliptic Equations

UNIT - V:

Finite Difference Applications in Fluid flow problems: Fundamentals of fluid Flow modeling using Burger's Equation – Discretization using FTCS method with respect to Upwind Scheme and Transport Property – Upwind Scheme and Artificial Viscosity

Solutions of Navier Stokes Equations for Incompressible Fluid Flows: Staggered Grid – Marker and Cell (MAC) Formulation – Numerical Stability Considerations – Pressure correction method - SIMPLE Algorithm

REFERENCE BOOKS:

1. Computational Fluid Flow and Heat Transfer – K Muralidharan and T Sudarajan, Narosa Publishers
2. Computational Fluid Dynamics : The basics with applications – John D Anderson, McGraw Hill Publications

AIRPORT PLANNING AND MANAGEMENT
(PROFESSIONAL ELECTIVE – III)

	L	T	P	C
B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: AE733PE	**3**	**0**	**0**	**3**

UNIT- I

Airport and Airport Systems: Introduction, Airport management on an International level, The National Plan of Integrated Airport Systems, The rules that govern airport management, organizations that influence airport regulatory bodies; Airport organization and administration: Airport ownership and operation, the airport organization chart, the airport manager and public relations

UNIT-II

The Airfield, Airspace and Air Traffic Management: Airfield: The components of an airport, the airfield, airfield lighting, navigational aids located on airfields, air traffic control and surveillance facilities located on the airfield, weather reporting facilities located on airfields, security infrastructure on airfields; Airspace and Air Traffic Management: The present–day air traffic control management and operating infrastructure, The basics of air traffic control, Current and future enhancements to air traffic management

UNIT - III

Airport Operations Management, Airport Terminals and Ground Access, Airport Security: Airport Operations: Inspection and compliance, Specific Areas of Importance-Pavement management, runway surface friction, aircraft rescue and fire fighting, snow and ice control, self inspection programs, safety management systems for airports; Airport Terminals and Ground Access: Historical Development of airport terminals, components of the airport terminal, airport ground access; Airport Security-The transportation security administration, security at commercial service airports, security at general aviation airports, the future of airport security

UNIT - IV

Airport Financial Management, Airport Planning: Airport Financial Management: Introduction, airport financial accounting, liability insurance, planning and administering an operational budget, revenue strategies at commercial airports, pricing of airport facilities and services, variation in the sources of operating revenues, rise in airport financial burdens, airport funding, grant programs, airport financing, private investment; Airport Planning: Airport system planning, airport master plan, airport layout plan, forecasting, facilities requirement, design alternatives, financial plans, land use planning, environmental planning

UNIT-V

Airport Capacity and Delay: Introduction, Defining capacity, Factors affecting capacity and delay, estimating capacity, illustrating capacity with time-space diagram, FAA approximation charts, simulation models, defining delay, estimating delay, analytical estimates of delay-the queuing diagram, other measures of delay, approaches to reducing delay, administrative and demand management

TEXT BOOK:

1. Seth B. Young and Alexander T. Wells, 'Airport Planning and Management', Sixth Edition, McGraw-Hill Education, 2011

REFERENCES:

1. Kazda, A. and Caves, R.E., 'Airport Design and Operation', 2^{nd} edn., Elsevier, 2007.
2. Horonjeff, R., McKelvey, F.X., Sproule, W.J. and Young, S.B., 'Planning and Design of Airports', 5^{th} edn., McGraw-Hill, 2010.
3. Norman J. Ashford, Pierre Coutu and John R. Beasley, 'Airport Operations', 3^{rd} edition, McGraw-Hill, 2012.

SYSTEM MODELING AND SIMULATION
(PROFESSIONAL ELECTIVE – III)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: AE734PE	**3**	**0**	**0**	**3**

UNIT - I

Introduction to Simulation: When simulation is the appropriate tool and when it is not appropriate; Advantages and disadvantages of Simulation; Areas of application; Systems and system environment; Components of a system; Discrete and continuous systems; Model of a system; Types of Models; Discrete-Event System Simulation; Steps in a Simulation Study. The basics of Spreadsheet simulation, Simulation example: Simulation of queuing systems in a spreadsheet; Concepts in Discrete-Event Simulation: The Event- Scheduling / Time-Advance Algorithm, World Views, Manual simulation Using Event Scheduling

UNIT - II

Statistical Models in Simulation: Review of terminology and concepts; Useful statistical models; discrete distributions; Continuous distributions; Poisson process; Empirical distributions.

Queuing Models: Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behaviour of M/G/1 queue; Networks of queues; Rough-cut modeling: An illustration

UNIT - III

Random-Number Generation, Random-Variate Generation: Properties of random numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random Numbers Random-Variate Generation: Inverse transform technique; Acceptance- Rejection technique; Special properties

UNIT - IV

Input Modeling: Data Collection; Identifying the distribution with data; Parameter estimation; Goodness of Fit Tests; Fitting a non-stationary Poisson process; Selecting input models without data; Multivariate and Time-Series input models

Estimation of Absolute Performance: Types of simulations with respect to output analysis; Stochastic nature of output data; Absolute measures of performance and their estimation; Output analysis for terminating simulations; Output analysis for steady-state simulations

UNIT - V

Verification, Calibration, and Validation; Optimization: Model building, verification and validation; Verification of simulation models; Calibration and validation of models, optimization via Simulation

TEXT BOOKS:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, 5th Edition, Pearson Education, 2010

REFERENCES

1. Devendra K. Chaturvedi: Modeling and Simulation of Systems Using MATLAB and Simulink, CRC Press, Taylor and Francis Group, 2010
2. Frank L. Severance: System Modeling and Simulation: An Introduction, John Wiley & Sons Ltd, 2001

ADVANCED MANUFACTURING TECHNIQUES
(PROFESSIONAL ELECTIVE – IV)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: AE741PE	**3**	**0**	**0**	**3**

UNIT - I

Advanced Machining Processes: Classification of Advanced Machining Process, Mechanical Energy Based Processes: AJM, WJM, AWJM and USM-Working Principles, Equipment, Process parameters, Applications, Electrical Energy Based Processes: EDM & WEDM-Working Principles, Equipment, Process parameters, Applications. Chemical and Electro-Chemical Energy Based Processes: CHM and ECM-Working Principles, Equipment, Process parameters, Applications. Thermal Energy Based Processes: LBM, PAM, EBM-Working Principles, Equipment, Process parameters, Applications.

UNIT - II

Advanced Casting Processes: Metal mould casting, Continuous casting, Squeeze casting, vacuum mould casting, Evaporative pattern casting, ceramic shell casting.

UNIT - III

Advanced Welding Processes: Electron Beam Welding (EBW), Laser Beam Welding (LBW), and Ultrasonic Welding (USW).

UNIT - IV

Advanced Metal Forming Processes: Details of High Energy Rate Forming (HERF) process, Electro-magnetic forming, explosive forming, Electro-hydraulic forming, Stretch forming, Contour roll forming

UNIT - V

Additive Manufacturing: Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS), 3-D Printing, Laminated Object Modeling (LOM), etc.

TEXT BOOKS:

1. Nontraditional Manufacturing Processes, G.F. Benedict, Marcel Dekker, Inc. New York.
2. Advanced Machining Processes, Vijay K. Jain, Allied Publishers Pvt. Ltd., New Delhi.
3. Manufacturing Engineering & Technology, Kalpakjian. S, Pearson Education Asia.
4. Materials and Processes in Manufacturing, E. P. DeGarmo, J. T Black, R. A. Kohser, Prentice Hall of India, New Delhi
5. Material and Processes in manufacturing, Paul De Garmo, J.T. Black, and Ronald A. Kohser, Prentice Hall of India Pvt. Ltd., New Delhi.

AIR TRAFFIC CONTROL
(PROFESSIONAL ELECTIVE – IV)

B.Tech. IV Year I Sem.	**L T P C**
Course Code: AE742PE	**3 0 0 3**

UNIT - I

Air Traffic Control System Structure: Airspace Classification-general categories of airspace, controlled versus uncontrolled airspace, IFR flight in controlled and uncontrolled airspace, VFR flight in controlled and uncontrolled airspace; Airspace Classes-classes A to G, special VFR, federal airways, flight levels, tango routes, special use airspace; Airport Air Traffic Control Communications-Radio communication, ATC communication procedures

UNIT - II

Air Traffic Control Procedures and Organization: Separation responsibilities in controlled airspace-air traffic control procedures-delegation of responsibility-controller duties in an air route traffic control centre-air traffic control tower responsibilities; Control Tower Procedures: control towers, flight data controller duties, clearance delivery controller duties-ground controller duties, local controller duties

UNIT - III

Nonradar Enroute and Terminal Separation; Radar Separation: Design of Separation Procedures, Airspace Dimensions, Separation Procedures: Vertical Separation, lateral separation, holding patterns, longitudinal separation, initial separation of aircraft, visual separation; Radar Separation: Aircraft identification, transfer of radar identification, basic radar separation, radar assisted navigation, radar arrivals and approaches, radar traffic information, use of automation tools

UNIT - IV

Operation in the National Airspace System: Overview of an IFR flight: Flight planning and IFR clearances, coded departure route, Traffic flow management programs, alternative routes, clearance delivery, phoenix airspace, ground control coded departure routes, local control, departure control, en-route separation , miles in trail restrictions, metering, delay techniques, approach control; example of a VFR flight; Oceanic and international air traffic control: International air traffic control, international airspace, European air traffic control

UNIT - V

Future of the National Air Space System: Automated air traffic control: Procedural separation standards, ATC Modernization; Current ATC Initiatives: Departure delay program, en-route metering program, en-route sector loading program; Procedural changes: National route program; CNS Improvements: Communication system changes, required navigation performance, navigation security and surveillance systems;

Air traffic Management: Hardware, Next Generation air traffic control (NextGen), major components of NextGen, trajectory based operations, flexible airspace management, collaborative air traffic management, negotiated routes, improved aircraft separation, additional ADS functions, en-route automation modernization

TEXT BOOK:

1. Fundamentals of Air Traffic Control, Michael S Nolan, Fifth Edition, 2011

SPACE MECHANICS
(PROFESSIONAL ELECTIVE – IV)

B.Tech. IV Year I Sem.	**L**	**T**	**P**	**C**
Course Code: AE743PE	**3**	**0**	**0**	**3**

UNIT - I

Basic Concepts: The solar system, comets and meteors, Kepler's laws and Newton's law of gravitation, concept of celestial sphere, vernal equinox, ecliptic. Coordinate systems- ECI system, geographic coordinate system, azimuth-elevation coordinate system, ecliptic system, Time systems- sidereal time, mean solar time, Julian date, universal time, ephemeris time.

UNIT - II

Two-Body and Restricted Three Body Problems: N-body problem, two-body problem-simplifying assumptions, Equations of relative motion, Constants of the motion- conservation of angular momentum, Trajectory equation, elliptical orbit- geometry of the ellipse, period of an elliptical orbit, circular orbit, parabolic orbit, hyperbolic orbit. Geometry of the hyperbola, hyperbolic excess speed, Orbital elements.

Introduction, equations of motion, Lagrangian points, stability of the Lagrangian points, Jacobi's integral, accessible regions.

UNIT- III

Basic Orbital Manoeuvres and Orbit Perturbations: Low altitude earth orbits- effect of orbital altitude on satellite life times, direct ascent to orbit, perturbations of low earth orbits due to the oblate shape of the Earth. High altitude earth orbits- the synchronous satellite, launching a high altitude satellite. In-plane orbit changes- adjustment of perigee and apogee height, Hohmann transfer, general coplanar transfer between circular orbits, Out-of plane orbit changes-simple plane change.General overview of orbit perturbations, Earth gravity harmonics, lunisolar gravitational attractions, solar radiation pressure effects, atmospheric drag effects, tidal friction effects and mutual gravitational attraction, earth's oblateness (J_2) effects, critical inclination. Sun-synchronous orbits, J_3 effects and frozen orbits, Earth's triaxiality effects and east-west station keeping.

UNIT- IV

Ballistic Missile Trajectories: The general ballistic missile problem- geometry of the trajectory, free flight range equations, flight path angle equation, maximum range trajectory, time of free flight. Effect of launching errors on range- effect of lateral displacement of the burnout point, cross range error due to incorrect launch azimuth, effect of down range displacement of the burnout point, errors in burn-out flight-path angle, down range errors caused by incorrect burnout height and in correct speed at burnout. The effect of earth rotation- compensating for the initial velocity of missile due to earth rotation, compensating for movement of the target due to earth rotation.

UNIT- V

Interplanetary Trajectories: Patched-conic approximation-heliocentric transfer orbit, phase angle at departure, escape from the earth's sphere of influence, arrival at the target planet, effective collision cross-section. Locating the planets- launch opportunity, synodic period, trajectory type and class, ephemeris calculations, Non-coplanar interplanetary trajectories, Gravity-assist manoeuvre. Fast interplanetary trajectories.

TEXT BOOKS:

1. Bate, R.R., Mueller, D.D. and White, J.E., *Fundamentals of Astrodynamics*, Dover Publications Inc., New York, 1971.

REFERENCES:

1. Wiesel, W.E., *Spaceflight Dynamics,* 3rd edn., McGraw-Hill, New York, 2010.
2. Hale, F.J., *Introduction to Space Flight,* Prentice Hall, 1994.
3. Sellers, J.J., *Understanding Space: An Introduction to Astronautics*, 2nd edn., McGraw-Hill, 2004
4. Chobotov, V.A., ed, *Orbital Mechanics,* 3rd edn., AIAA Education Series, 2002.
5. David A. Vallado, *Fundamentals of Astrodynamics and Applications,*4th edition, Microcosm Press, 2013
6. Charles D. Brown, "Spacecraft Mission Design", AIAA Education Series, 1998
7. Cornelisse, J.W., Schoyer H.F.R. and Wakker, K.F., *Rocket Propulsion and Space-flight Dynamics,* Pitman, 1979.

MECHANICS OF COMPOSITE STRUCTURES
(PROFESSIONAL ELECTIVE – IV)

B.Tech. IV Year I Sem.	**L T P C**
Course Code: AE744PE	**3 0 0 3**

UNIT- I

Introduction to Composite Materials: Classification and characteristics, Mechanical behavior of composite materials, Basic terminology, Manufacture of laminated fiber-reinforced composite materials, Current and potential advantages of fiber-reinforced composite materials, Applications of composite materials.

UNIT - II

Macromechanical Behavior of a Lamina: Introduction, Stress-strain relations for anisotropic materials, Stiffnesses, compliances, and engineering constants for orthotropic materials, Restrictions on engineering constants, Stress-strain relations for plane stress in an orthotropic material, Stress-strain relations for a lamina of arbitrary orientation, Invariant properties of an Orthotropic lamina, Strengths of an Orthographic lamina, Biaxial strength criteria for an Orthotropic lamina.

UNIT - III

Micromechanical and Macromechanical behavior of lamina: Introduction, Mechanics of materials approach to stiffness, Elasticity approach to stiffness, Comparison of approaches to stiffness, Mechanics of materials approach to strength. Introduction, Classical lamination theory, Special cases of laminate stiffness, theoretical versus measured laminate stiffness, Strength of laminates, Inter-laminar stresses.

UNIT - IV

Bending and Buckling of Laminated Plates: Introduction, Governing equations, Deflection of simply supported laminated plates, under distributed transverse load, buckling of simply supported laminated plates under in-plane load.

UNIT - V

Introduction to Design of Composite Structures: Introduction to structural design, Materials selection, Configuration selection, Laminate joints, Design requirements and design failure criteria, Optimization concepts, Design analysis philosophy for composite structures.

TEXT BOOK:

1. Mechanics of Composite Materials, Robert. M. Jones, Second Edition, Taylor and Francis, 1999.

REFERENCE BOOKS:

1. Mechanics of Fibrous composites- Carl. T. Herakovich-John Wiley & Sons, 1997.
2. Advanced Composite Materials, Lalit Gupta, Himalayan Books. New Delhi, 1998.

FLIGHT VEHICLE DESIGN AND INSTRUMENTATION LAB

B.Tech. IV Year I Sem. **L T P C**
Course Code: AE703PC **0 0 3 2**

List of Experiments

1. Specification of design requirements- mission profile-conceptual sketches, initial sizing.
2. Airfoil and geometry selection, determination of thrust to weight ratio, wing loading.
3. First sizing & configuration layout, crew station, passengers & payload.
4. Baseline design- stability & control, performance and constraint analysis.
5. Cost estimation, parametric analysis, optimization, refined sizing & trade studies.
6. Determination of final baseline design configuration, preparation of specification report.
7. Hydraulic system.
8. Pneumatic system.
9. Demonstration on (a) Landing gears (b) Shock absorbers (c) Electro-mechanical operations of Elevators, Rudder, Flap etc on an actual aircraft (d) Artificial Horizon, Airspeed Indicator,
10. Instrument landing system.

REFERENCES:

1. Jenkinson, L.R. and Marchman III, J. F., Aircraft Design Projects for Engineering Students,
2. Butterworth Heinemann, 2003, ISBN: 0 7506 5772 3.
3. Raymer, D.P., Aircraft Design: A Conceptual Approach, 3rd edn., AIAA Education Series, AIAA, 1999, ISBN: 1-56347-281-0.
4. Fielding, J.P., Introduction to Aircraft Design, Cambridge University Press, 2005, ISBN: 0- 521-657222-9.AIAA Aerospace Design Engineer's Guide, 5th edn., AIAA Education Series, 2003, ISBN 1-56347-590-1.
5. Keane, A.J. And Nair, P.B., Computational Approaches for Aerospace Design, Wiley, 2005, ISBN:0-470-85540-1.
6. Taylor, J., Jane's All the World Aircraft, latest edition, Jane's, London.
7. Stinton, The Design of the Airplane, second edition, AIAA, 2001, ISBN: 0-56347-524-6.

COMPUTATIONAL FLUID DYNAMICS LAB

B.Tech. IV Year I Sem.	**L T P C**
Course Code: AE704PC	**0 0 3 2**

1. Numerical solutions for any one of the following using Finite Difference method
   Elliptic Equations
   Parabolic Equations
   Hyperbolic Equations

2. Grid generations for any one of the following
   Algebraically stretched Cartesian grids
   Elliptic Grids

3. Numerical Solutions for any one of the following
   Vortex Panel method
   Source Panel method
   Incompressible Coutte flow
   Supersonic flow over a flat plate
   Grid generation of aerofoil NACA 0012

Equipment Needed For CFD Lab

1. Computers P- IV with 1GB Ram and parallel computational facilities 30 nos / 30 students a batch.
2. Licensed Software's
   a. MAT LAB b. ANSYS c. CFX

HELICOPTER ENGINEERING
(PROFESSIONAL ELECTIVE – V)

B.Tech. IV Year II Sem. **L T P C**
Course Code: AE851PE **3 0 0 3**

UNIT- I

Basic Concepts: Helicopter Configurations-Single Main Rotor/Tail Rotor Configuration, Tandem Rotors, Coaxial Rotors, Side-By-Side Rotors, Intermeshing Rotors; Main Rotor System-Fully Articulated, Semi-Rigid and Rigid Rotor Systems, Combination Rotor Systems, Swash Plate Assembly, Anti-Torque Systems-Tail Rotor, Fenestron, NOTAR; Helicopter Controls: Collective Pitch Control, Cyclic Pitch Control, Anti-Torque Pedals, Throttle Control

UNIT- II

Fundamentals of Rotor Aerodynamics: Momentum Theory Analysis in Hovering Flight, Disk Loading and Power Loading, Induced Inflow Ratio, Thrust and Power Coefficients, Comparison of Theory with Measured Rotor Performance, Non-Ideal Effects on Rotor Performance, Figure of Merit, Induced Tip Loss, Rotor Solidity and Blade Loading Coefficients, Momentum Analysis in Axial Climb and Descent, Momentum Analysis in Forward Flight

UNIT III

Blade Element Analysis, Rotating Blade Motion: Blade Element Analysis in Hover and Axial flight, Forward Flight; Rotating Blade Motion-Introduction, Types of rotors, Equilibrium about the flapping hinge and lead-lag hinge, Equations of motion for a flapping blade, Blade feathering and the swash plate,

UNIT-IV

Helicopter Performance: Introduction, Hovering and Axial Climb Performance, Forward Flight Performance, Performance Analysis, Auto-Rotational Performance, Vortex Ring State, Ground Effect, Performance in Maneuvering Flight, Factors Influencing Performance Degradation

UNIT-V

Aerodynamic Design of Helicopters: Introduction, Overall Design Requirements, Conceptual and Preliminary Design Processes, Design of the Main Rotor, Fuselage Aerodynamic Issues, Empennage Design, Role of Wind Tunnels in Aerodynamic Design, Design of Tail Rotors, Other Ant-Torque Devices, High-Speed Rotorcraft

TEXT BOOKS

1. Principles of Helicopter Aerodynamics, 2^{nd} edition, J. Gordon Leishman, Cambridge University Press, 2006

REFERENCES:

1. Rotorcraft Aeromechanics, Wayne Johnson, Cambridge University Press, 2013
2. Aerodynamics of the Helicopter, Alfred Gessow and Garry C. Myers, Jr., Frederic Ungar Publishing Co, New York, 1985
3. Fundamentals of Helicopter Dynamics, C. Venkatesan, CRC Press, 2015
4. The Art of the Helicopter, John Watkinson, Elsevier, 2004
5. Helicopter Performance, Stability and Control, Raymond W. Prouty, Kriger Publishing Company, 1986
6. Basic Helicopter Aerodynamics, 3rd edition, John Seddon and Simon Newman, Wiley, 2011
7. Helicopter Engineering, Lalit Gupta, M. R. Sivaraman, Himalaya Publishing House, 2015

FABRICATION AND MACHINING OF COMPOSITE STRUCTURES (PROFESSIONAL ELECTIVE – V)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE852PE	**3**	**0**	**0**	**3**

UNIT – I

Overview and Introduction: Definition of composite material, Classification based on matrix and topology, Classification and characteristics of composites, Conventional vs. Composite materials, Advantages and limitations, Salient applications in various fields Constituents of composites, Interfaces and Interphases, Distribution of constituents, Nano-composites. Classification of Polymers Properties of Thermo plastics Properties of Thermosetting Plastics, prepreg layup and autoclave processing.

UNIT - II

Fibers and Matrix Materials: Fibers Fabrication, Structure, properties and applications Glass fiber, Boron fiber, carbon fiber, organic fiber, ceramic and metallic fibers whiskers Fabrication of Matrix materials polymers, metals and ceramics and their properties interfaces Wettability Types of bonding at the interface Tests for measuring interfacial strength Physical and chemical properties.

UNIT - III

Processing of Polymer Matrix, Metal Matrix and Ceramic Matrix Composites: Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer molding, autoclave molding bag molding, compression molding with Bulk Molding Compound and sheet Molding Compound thermoplastic matrix composites film stacking, diaphragm forming, thermoplastic tape laying, injection molding interfaces in PMCs structure, properties and application of PMCs recycling of PMCs.

Metallic matrices: aluminum, titanium, magnesium, copper alloys processing of MMCs: liquid state, Solid state, in situ fabrication techniques diffusion bonding powder metallurgy techniques interfaces in MMCs.

Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process in situ chemical reaction techniques: chemical vapor deposition, chemical vapor impregnation, solgel interfaces in CMCs.

UNIT - IV

Conventional Machining, Mechanics of Operation and Chip Formation: Requirement for machining FRPs, turning, single point cuttings, milling and trimming, drilling. Abrasive cutting, surface finish, fundamental considerations: orthogonal machining, machining of polymers, machining of unidirectional FRPs: chip formation modes, cutting forces, machining of multidirectional laminates: chip formations, cutting forces, modeling of the chip formation process: shear plane models, mechanics model of Zhang, mechanistic modeling.

UNIT - V

Nontraditional machining of FRPS and health and safety aspects in machining FRPS: Abrasive water jet machining, laser machining, electric discharge machining. Hazard sources and route exposure, Dust generation in dry machining, aerosol emission in laser machining, work place control.

Expected Results: At the end of this course student would be in a position to work on advance research and development projects on composite materials and its fabrication

TEXT BOOKS:

1. Krishnan K Chawla, Composite Materials: Science and Engineering, International Edition, Springer, 2012.
2. Jamal Y. Sheikh ahmad, Machining of polymer composites, International Edition, Springer 2009.
3. Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010.

REFERENCES:

1. Mechanics of Composite Materials, Autar_K._Kaw, 2006 by Taylor & Francis Group, LLC.
2. Mechanics of laminated composite plates and shells theory and Analysis, 2nd ed., J.N Reddy, 2004 by CRC Press LLC.

AIRLINES PLANNING, SCHEDULING AND OPERATIONS
(PROFESSIONAL ELECTIVE – V)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE853PE	**3**	**0**	**0**	**3**

UNIT - I

Airline Economics, Markets and Demand: Airline Terminology and Definitions-basic airline profit equation, Air transportation markets, Origin-Destination market demand, Air travel demand models, Airline competition and market share; Airline Pricing Theory and Practice: Airline prices and O-D markets, airline differential pricing, recent trends in airline pricing, airline pricing strategies; Airline Revenue Management: Computerized Revenue Management Systems, Flight Overbooking, EMSR Model for flight leg revenue optimization, network revenue management, revenue management for less restricted fare structures ; Airline operating Costs: Airline cost categorization, operating expense comparisons, comparison of airline unit costs; Measures of airline productivity: aircraft productivity and labour productivity

UNIT - II

The Airline Planning Process: Fleet Planning-airline fleet decisions, fleet planning methods; Route Planning- Hub economics and network structure, Route planning and evaluation; Airline Schedule Development-Frequency planning, time table development, fleet assignment and aircraft rotations; Integrated airline planning

UNIT - III

Airline Schedule Optimization: Schedule optimization problems, Fleet Assignment-The fleet assignment problem, fleet assignment solutions/impacts, extending basic fleet assignment models, Schedule Design optimization-Modeling the optimization of flight retiming and fleet assignment problems, importance of modelling competition in schedule design; Crew Scheduling- The crew pairing problem, crew scheduling problem solutions and impacts; Aircraft Maintenance Routing and crew pairing optimization, Future directions for schedule optimization

UNIT - IV

Airline Flight Operations: Regulation and scheduling-General regulatory requirements, flight crew regulation and Training, flight crew scheduling, Flight crew activities during a typical flight-flight crew sign-in, operations/planning, pre-flight, pre-departure, gate departure, taxi-out, take off, terminal area departure, climb, cruise, descent, terminal area arrival, final approach, landing rollout, taxi-in, parking, post-flight

UNIT - V

Irregular Operations: Schedule Recovery and Robustness: Irregular operations: Managing irregular operations- Airline operations control centers, options for schedule recovery from irregular operations, Schedule recovery from irregular operations: objectives and process, Evaluating the costs of recovery options: The challenges imparted by uncertainty and downstream effects; Robust Airline Scheduling: Robust schedule design, robust fleet assignment, robust aircraft routing, robust crew scheduling

TEXT BOOK:

1. Peter Belobaba, Amedeo Odoni, Cynthia Barnhart (Editors), The Global Airline Industry, Second Edition, Wiley (2016),

HYPERSONIC AERODYNAMICS
(PROFESSIONAL ELECTIVE – V)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE854PE	**3**	**0**	**0**	**3**

UNIT - I

Introduction: History of hypersonic flight- a logical progression in the light of advancing technical findings. Hypersonic flow- definition, importance, physical aspects. Brief descriptive introductory pre-view of various phenomena such as Thin shock layer, Entropy layer, Viscous interaction, Effects of high temperature and communication black out. Low density flow, free molecular flow.

Hypersonic Shock and Expansion Wave Relations: Oblique shock relations for high Mach numbers, Expansion wave relations for high Mach numbers. Theoretical basis of Mach number independence principle- corroboration by experimental results. Importance of experiments.

UNIT- II

Local Surface Inclination Methods: Newtonian flow and the hypersonic double limit of $M \rightarrow \infty$ & $\gamma \rightarrow 1$, Modified Newtonian flow, Centrifugal force correction to Newtonian flow, Tangent wedge and tangent cone methods.

Hypersonic Inviscid Flows - I: Hypersonic small disturbance theory, Equivalence principle and hypersonic similarity parameter; Hypersonic shock relations in terms of similarity parameter.

UNIT-III

Hypersonic Inviscid Flows – II: Application of small disturbance theory and equivalence of 1-dimensional piston motion with 2-dimensional hypersonic flow, Flat plate at an angle of attack by piston theory and comparison with exact shock expansion method, Bi-convex airfoil at zero angle of attack: comparison of piston theory and exact shock expansion method, Phenomenological aspects of hypersonic blunt body problem, Importance of blunt body problem and brief outline of computational time-marching finite difference method and its advantage over other methods.

UNIT– IV

Viscous Flows: Derivation of compressible boundary layer equations, Brief introduction to the flat plate case and some important results and conclusions for high Mach number flows, Special characteristics of hypersonic boundary layers, Introduction to hypersonic interaction parameters – weak & strong.

UNIT– V

Shock Tube Based Experimental Facilities: Shock tunnel, Gun tunnel, Free piston wind tunnel, Ludweig tube, Measurement techniques, Samples of comparison of experimental and theoretical results.

Other Hypersonic Facilities: Continuous hypersonic tunnel free flight experiments in tunnels and ballistic ranges- Measurement techniques. Role of experiments in computer code validation and calibration, Brief introduction to heat transfer measurements.

TEXT BOOKS:

1. Anderson J D, *Hypersonic and High Temperature Gas Dynamics*, 2nd Edition, AIAA Education series, 2000.
2. Bertin, J. J., *Hypersonic Aerothermo-dynamics*, AIAA Education series, 1994.
3. Spurk, J., *Fluid Mechanics,* Springer, Heidelberg, 1997.

REFERENCES:

1. Hayes W. D. and Probstein R. F., Hypersonic Flow Theory, Academic Press, 1959
2. Wendt J F, European Hypersonic Wind Tunnels, AGARD Conference Proceedings No. 428, Nov. 1987, Paper 2.
3. Canning T. N., Seiff A. and James, C. S., Ballistic Range Technology, AGARDograph Report AD 07 13915, Aug. 1970.
4. Brun, Raymond, Introduction to Reactive Gas Dynamics, Oxford Univ. Press, 2009, Chapter 11: Facilities and Experimental Methods.
5. Davies, H.J. and Churchack, H.D., Shock Tube Techniques & Instrumentation, 1969, US Army Material Command, Harry Diamond Lab, Washington DC (available on net – Free Copy).
6. Burtschell, Y., Brun, R., and Zeitoun, D., Shock Waves, Springer Verlag, Berlin , 1992.
7. An Album of Supersonic Flow Visualization, Edited by P I Kovalev & N P Mende, National Defense Industry Press (Write to Prof S V Bobashev, 26 Politechnicheskaya Street, St. Petersburg 194021, Russia).
8. Curtis, P. Shock tubes, Pegasus Eliot Mackenzie Publishers, October 2004.

AEROELASTICITY
(PROFESSIONAL ELECTIVE-VI)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE861PE	**3**	**0**	**0**	**3**

UNIT – I

Introduction to Aeroelasticity: Collar's aeroelastic triangle, interaction of aerodynamic, structural and inertial forces, static aeroelasticity phenomena, dynamic aeroelasticity phenomena, aeroelastic problems at transonic speeds, aeroelastic tailoring, active flutter suppression.

UNIT - II

Structural Dynamic Aspects: Generalized coordinates and generalized forces, Strain energy, kinetic energy and dissipation function, Lagrange’s equations of motion, Formulations of structural dynamics equation, Hamilton’s principle, and orthogonality conditions.

UNIT - III

Steady and Unsteady Aerodynamic Aspects: Small perturbation theory, Two-dimensional unsteady flow over wings, simple harmonic motion, Theodorsen’s function, arbitrary motion and Wagner function, gust problem, Küssner function.

UNIT - IV

Static Aeroelastic Problems: Static aeroelastic studies using strip theory - divergence, control effectiveness and control reversal; slender straight wing and swept wings, Static aeroelastic problems of low aspect ratio wings.

UNIT - V

Dynamic Aeroelastic Phenomenon – Flutter: Formulation of aeroelastic equations for a typical section, Torsion-flexure flutter – solution of flutter determinant, Method of determining the classical flutter speed using Theodorsen’s and U-g methods.

TEXT BOOKS:

1. Wright, J.R., and Cooper, J.E., Introduction to Aircraft Aeroelasticity and Loads, John Wiley and Sons Ltd, 2007.
2. Bisplinghoff, R. L., Ashley, H. and Halfman, R. L., Aeroelasticity, Addison-Wesley Publishing Company, Cambridge, Mass., 1955., Dover Pub., Inc., 1996, (BAH).
3. Fung, Y.C., An Introduction to the Theory of Aeroelasticity, Dover Publication, Inc., 1969.
4. Scanlan, R.H., and Rosenbaum, R., Introduction to the Study of Aircraft Vibration and Flutter, The MacMillan Co., 1962.

REFERENCES:

1. Főrsching, H.W., Grundlagen der Aeroelastik, Springer-Verlag, 1974. (Excellent book, written in German but easy to understand)
2. Bisplinghoff, R. L., and Ashley, H., *Principles of Aeroelasticity,* John Wiley and Sons, Inc., New York, N.Y., 1962. Also available in Dover Edition. (BA)
3. AGARD Manual on Aeroelasticity, Vols. I-VII, Beginning 1959 with continual updating. (AGARD)
4. Broadbent, E.G., *The Elementary Theory of Aeroelasticity,* Aircraft Engineering, 1954.

WIND ENGINEERING AND INDUSTRIAL AERODYNAMICS
(PROFESSIONAL ELECTIVE - VI)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE862PE	**3**	**0**	**0**	**3**

UNIT - I

Atmospheric Winds and Atmospheric Boundary Layer: Causes of wind thermal drive, Coriolis effect, pressure gradient effect, Geotrophic winds. Land and sea breeze, mountain winds, thermals, cause of turbulence at ground level. Atmospheric boundary layer, velocity profile laws-effects of terrain on atmospheric boundary Layer. Wind tunnels basic features and components. Wind tunnel models-role of non-dimensional groups. Creation of atmospheric boundary Layer type flow in a wind tunnel.

UNIT - II

Wind Energy: Ship propulsion-sails-lift and drag translators-modern yachts. Horizontal (HAWT) and vertical axis (VAWT) wind turbines-history, first example of automatic feedback control for yaw in 16th century English windmills, classification. Horizontal axis wind turbine (HAWT- elementary actuator disc theory-Betz coefficient. Definition of power coefficient &torque coefficient for all wind turbines. Working principle, power coefficients, tip speed ratio explanation: by introductory blade element theory- conventional horizontal axis wind turbine (HAWT), savonious vertical axis wind turbine (VAWT), Darries VAWT, merits and demerits of HAWTs and VAWTs.

UNIT - III

Vehicle Aerodynamics: relative importance of rolling resistance and aerodynamics resistance, power requirements and drag coefficients of automobiles-notch front and notch rear wind screens versus streamlined shape, Causes of vortex formation and drag—attached transverse vortex , trailing vortex, trailing vortex drag-effect of floor height on lift, effects of cut bank angle, rear end taper: side panels and bottom. Effects of chamfering of edges and cambering of roof & side panels. Racing cars-traction and steering strip and use of aerofoils, high cornering seed. Commercial transport vehicles-drag reduction on buses and tucks; driver cabin and trailer combinations.

UNIT- IV

Building Aerodynamics: Use of light weight components in modern buildings, pressure distribution on low-rise buildings, wind forces on buildings-aerodynamics of flat plate and circular cylinder , critical Reynold's no, sub -, super- & ultra critical Reynold's No. Role of wind tunnel requirements in determining shape factors (Drag coefficients) of building/structure shapes such as circular cylinder (chimneys & towers), rectangle, I- shape, L-shape, H-shape etc. vortex shedding & transverse oscillating loads. Slenderness ratio & correction factor. Special problems of tall buildings, interference effect of building.

UNIT-V

Flow Induced Vibrations: Classification – vortex induced vibration & flow induced instability such as Galloping & Stall flutter. Effects of Reynolds number on wake formation of bluff shapes. Vortex induced vibration – experimental determination of strouhal numbers for different shapes such as circular cylinder, square, rectangle, L-shape ect, universal strouhal number, unsteady Bernoulli equation, concept of added mass, Resonance, fluid – structure interaction – effect of transverse cylinder motion on flow and wake, "lock-in" vortex shedding near resonant frequency, experimental evidence of cylindrical motion influencing flow and thereby reducing strength of shed vortices. Methods of suppression of vortex induced vibration. Galloping & Stall flutter – motion of one degree-of-freedom, quasi steady flow assumption, Aerodynamic damping, Galloping – force in the direction of plunging (transverse motion) and positive force coefficient, critical speed, Galloping of transmission wire with winter ice, stall flutter of airfoils.

TEXT BOOKS:

1. Blevins R.D Flow Induced Vibrations, van Nostard, 1990.
2. Sachs. P. Wind Forces in Engineering, Pergamon press 1988.
3. Calvert N.G. Wind Power Principles, Charles Griffin & co. London, 1979.

REFERENCES:

1. Scorer R.S. Environmental Aerodynamics, Ellis Harword Ltd, England, 1978.
2. Sorvan, M. Aerodynamics Drag Mechanisms of Bluff Bodies and Road vehicles, plenum press, N.Y.1978.

HEAT TRANSFER
(Professional Elective: VI)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: AE863PE	**3 0 0 3**

Note: Heat Transfer Data Book is permitted.
Pre-requisite: Thermodynamics

Course Objectives: To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications

Course Outcome: At the end of this course, student will be able to
- Understand the basic modes of heat transfer
- Compute one dimensional steady state heat transfer with and without heat generation
- Understand and analyze heat transfer through extended surfaces
- Understand one dimensional transient conduction heat transfer
- Understand concepts of continuity, momentum and energy equations
- Interpret and analyze forced and free convective heat transfer
- Understand the principles of boiling, condensation and radiation heat transfer
- Design of heat exchangers using LMTD and NTU methods

UNIT – I
Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer – General discussion about applications of heat transfer.
Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady, and periodic heat transfer – Initial and boundary conditions
One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders, and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

UNIT – II
One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity – systems with heat sources or Heat generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature
One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi infinite body.

UNIT – III
Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for

experimental investigation – Buckingham Π Theorem and method, application for developing semi – empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.
Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

UNIT – IV
Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.
Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.
Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT - V
Heat Transfer with Phase Change:
Boiling: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling. **Condensation:** Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.
Radiation Heat Transfer : Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

TEXT BOOKS:
1. Heat and Mass Transfer – Dixit /Mc Graw Hill
2. Heat and Mass Transfer / Altamush Siddiqui/ Cengage

REFERENCE BOOKS:
1. Essential Heat Transfer - Christopher A Long / Pearson
2. Heat Transfer –Ghoshdastida / Oxford

GROUND VEHICLE AERODYNAMICS
(PROFESSIONAL ELECTIVE - VI)

	L	T	P	C
B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE864PE	**3**	**0**	**0**	**3**

UNIT - I

Overview and Introduction: Historical developments and trends, fundamentals of fluid mechanics, flow phenomenon related to vehicles, external and internal flow problem, resistance to vehicle motion, Mechanics of air flow around a vehicle, pressure distribution, Aerodynamic forces, Vehicle drag and types, side and lift forces, cars as a bluff body, flow field around car, performance potential of vehicle aerodynamics.

UNIT - II

Aerodynamic Drag and Shape Optimization of Cars: Cars as a bluff body, flow field around a car, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles. Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear. Effect of rear configuration, effect of fasteners

UNIT - III

Vehicle Handling and Stability: Origin, characteristics and effects of forces and moments on a vehicle, lateral stability problems, vehicle dynamics under side winds-dirt accumulation on the vehicle, wind noise- Mechanisms and generation design features, measurement and techniques.

UNIT - IV

Race Car Aerodynamics: Basic vehicle body concepts, aerodynamics of the complete vehicle, flow over wheels, sliding seal, and skirts, under body channels, simple add ons: spoilers, strakes and wickers, internal flow, Race car wings, most current examples in detail-design, aerodynamic behavior, and flow field.

UNIT - V

Measurement and Test Techniques: Wind tunnel- scope, Fundamental techniques, simulation limitations, prototype tests, wind tunnel types and testing methods, Test techniques- scope, measuring equipment and transducers, road testing methods.

TEXT BOOKS:

1. Wolf- Heinrich Hucho, Aerodynamics of Road vehicles, SAE International 1998 A. Pope- "Wind Tunnel Testing"- John wiley & sons- 2nd Edition, New York- 1974
2. Katz, J., Race Car Aerodynamics Designing for Speed, Bentley Publishers

REFERENCES:

1. Automotive Aerodynamics: Update SP-706- SAE- 1987
2. Vehicle Aerodynamics – SP-1145- SAE-1996

B.TECH. AERONAUTICAL ENGINEERING
INTRODUCTION TO SPACE TECHNOLOGY
(OPEN ELECTIVE - I)

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: AE511OE	**3**	**0**	**0**	**3**

UNIT - I

Fundamentals of Rocket Propulsion and Trajectories: Space Mission- Types-Space environment-launch vehicle selection.; Introduction to rocket propulsion-fundamentals of solid propellant rockets- Fundamentals of liquid propellant rockets-Rocket equation, Two-dimensional trajectories of rockets and missiles-Multi-stage rockets-Vehicle sizing-Two multi-stage rockets-Trade-off ratios-Single stage to orbit- Sounding rocket-Aerospace plane-Gravity turn trajectories-Impact point calculation-Injection conditions-Flight dispersions

UNIT- II

Atmospheric Re-entry: Introduction-Steep ballistic re-entry-Ballistic orbital re-entry-Skip re-entry-"Double- Dip" re-entry - Aero-braking - Lifting body re-entry

UNIT-III

Fundamentals of Orbital Mechanics, Orbital Manoeuvres: Two-body motion-circular, elliptic, hyperbolic, and parabolic orbits-Basic orbital elements-Ground trace**.** In-Plane orbit changes-Hohmann transfer-Bi-elliptical transfer-Plane changes- Combined manoeuvres-Propulsion for manoeuvres

UNIT - IV

Satellite Attitude Dynamics: Torque free axisymmetric rigid body-Attitude control for spinning spacecraft - Attitude control for non-spinning spacecraft - The Yo-Yo mechanism – Gravity – Gradient satellite-Dual spin spacecraft-Attitude determination

UNIT-V

Space mission Operations: Supporting ground system architecture and team interfaces - Mission phases and core operations- Team responsibilities – Mission diversity – Standard operations practices

TEXT BOOK:

1. 'Spaceflight Dynamics', W.E. Wiesel, 3rd edition, McGraw-Hill, 2010

REFERENCES

1. 'Rocket Propulsion and Space flight dynamics', Cornelisse JW, Schoyer HFR, and Wakker KF, Pitman, 1984
2. 'Fundamentals of Space Systems', Vincet L. Pisacane, Oxford University Press, 2005.
3. 'Understanding Space: An Introduction to Astronautics', J. Sellers, 2nd edition, McGraw- Hill, 2004
4. 'Introduction to Space Flight', Francis J Hale, Prentice-Hall, 1994
5. 'Spacecraft Mission Design', Charles D. Brown, AIAA Education Series, 1998
6. 'Elements of Space Technology for Aerospace Engineers', Meyer Rudolph X, Academic Press, 1999

B.TECH. AERONAUTICAL ENGINEERING
INTRODUCTION TO AEROSPACE ENGINEERING
(OPEN ELECTIVE - II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: AE621OE	**3 0 0 3**

UNIT – I

History of Flight and Space Environment: Balloons and dirigibles, heavier than air aircraft, commercial air transport; Introduction of jet aircraft, helicopters, missiles; Conquest of space, commercial use of space; Different types of flight vehicles, classifications exploring solar system and beyond, a permanent presence of humans in space; Earth's atmosphere, the standard atmosphere; The temperature extremes of space, laws of gravitation, low earth orbit, microgravity, benefits of microgravity; Environmental impact on spacecraft, space debris; Planetary environments.

UNIT – II

Introduction to Aerodynamics: Anatomy of the airplane, helicopter; Understanding engineering models; Aerodynamic forces on a wing, force coefficients; Generating lift, moment coefficients; Aerodynamic forces on aircraft – classification of NACA airfoils, aspect ratio, wing loading, Mach number, centre of pressure and aerodynamic centre-aerofoil characteristics-lift, drag curves; Different types of drag.

UNIT – III

Flight Vehicle Performance and Stability: Performance parameters, performance in steady flight, cruise, climb, range, endurance, accelerated flight symmetric manoeuvres, turns, sideslips, takeoff and landing; Flight vehicle Stability, static stability, dynamic stability; Longitudinal and lateral stability; Handling qualities of the airplanes.

UNIT – IV

Introduction to Airplane Structures and Materials, Power Plants: General types of construction, monocoque, semi-monocoque; Typical wing and fuselage structure; Metallic & non-metallic materials, use of aluminium alloy, titanium, stainless steel and composite materials. Basic ideas about engines, use of propeller and jets for thrust production; Principles of operation of rocket, types of rockets.

UNIT – V

Satellite Systems Engineering Human Space Exploration: Satellite missions, an operational satellite system, elements of satellite, satellite bus subsystems; Satellite structures, mechanisms and materials; Power systems; Communication and telemetry; Propulsion and station keeping; Space missions, mission objectives. Goals of human space flight missions, historical background, The Soviet and US missions; The Mercury, Gemini, Apollo (manned flight to the moon), Skylab, Apollo-Soyuz, Space Shuttle; International Space Station, extravehicular activity; The space suit; The US and Russian designs; Life support systems, Flight safety; Indian effort in aviation, missile and space technology.

TEXT BOOKS:

1. Anderson J. D, "Introduction to Flight", McGraw-Hill, 5th Edition, 1989.
2. Newman D, "Interactive Aerospace Engineering and Design", McGraw-Hill, 1st Edition, 2002.
3. Barnard R.H and Philpot. D.R, "Aircraft Flight", Pearson, 3rd Edition, 2004.

REFERENCES

1. Kermode, A. C, “Flight without Formulae”, McGraw Hill, 4th Edition, 1997.
2. Swatton P. J, “Flight Planning”, Blackwell Publisher, 6th Edition, 2002.

B.TECH. AERONAUTICAL ENGINEERING
AIR TRANSPORTATION SYSTEMS
(OPEN ELECTIVE - III)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE831OE	**3**	**0**	**0**	**3**

UNIT- I

Aviation Industry & Its Regulatory Authorities: Introduction, history of aviation-evolution, development, growth, challenges. Aerospace industry, air transportation industry-economic impact- types and causes. Airline Industry- structure and economic characteristics. The breadth of regulation- ICAO, IATA, national authorities (DGCA, FAA). Safety regulations- risk assessment- human factors and safety, security regulations, environmental regulations.

UNIT-II

Airspace: Categories of airspace- separation minima, airspace sectors- capacity, demand and delay. Evolution of air traffic control system- procedural ATC system, procedural ATC with radar assistance, first generation 'automated' ATC system, current generation radar and computer-based ATC systems. Aerodrome air traffic control equipment and operation - ICAO future air-navigation systems (FANS). Air-navigation service providers as businesses. Communication, navigation and surveillance systems (CNSS). Radio communications- VHF, HF, ACARS, SSR, ADS. Navigation- NDB, VOR, DME, area-navigation systems(R-Nav), ILS, MLS, GPS, INS.

UNIT- III

Aircraft: Costs- project cash-flow, aircraft price. Compatibility with the operational infrastructure. Direct and indirect operating costs. Balancing efficiency and effectiveness-payload-range, fuel efficiency, technical contribution to performance, operating speed and altitude, aircraft field length performance. typical operating costs. Effectiveness- wake-vortices, cabin dimensions, flight deck.

UNIT- IV

Airports: Setting up an airport- airport demand, airport siting, runway characteristics- length, declared distances, aerodrome areas, obstacle safeguarding. Runway capacity- evaluating runway capacity- sustainable runway capacity. Runway pavement length, Manoeuvring area-airfield lighting, aprons, Passenger terminals-terminal sizing and configuration. Airport demand, capacity and delay.

UNIT - V

Airlines: Setting up an airline- modern airline objectives. Route selection and development, airline fleet planning, annual utilization and aircraft size, seating arrangements. Indirect operating costs. Aircraft- buy or lease. Revenue generation, computerized reservation systems, yield management. Integrating service quality into the revenue-generation process. Marketing the seats. Airline scheduling. Evaluating success- financial viability, regulatory compliance, efficient use of resources, effective service.

TEXT BOOK:

1. Hirst, M., *The Air Transport System*, Woodhead Publishing Ltd, Cambridge, England, 2008.

REFERENCES:

1. Wensven, J.G., *Air Transportation: A Management Perspective*, Eighth Edition, shgate, 2015.
2. Belobaba, P., Odoni, A. and Barnhart, C., *Global Airline Industry*, Second Edition, Wiley, 2015.
3. M. Bazargan, M., *Airline Operations and Scheduling*, Second Edition, Ashgate, 2010.
4. Nolan, M.S., *Fundamentals of Air Traffic Control*, 5th edn., Thomson Learning, 2011.
5. Wells, A. and Young, S., *Airport Planning and Management*, 6th edn., McGraw-Hill, 2011.

B.TECH. AERONAUTICAL ENGINEERING
ROCKETS AND MISSILES
(OPEN ELECTIVE - III)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: AE832OE	**3**	**0**	**0**	**3**

UNIT- I

Introduction: Space launch vehicles and military missiles- function, types, role, mission, mission profile, thrust profile, propulsion system, payload, staging, control and guidance requirements, performance measures, design, construction, operation- similarities and differences.

UNIT – II

Solid and Liquid Propulsion Systems: Solid propellant rocket motors, principal features, applications. Solid propellants- types, composition, properties, performance. Propellant grain-desirable properties, grain configurations, Liners, insulators and inhibitors-function, requirements, materials. Rocket motor casing-materials. Combustion system of solid rockets, igniters, types, construction. Nozzles-types, Liquid propellants- types, composition, properties, performance. Propellant tanks feed systems- pressurisation, turbo-pumps- valves and feed lines, injectors, starting and ignition. Engine cooling, support structure, control of engine starting and thrust build-up, liquid rocket combustion chamber

UNIT – III

Aerodynamics of Rockets and Missiles: Classification of missiles. Airframe components of rockets and missiles, Forces acting on a missile while passing through atmosphere, method of describing aerodynamic forces and moments, lateral aerodynamic moment, lateral damping moment, longitudinal moment of a rocket, lift and drag forces, drag estimation, body upwash and downwash in missiles. Rocket dispersion, re-entry body design considerations

UNIT - IV

Dynamics and Control of Rockets and Missiles: Tsiolskovsky's rocket equation- range in the absence of gravity, vertical motion in the earth's gravitational field, inclined motion, flight path at constant pitch angle, motion in the atmosphere, the gravity turn- the culmination altitude. Multi-staging. Earth launch trajectories- vertical segment, the gravity turn, constant pitch trajectory, orbital injection; Rocket thrust vector control-methods of thrust vector control for solid and liquid propulsion systems, thrust magnitude control, thrust termination

UNIT - V

Rocket Testing: Ground testing and flight testing- types of tests, test facilities and safeguards, monitoring and control of toxic materials, instrumentation and data management. Ground testing, flight testing, trajectory monitoring, post accident procedures, Description of a typical space vehicle launch procedure.

TEXT BOOKS:

1. Sutton, G.P., and Biblarz, O., *Rocket Propulsion Elements*, 8th edition, Wiley-Interscience, 2010.
2. Cornelisse, J.W., Schoyer H.F.R. and Wakker, K.F., *Rocket Propulsion and Space-flight Dynamics,* Pitman, 1979.
3. Turner, M.J.L., *Rocket and Spacecraft Propulsion,* 3rd edition, Springer, 2009.

REFERENCES

1. Chin, S.S., *Missile Configuration Design,* McGraw Hill, 1961
2. Ball, K.J., Osborne, G.F., *Space Vehicle Dynamics*, Oxford University Press, 1967.

B.TECH. AUTOMOBILE ENGINEERING
DISASTER MANAGEMENT
(Open Elective - I)

B.Tech. III Year I Sem.	**L T P C**
Course Code: CE511OE	**3 0 0 3**

Course Objectives: The subject provides different disasters, tools and methods for disaster management.

Course Outcomes: At the end of the course, the student will be able to:
- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

UNIT - I
Understanding Disaster: Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)
Hazards and Vulnerabilities: Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

UNIT - II
Disaster Management Mechanism: Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

UNIT - III
Capacity Building: Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

UNIT - IV
Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

UNIT - V
Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India -

Organizational structure for disaster management in India - Preparation of state and district disaster management plans

TEXT BOOKS:

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

REFERENCES:

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

B.TECH. AUTOMOBILE ENGINEERING
INTELLECTUAL PROPERTY RIGHTS
(Open Elective - I)

B.Tech. III Year I Sem.	**L T P C**
Course Code: MT512OE	**3 0 0 3**

UNIT – I
Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II
Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III
Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.
Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV
Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V
New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.
International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT BOOKS & REFERENCES:
1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

B.TECH. AUTOMOBILE ENGINEERING
DATA STRUCTURES
(Open Elective – II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: EM614PE/MT621OE	**3 0 0 3**

Course Objectives:

- To understand the basic concepts such as Abstract Data Types, Linear, and Non Linear Data structures.
- To understand the notations used to analyze the Performance of algorithms.
- To understand the behavior of data structures such as stacks, queues, trees, hash tables, search trees, Graphs and their representations.
- To choose the appropriate data structure for a specified application.
- To understand and analyze various searching and sorting algorithms.
- To write programs in C to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, graphs, hash tables, search trees.

Course Outcomes:

- Learn how to use data structure concepts for realistic problems.
- Ability to identify appropriate data structure for solving computing problems in respective language.
- Ability to solve problems independently and think critically.

UNIT- I

Basic concepts- Algorithm Specification-Introduction, Recursive algorithms, Data Abstraction Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega and Theta notations, Introduction to Linear and Non Linear data structures.

Singly Linked Lists-Operations-Insertion, Deletion, Concatenating singly linked lists, Circularly linked lists-Operations for Circularly linked lists, Doubly Linked Lists-Operations- Insertion, Deletion.

Representation of single, two dimensional arrays, sparse matrices-array and linked representations.

UNIT- II

Stack ADT, definition, operations, array and linked implementations in C, applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue ADT, definition and operations ,array and linked Implementations in C, Circular queues-Insertion and deletion operations, Deque (Double ended queue)ADT, array and linked implementations in C.

UNIT- III

Trees – Terminology, Representation of Trees, Binary tree ADT, Properties of Binary Trees, Binary Tree Representations-array and linked representations, Binary Tree traversals, Threaded binary trees, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap.

Graphs – Introduction, Definition, Terminology, Graph ADT, Graph Representations-Adjacency matrix, Adjacency lists, Graph traversals- DFS and BFS.

UNIT- IV

Searching- Linear Search, Binary Search, Static Hashing-Introduction, hash tables, hash functions, Overflow Handling.

Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Comparison of Sorting methods.

UNIT- V

Search Trees-Binary Search Trees, Definition, Operations- Searching, Insertion and Deletion, AVL Trees-Definition and Examples, Insertion into an AVL Tree ,B-Trees, Definition, B-Tree of order m, operations-Insertion and Searching, Introduction to Red-Black and Splay Trees(Elementary treatment-only Definitions and Examples), Comparison of Search Trees.

Pattern matching algorithm- The Knuth-Morris-Pratt algorithm, Tries (examples only).

TEXT BOOKS:

1. Fundamentals of Data structures in C, 2nd Edition, E.Horowitz, S.Sahni and Susan Anderson-Freed, Universities Press.
2. Data structures A Programming Approach with C, D.S.Kushwaha and A.K.Misra, PHI.

REFERENCE BOOKS:

1. Data structures: A Pseudocode Approach with C, 2nd edition, R. F. Gilberg And B.A. Forouzan, Cengage Learning.
2. Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
3. Data Structures using C, A. M. Tanenbaum, Y. Langsam, M.J. Augenstein, Pearson.
4. Data structures and Program Design in C, 2nd edition, R. Kruse, C. L. Tondo and B. Leung, Pearson.
5. Data Structures and Algorithms made easy in JAVA, 2nd Edition, Narsimha Karumanchi, and Career Monk Publications.
6. Data Structures using C, R. Thareja, Oxford University Press.
7. Data Structures, S. Lipscutz, Schaum’s Outlines, TMH.
8. Data structures using C, A. K. Sharma, 2nd edition, Pearson..
9. Data Structures using C &C++, R. Shukla, Wiley India.
10. Classic Data Structures, D. Samanta, 2nd edition, PHI.
11. Advanced Data structures, Peter Brass, Cambridge.

B.TECH. AUTOMOBILE ENGINEERING
ARTIFICIAL NEURAL NETWORKS
(Open Elective – II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: MT622OE	**3 0 0 3**

Course Objectives:

- To understand the biological neural network and to model equivalent neuron models.
- To understand the architecture, learning algorithm and issues of various feed forward and feedback neural networks.

Course Outcomes: By completing this course the student will be able to:

- Create different neural networks of various architectures both feed forward and feed backward.
- Perform the training of neural networks using various learning rules.
- Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.

UNIT - I

Introduction: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process

UNIT - II

Single Layer Perceptron: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment

Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

UNIT - III

Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

UNIT - IV

Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

UNIT - V

Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm

Hopfield Models – Hopfield Models, Computer Experiment

TEXT BOOKS:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.

REFERENCE BOOKS:

1. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

B.TECH. AUTOMOBILE ENGINEERING
INTRODUCTION TO MECHATRONICS
(Open Elective – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: AM831OE	**3 0 0 3**

Pre-requisites: Basic Electronics Engineering

Course Objectives:
- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Course Outcomes: At the end of the course, the student will be able to, Model, analyze and control engineering systems. Identify sensors, transducers and actuators to monitor and control the behavior of a process or product. Develop PLC programs for a given task. Evaluate the performance of mechatronic systems.

UNIT – I
Introduction: Definition – Trends - Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface , Simulation) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.
Signal Conditioning : Introduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering

UNIT – II
Precision Mechanical Systems : Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.
Electronic Interface Subsystems : TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

UNIT – III
Electromechanical Drives : Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

Microcontrollers Overview : 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C (LED Blinking , Voltage measurement using ADC).

UNIT – IV

Programmable Logic Controllers : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

UNIT – V

Programmable Motion Controllers : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

TEXT BOOKS:

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson.
2. Introduction to Mechatronics / Appukuttan /Oxford

REFERENCE BOOKS:

1. Mechatronics Principles concepts & Applications / N.P.Mahalik/ Mc Graw Hill
2. “Designing Intelligent Machines”. open University, London.

B.TECH. AUTOMOBILE ENGINEERING
MICROPROCESSORS AND MICROCONTROLLERS
(Open Elective – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: AM832OE	**3 0 0 3**

Course Objectives:

- To develop an understanding of the operations of microprocessors and micro controllers; machine language programming and interfacing techniques.

Course Outcomes:

- Understands the internal architecture and organization of 8086, 8051 and ARM processors/controllers.
- Understands the interfacing techniques to 8086 and 8051 and can develop assembly language programming to design microprocessor/ micro controller based systems.

UNIT - I

8086 Architecture: 8086 Architecture-Functional diagram, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, interrupts of 8086.

Instruction Set and Assembly Language Programming of 8086: Instruction formats, Addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.

UNIT - II

Introduction to Microcontrollers: Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instruction set of 8051.

8051 Real Time Control: Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters

UNIT – III

I/O And Memory Interface: LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

Serial Communication and Bus Interface: Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232,USB.

UNIT – IV

ARM Architecture: ARM Processor fundamentals, ARM Architecture – Register, CPSR, Pipeline, exceptions and interrupts interrupt vector table, ARM instruction set – Data processing, Branch instructions, load store instructions, Software interrupt instructions, Program status register instructions, loading constants, Conditional execution, Introduction to Thumb instructions.

UNIT – V

Advanced ARM Processors: Introduction to CORTEX Processor and its architecture, OMAP Processor and its Architecture.

TEXT BOOKS:

1. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, MHE, 2nd Edition 2006.
2. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed.
3. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012

REFERENCE BOOKS:

1. Microprocessors and Interfacing, D. V. Hall, MGH, 2nd Edition 2006.
2. Introduction to Embedded Systems, Shibu K.V, MHE, 2009
3. The 8051Microcontrollers, Architecture and Programming and Applications -K.Uma Rao, Andhe Pallavi, Pearson, 2009.

B.TECH. BIOMEDICAL ENGINEERING
RELIABILITY ENGINEERING
(Open Elective – I)

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: BM511OE	**3**	**0**	**0**	**3**

Prerequisite: Mathematics III

Course Objectives:
- To introduce the basic concepts of reliability, various models of reliability
- To analyze reliability of various systems
- To introduce techniques of frequency and duration for reliability evaluation of repairable systems.

Course Outcomes: After completion of this course, the student will be able to
- model various systems applying reliability networks
- evaluate the reliability of simple and complex systems
- estimate the limiting state probabilities of repairable systems
- apply various mathematical models for evaluating reliability of irrepairable systems

UNIT – I
Basic Probability Theory: Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.
Definition of Reliability: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time Between Failures.

UNIT – II
Network Modeling and Evaluation Of Simple Systems: Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems- Series-Parallel systems- Partially redundant systems- Examples.
Network Modeling and Evaluation of Complex systems: Conditional probability method- tie set, Cutset approach- Event tree and reduced event tree methods- Relationships between tie and cutsets- Examples.

UNIT – III
Time Dependent Probability: Basic concepts- Reliability function f(t). F(t), R(t) and h(t) - Relationship between these functions.

Network Reliability Evaluation Using Probability Distributions: Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

UNIT – IV

Discrete Markov Chains: Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Examples

Continuous Markov Processes: Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems

UNIT – V

Frequency and Duration Techniques: Frequency and duration concepts, application to multi state problems, Frequency balance approach.

Approximate System Reliability Evaluation: Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

TEXT BOOKS:

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press, 1983.
2. E. Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited, 2002.

REFERENCE BOOK:

1. K. K. Agarwal, Reliability Engineering-Kluwer Academic Publishers, 1993**.**

B.TECH. BIOMEDICAL ENGINEERING
MEDICAL ELECTRONICS
(Open Elective – II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: BM621OE	**3 0 0 3**

Pre-requisites: Nil.

UNIT - I
Action Potential and Transducers: Electrical activity in cells, tissues, muscles and nervous systems -transducers-types and characteristics
Physiological transducers – pressure transducers-transducers for body temperature measurement – Pulse sensors-respiratory sensors.

UNIT - II
Biosignal Acquisition: Physiological signal amplifiers-isolation amplifiers-medical pre-amplifier design-bridge amplifiers-line driving amplifier-current amplifier – chopper amplifier-biosignal analysis - signal recovery and data acquisition-drift compensation in operational amplifiers-pattern recognition-physiological assist devices.

UNIT - III
Biopotential Recorders: Characteristics of recoding system - electrocardiography (ECG) – electro encephalography (EEG) - electromyography (EMG) - electroretinography (ERG) - electrooculography (EOG) – recorders with high accuracy –recorders for OFF line analysis.

UNIT - IV
Specialized Medical Equipment: Digital thermometer-audio meter –X-ray machines-radiography and fluoroscopy - angiography – elements of bio-telemetry system-design of bio-telemetry system-radio telemetry system-pace makers-Heart lung machine-Dialysis machine.

UNIT - V
Advanced Biomedical Instrumentation: Computers in medicine - lasers in medicine – basic principles of endoscopes- nuclear imaging techniques - computer tomography (CT) Scanning –Ultrasonic imaging system-construction propagation and delay – magnetic resonance imaging (MRI).

TEXT BOOKS:
1. Biomedical Instrumentation and Measurements-L. Cromwell, F.J. Weibel land E. A. Pfeiffer.
2. Biomedical Instrumentation- M. Arumugam - Anuradha Publications.
3. Handbook of Biomedical Instruments- R.S. Khandpur.

B.TECH. BIOMEDICAL ENGINEERING
TELEMETRY AND TELECONTROL
(Open Elective – III)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: BM831OE	**3**	**0**	**0**	**3**

Pre-requisites: Nil.

Course Objective: To make students understand the application of telemetry techniques to Instrumentation.

Course Outcome: Upon completion of this course students will appreciate t he application of different telemetry systems and control to any process.

UNIT – I

Telemetry Principles: Introduction, Functional blocks of Telemetry system, Methods of Telemetry – Non Electrical, Electrical, Pneumatic, Frequency.

Symbols and Codes: Bits and Symbols, Time function pulses, Line and Channel Coding, Modulation Codes. Inter symbol Interference.

UNIT – II

Frequency& Time Division Multiplexed Systems: FDM, IRIG Standard, FM and PM Circuits, Receiving end, PLL.

TDM - PAM, PAM /PM and TDM – PCM Systems. PCM reception. Differential PCM Introduction, QAM, Protocols.

UNIT – III

Satellite Telemetry: General considerations, TT & C Service, Digital Transmission systems, TT & C Subsystems, Telemetry, and Communications.

Modern Telemetry: Zigbee, Ethernet.

UNIT – IV

Optical Telemetry: Optical fibers Cable – Sources and detectors – Transmitter and Receiving Circuits, Coherent Optical Fiber Communication System.

UNIT – V

Telecontrol Methods: Analog and Digital techniques in Telecontrol, Telecontrol apparatus – Remote adjustment, Guidance, and regulation – Telecontrol using information theory – Example of a Telecontrol System.

TEXT BOOKS:

1. Telemetry Principles – D. Patranabis, TMH

2. Telecontrol Methods and Applications of Telemetry and Remote Control – by Swoboda G., Reinhold Publishing Corp., London, 1991

REFERENCE BOOKS:

1. Handbook of Telemetry and Remote Control – by Gruenberg L., McGraw Hill, New York, 1987.
2. Telemetry Engineering – by Young R.E., Little Books Ltd., London, 1988.
3. Data Communication and Teleprocessing System – by Housley T., PH Intl., Englewood Cliffs, New Jersey, 1987.

B.TECH. BIOMEDICAL ENGINEERING
ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY
(Open Elective – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: BM832OE	**3 0 0 3**

Course Objectives:

- To introduce important system concepts such as Electromagnetic interference and Electromagnetic compatibility (EMI & EMC).
- To familiarize with unavoidable and naturally happening sources of EMI and problems to ensure EMC.
- To study various techniques to reduce EMI from systems and to improve EMC of electronic systems.

Course Outcomes: Upon completion of this course, the student will be able to

- Gain basic knowledge of problems associated with EMI and EMC from electronic circuits and systems.
- Analyze various sources of EMI and various possibilities to provide EMC.
- Understand and analyze possible EMI prevention techniques such as grounding, shielding, filtering, and use of proper coupling mechanisms to improve compatibility of electronic circuits and systems in a given electromagnetic environment.

UNIT – I

Sources of EMI: Definition of EMI and EMC, Classification, Natural and Man-Made EMI Sources, Switching Transients, Electrostatic Discharge, Nuclear Electromagnetic Pulse and High Power Electromagnetics.

EMI/EMC Standards: Introduction, Standards for EMI/EMC – MIL –STD 461/462 – IEEE/ANSI Standards – CISPR/IEC, Standards – FCC Regulations.

UNIT - II

EMI Coupling Modes: Penetration: Introduction, Shielding Theory - Shielding Effectiveness, The Circuit Approach, The Wave Approach, Aperture Theory, Calculation of Effectiveness of a Conducting Box with an Aperture, Introduction to Propagation and Cross Talk – Introduction, Basic Principles, Determination of EM Field from Transmission Lines.

UNIT - III

EMI Controlling Techniques - I: Grounding, Principles and Practice of Earthing, Precautions in Earthing, Measurements of Ground Resistance, System Grounding for EMC, Cable Shielding Grounding.

Shielding, Theory and Effectiveness, Materials, Integrity at Discontinuities, Conductive Coatings, Cable Shielding, Effectiveness Measurements, Electrical Bonding.

UNIT – IV

EMI Controlling Techniques - II: Characteristics and Types of Filters – Impedance Mismatch, Lumped Element Low-Pass, High- Pass, Band-Pass and Band-Reject Filters, Power Line Filter Design - Common Mode, Differential Mode, Combined CM and DM Filters, Design Example.
EMC Gaskets – Knitted Wire-Mesh Gaskets, Wire-Screen Gaskets, Oriented Wire Mesh, Conductive Elastomer, Transparent Conductive Windows, Conductive Adhesive, Conductive Grease, Conductive Coatings, Isolation Transformers, Opto-Isolators.

UNIT - V

EMI Measurements: Introduction to Open Area Test Site Measurements – Measurement Precautions – Open Area Test Site – Terrain Roughness – NSA – Measurement of Test Site Imperfections – Antenna Factor Measurement – Measurement Errors.
Radiated Interference Measurements – Anechoic Chamber – TEM Cell – Reverberating Chamber – Ghz TEM Cell – Comparison of Test Facilities – Measurement Uncertainties
Conducted Interference Measurements – Characterization – Conducted EM Noise on Power Supply Lines – Conducted EMI from Equipment – Immunity – Detectors and Measurement – Pulsed EMI Immunity – Electrostatic Discharge.

TEXT BOOKS:

1. Engineering Electromagnetic Compatibility – V. Prasad Kodali – 2/e – IEEE Press – Wiley India Pvt. Ltd – 2001.

REFERENCES:

1. Introduction to Electromagnetic Compatibility – Clayton R. Paul – John Wiley & Sons, 1992.
2. Electromagnetic Compatibility of Integrated Circuits – Techniques for Low Emission and Susceptibility – Edited by Sonia Ben Dhia, Mohamed Ramdani and Etienne Sicard – Springer, 2006.
3. EMI reduction in Electronic Systems – Mills – J.P – Prentice Hall Inc.
4. Noise Reduction in Electronic Systems – Henry W. Ott, 2nd Edition, Wiley Interscience, 1988.

B.TECH. CIVIL ENGINEERING
DISASTER MANAGEMENT
(Open Elective - I)

B.Tech. III Year I Sem	**L T/P/D C**
Course Code: **CE511OE**	**3 0/0/0 3**

Course Objectives: The subject provide different disasters, tools and methods for disaster management

Course Outcomes: At the end of the course, the student will be able to:
- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

UNIT - I
Understanding Disaster: Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)
Hazards and Vulnerabilities: Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

UNIT - II
Disaster Management Mechanism: Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

UNIT - III
Capacity Building: Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

UNIT - IV
Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

UNIT - V
Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India -

Organizational structure for disaster management in India - Preparation of state and district disaster management plans

TEXT BOOKS:

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

REFERENCES:

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

B.TECH. CIVIL ENGINEERING
REMOTE SENSING AND GIS
(Open Elective - II)

B.Tech.IV Year II Sem	**L T/P/D C**
Course Code: **CE621OE**	**3 0/0/0 3**

Pre Requisites: Surveying

Course Objectives: This course will make the student to understand about the principles of GIS, Remote Sensing, Spatial Systems, and its applications to Engineering Problems.

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

- Retrieve the information content of remotely sensed data
- Analyze the energy interactions in the atmosphere and earth surface features
- Interpret the images for preparation of thematic maps
- Apply problem specific remote sensing data for engineering applications
- Analyze spatial and attribute data for solving spatial problems
- Create GIS and cartographic outputs for presentation

UNIT – I

Introduction to Photogrammetry: Principles& types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy, fiducial points, parallax measurement using fiducial line.

UNIT – II

Remote Sensing: Basic concept of remote sensing, Data and Information, Remote sensing data Collection, Remote sensing advantages & Limitations, Remote Sensing process.
Electro-magnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.

UNIT – III

Geographic Information Systems: Introduction to GIS; Components of a GIS; Geospatial Data: Spatial Data-Attribute data – Joining Spatial and Attribute data; GIS Operations: Spatial Data Input- Attribute data Management –Data display- Data Exploration- Data Analysis. COORDINATE SYSTEMS: Geographic Coordinate System: Approximation of the Earth, Datum; Map Projections: Types of Map Projections-Map projection parameters-Commonly used Map Projections - Projected coordinate Systems

UNIT – IV

Vector Data Model: Representation of simple features- Topology and its importance; coverage and its data structure, Shape file; Data models for composite features Object Based Vector Data Model; Classes and their Relationship; The geobase data model; Geometric representation of Spatial Feature and data structure, Topology rules

UNIT – V

Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data Conversion, Integration of Raster and Vector data.

Data Input: Metadata, Conversion of Existing data, creating new data; Remote Sensing data, Field data, Text data, Digitizing, Scanning, on screen digitizing, importance of source map, Data Editing

TEXT BOOKS:

1. Remote Sensing and GIS Lillesand and Kiefer, John Willey 2008.
2. Remote Sensing and GIS B. Bhatta by Oxford Publishers 2015.
3. Introduction to Geographic Information System – Kang-Tsung Chang, McGraw-Hill 2015

REFERENCES:

1. Concepts & Techniques of GIS by C. P. Lo Albert, K.W. Yonng, Prentice Hall (India) Publications.
2. Principals of Geo physical Information Systems – Peter A Burragh and Rachael A. Mc Donnell, Oxford Publishers 2004.
3. Basics of Remote sensing & GIS by S. Kumar, Laxmi Publications.

B.TECH CIVIL ENGINEERING
GEOINFORMATICS
(Open Elective - II)

B.Tech. III Year II Sem — **L T/P/D C: 3 0/0/0 3**
Course Code: **CE622OE**

Course Objectives:

- To introduce the concepts of remote sensing, satellite image characteristics and its components.
- To expose the various remote sensing platforms and sensors and to introduce the concepts of GIS, GPS and GNSS.

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

- The characteristics of Aerial photographic images ,Remote sensing satellites and Applications of remote sensing.
- The GIS and its Data models.
- The Global Navigation Satellite System.

UNIT – I

Aerial Photographs- Basic terms & Definitions, scales, relief displacements, Flight Planning, Stereoscopy, Characteristics of photographic images, Fundamentals of aerial photo-interpretation, Introduction to Digital Photogrammetry.

UNIT - II

Remote Sensing: Physics of remote sensing, Remote sensing satellites, and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution and multi-concept, FCC

UNIT – III

Satellite Image - Characteristics and formats, Image histogram, Introduction to Image rectification, Image Enhancement, Land use and land cover classification system, Unsupervised and Supervised Classification, Applications of remote sensing

UNIT - IV

Basic concepts of geographic data, GIS and its components, Data models, Topology, Process in GIS: Data capture, data sources, data encoding, geospatial analysis, GIS Applications

UNIT - V

Global Navigation Satellite System (GNSS), GPS, GLONASS, GALILEO, GPS: Space segment, Control segment, User segment, GPS satellite signals, Datum, coordinate system and map projection, Static, Kinematic and Differential GPS, GPS Applications

TEXT BOOKS:

1. Remote Sensing & GIS , BS Publications
2. Higher Surveying by A M Chandra New Age International Publisher
3. Remote Sensing & GIS by B. Bhatta Oxford University Press
4. Introduction to GPS by A. E Rabbany Library of congress cataloging in Publication data

REFERENCES:

1. T M Lillesand et al: Remote Sensing & Image Interpretation
2. Higher Surveying by B C Punmia Ashok kr. Jain Laxmi Publications
3. N K Agarwal : Essentials of GPS , Spatial Networks: Hyderabad

B.TECH. CIVIL ENGINEERING
INTELLECTUAL PROPERTY RIGHTS
(Open Elective - II)

B.Tech. III Year II Sem	**L T/P/D C**
Course Code: **CE623OE**	**3 0/0/0 3**

UNIT – I
Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II
Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III
Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.
Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV
Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V
New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.
International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT BOOKS & REFERENCES:
1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tate McGraw Hill Publishing company ltd.,

B.TECH CIVIL ENGINEERING
ENVIRONMENTAL IMPACT ASSESSMENT
(Open Elective - III)

B.Tech. IV Year II Sem	**L T/P/D C**
Course Code: CE831OE	**3 0/0/0 3**

Pre Requisites: Environmental Engineering

Course Objectives: This subject will cover various aspects of Environment Impact Assessment methodologies, impact of development activities. Impact on surface water, Air and Biological Environment, Environment legislation Environment.

Course Outcomes:

- Identify the environmental attributes to be considered for the EIA study.
- Formulate objectives of the EIA studies.
- Identify the suitable methodology and prepare Rapid EIA.
- Indentify and incorporate mitigation measures.

UNIT – I

Basic concept of EIA : Initial environmental Examination, Elements of EIA, - factors affecting E-I-A Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters.

E I A Methodologies: introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods, cost/benefit Analysis.

UNIT- II

Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation – Causes and effects of deforestation.

UNIT- III

Procurement of relevant soil quality, Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures.

UNIT – IV

Environmental Audit & Environmental legislation objectives of Environmental Audit, Types of environmental Audit, Audit protocel, stages of Environmental Audit, onsite activities, evaluation of Audit data and preparation of Audit report, Post Audit activities.

UNIT - V

The Environmental Protection Act, The water Act, The Air (Prevention & Control of pollution Act.), Motor Act, Wild life Act. Case studies and preparation of Environmental Impact assessment statement for various Industries.

TEXT BOOKS:

1. Larry Canter – Environmental Impact Assessment, McGraw-Hill Publications
2. Environmental Impact Assessment, Barthwal, R. R. New Age International Publications

REFERENCES:

1. Environmental Pollution by R.K. Khitoliya S. Chand, 2014.
2. Glynn, J. and Gary, W. H. K. - Environmental Science and Engineering, Prentice Hall Publishers
3. Suresh K. Dhaneja - Environmental Science and Engineering, S.K. Kataria & Sons Publication. New Delhi.
4. Bhatia, H. S. - Environmental Pollution and Control, Galgotia Publication (P) Ltd, Delhi.
5. Wathern, P. – Environmental Impact Assessment: Theory & Practice, Publishers-Rutledge, London, 1992.

B.TECH. CIVIL ENGINEERING
OPTIMIZATION TECHNIQUES IN ENGINEERING
(Open Elective - III)

B.Tech. IV Year II Sem	**L T/P/D C**
Course Code: **CE832OE**	**3 0/0/0 3**

Prerequisites: Operations Research

Course Objectives: After doing this subject student should know

- The various optimization techniques for single variable optimization problem
- Direct search methods and Gradient methods for multi variable un constraint Optimization problems
- Formulate a Geometric Programming model and solve it by using Arithmetic Geometric in equality theorem
- Simulate the system
- Thorough of state of art optimization techniques like Genetic Algorithms, simulated Annealing

Course Outcomes: For a given system, as per customer requirement it is required to

- Formulate optimization problem.
- Solve the problem by using a appropriate optimization techniques.

UNIT - I

Single Variable Non-Linear Unconstrained Optimization: Elimination methods: Uni-Model function-its importance, Fibonacci method & Golden section method. Interpolation methods: Quadratic & Cubic interpolation methods.

UNIT - II

Multi variable non-linear unconstrained optimization: Direct search methods – Univariant method, Pattern search methods – Powell's, Hook - Jeeves, Rosen brock search methods. Gradient methods: Gradient of function& its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves method & variable metric method.

UNIT - III

Linear Programming – Formulation, Simplex method, & artificial variable optimization techniques: Big M & Two phase methods. Sensitivity analysis: Changes in the objective coefficients, constants& coefficients of the constraints. Addition and deletion of variables, constraints.

Simulation – Introduction – Types- steps – applications: inventory & queuing – Advantages and disadvantages

UNIT - IV

Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method

Stochastic Programming: Basic concepts of probability theory, random variables-distributions-mean, variance, correlation, co variance, joint probability distribution. Stochastic linear programming: Chance constrained algorithm.

UNIT - V

Geometric Programming: Polynomials – Arithmetic - Geometric inequality – unconstrained G.P- constrained G.P ($\leq$ type only)

Non Traditional Optimization Algorithms: Genetics Algorithm-Working Principles, Similarities, and Differences between Genetic Algorithm & Traditional Methods. Simulated Annealing- Working Principle-Simple Problems. Introduction to Particle Swarm Optimization (PSO)(very brief)

TEXT BOOKS:

1. Optimization theory & Applications / S. S. Rao / New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI

REFERENCES:

1. Operations Research by S. D. Sharma Kedarnath & Ramnath Publisher
2. Operation Research by Hamdy A Taha Pearson Educations
3. Optimization in operations research by Ronald L. Rardin Pearson Publisher
4. Optimization Techniques by Benugundu & Chandraputla, Pearson Asia.
5. Optimization Techniques theory and practice by M. C. Joshi, K. M. Moudgalya Narosa Publications

B.TECH. CIVIL ENGINEERING
ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES
(Open Elective - III)

B.Tech. IV Year III Sem	**L T/P/D C**
Course Code: CE833OE	**3 0/0/0 3**

Course Objective: The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

Course Outcome: It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

Unit – 1: Entrepreneurial Perspectives:
Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.
Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

Unit – 2: New Venture Creation:
Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

Unit – 3: Management of MSMEs and Sick Enterprises
Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

Units – 4: Managing Marketing and Growth of Enterprises:
Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

Units – 5: Strategic perspectives in Entrepreneurship:
Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

Text Books:
1. Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D. F. Kuratko and T.V.Rao, 3e, Cengage, 2012.

REFERENCES:

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING
DISASTER MANAGEMENT
(Open Elective - I)

B.Tech. III Year I Sem	**L T/P/D C**
Course Code: **CE511OE**	**3 0/0/0 3**

Course Objectives: The subject provide different disasters, tools and methods for disaster management

Course Outcomes: At the end of the course, the student will be able to:
- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

UNIT - I
Understanding Disaster: Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)
Hazards and Vulnerabilities: Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

UNIT - II
Disaster Management Mechanism: Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

UNIT - III
Capacity Building: Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

UNIT - IV
Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

UNIT - V
Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India -

Organizational structure for disaster management in India - Preparation of state and district disaster management plans

TEXT BOOKS:

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

REFERENCES:

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING
ENVIRONMENTAL IMPACT ASSESSMENT
(Open Elective - II)

B.Tech.III Year II Sem	**L T/P/D C**
Course Code: CN621OE	**3 0/0/0 3**

Pre Requisites: Environmental Engineering

Course Objectives: This subject will cover various aspects of Environment Impact Assessment methodologies, impact of development activities. Impact on surface water, Air and Biological Environment, Environment legislation Environment.

Course Outcomes:
- Identify the environmental attributes to be considered for the EIA study.
- Formulate objectives of the EIA studies.
- Identify the suitable methodology and prepare Rapid EIA.
- Indentify and incorporate mitigation measures.

UNIT – I
Basic concept of EIA : Initial environmental Examination, Elements of EIA, - factors affecting E-I-A Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters.
E I A Methodologies: introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods, cost/benefit Analysis.

UNIT- II
Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation – Causes and effects of deforestation.

UNIT- III
Procurement of relevant soil quality, Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures.

UNIT – IV
Environmental Audit & Environmental legislation objectives of Environmental Audit, Types of environmental Audit, Audit protocel, stages of Environmental Audit, onsite activities, evaluation of Audit data and preparation of Audit report, Post Audit activities.

UNIT - V

The Environmental Protection Act, The water Act, The Air (Prevention & Control of pollution Act.), Motor Act, Wild life Act. Case studies and preparation of Environmental Impact assessment statement for various Industries.

TEXT BOOKS:

1. Larry Canter – Environmental Impact Assessment, McGraw-Hill Publications
2. Environmental Impact Assessment, Barthwal, R. R. New Age International Publications

REFERENCES:

1. Environmental Pollution by R.K. Khitoliya S. Chand, 2014.
2. Glynn, J. and Gary, W. H. K. - Environmental Science and Engineering, Prentice Hall Publishers
3. Suresh K. Dhaneja - Environmental Science and Engineering, S.K. Kataria & Sons Publication. New Delhi.
4. Bhatia, H. S. - Environmental Pollution and Control, Galgotia Publication (P) Ltd, Delhi.
5. Wathern, P. – Environmental Impact Assessment: Theory & Practice, Publishers-Rutledge, London, 1992.

B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING
INTELLECTUAL PROPERTY RIGHTS
(Open Elective - II)

B.Tech.III Year II Sem	**L T/P/D C**
Course Code: **CE623OE**	**3 0/0/0 3**

UNIT – I
Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II
Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III
Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.
Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV
Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V
New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.
International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT BOOKS & REFERENCES:
1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tate McGraw Hill Publishing company ltd.,

B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING
REMOTE SENSING & GIS
(Open Elective - III)

B.Tech. IV Year II Sem	**L T/P/D C**
Course Code: **CN831OE**	**3 0/0/0 3**

Pre Requisites: Surveying

Course Objectives: This course will make the student to understand about the principles of GIS, Remote Sensing, Spatial Systems, and its applications to Engineering Problems.

Course Outcomes: At the end of the course, the student will be able to:
- Retrieve the information content of remotely sensed data
- Analyze the energy interactions in the atmosphere and earth surface features
- Interpret the images for preparation of thematic maps
- Apply problem specific remote sensing data for engineering applications
- Analyze spatial and attribute data for solving spatial problems
- Create GIS and cartographic outputs for presentation

UNIT – I
Introduction to Photogrammetry: Principles& types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy, fiducial points, parallax measurement using fiducial line.

UNIT – II
Remote Sensing: Basic concept of remote sensing, Data and Information, Remote sensing data Collection, Remote sensing advantages & Limitations, Remote Sensing process.
Electro-magnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.

UNIT – III
Geographic Information Systems: Introduction to GIS; Components of a GIS; Geospatial Data: Spatial Data-Attribute data – Joining Spatial and Attribute data; GIS Operations: Spatial Data Input- Attribute data Management –Data display- Data Exploration- Data Analysis. COORDINATE SYSTEMS: Geographic Coordinate System: Approximation of the Earth, Datum; Map Projections: Types of Map Projections-Map projection parameters-Commonly used Map Projections - Projected coordinate Systems

UNIT – IV

Vector Data Model: Representation of simple features- Topology and its importance; coverage and its data structure, Shape file; Data models for composite features Object Based Vector Data Model; Classes and their Relationship; The geobase data model; Geometric representation of Spatial Feature and data structure, Topology rules

UNIT – V

Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data Conversion, Integration of Raster and Vector data.

Data Input: Metadata, Conversion of Existing data, creating new data; Remote Sensing data, Field data, Text data, Digitizing, Scanning, on screen digitizing, importance of source map, Data Editing

TEXT BOOKS:

1. Remote Sensing and GIS Lillesand and Kiefer, John Willey 2008.
2. Remote Sensing and GIS B. Bhatta by Oxford Publishers 2015.
3. Introduction to Geographic Information System – Kang-Tsung Chang, McGraw-Hill 2015

REFERENCES:

1. Concepts & Techniques of GIS by C. P. Lo Albert, K.W. Yonng, Prentice Hall (India) Publications.
2. Principals of Geo physical Information Systems – Peter A Burragh and Rachael A. Mc Donnell, Oxford Publishers 2004.
3. Basics of Remote sensing & GIS by S. Kumar, Laxmi Publications.

B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING
ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES
(Open Elective – III)

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
Course Code: **CE833OE**	**3**	**0/0/0**	**3**

Course Objective: The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

Course Outcome: It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

Unit – 1: Entrepreneurial Perspectives:
Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.
Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

Unit – 2: New Venture Creation:
Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

Unit – 3: Management of MSMEs and Sick Enterprises
Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

Units – 4: Managing Marketing and Growth of Enterprises:
Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

Units – 5: Strategic perspectives in Entrepreneurship:
Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

TEXT BOOKS:

1. Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D. F. Kuratko and T.V. Rao, 3e, Cengage, 2012.

REFERENCES:

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY
OPERATING SYSTEMS
(OPEN ELECTIVE – I)

	L	T	P	C
B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: CS511OE	**3**	**0**	**0**	**3**

Course Objectives:

- To understand the OS role in the overall computer system
- To study the operations performed by OS as a resource manager
- To understand the scheduling policies of OS
- To understand the different memory management techniques
- To understand process concurrency and synchronization
- To understand the concepts of input/output, storage and file management
- To understand the goals and principles of protection
- Introduce system call interface for file and process management
- To study different OS and compare their features.

Course Outcomes:

- Apply optimization techniques for the improvement of system performance.
- Ability to design and solve synchronization problems.
- Learn about minimization of turnaround time, waiting time and response time and also maximization of throughput by keeping CPU as busy as possible.
- Ability to change access controls to protect files.
- Ability to compare the different operating systems.

UNIT - I

Overview-Introduction-Operating system objectives, User view, System view, Operating system definition ,Computer System Organization, Computer System Architecture, OS Structure, OS Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments.

Operating System services, User and OS Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, OS Structure.

UNIT - II

Process and CPU Scheduling - Process concepts-The Process, Process State, Process Control Block, Threads, Process Scheduling-Scheduling Queues, Schedulers, Context Switch, Operations on Processes, System calls-fork(),exec(),wait(),exit(), Interprocess communication-ordinary pipes and named pipes in Unix.

Process Scheduling-Basic concepts, Scheduling Criteria, Scheduling algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Thread scheduling, Linux scheduling and Windows scheduling.

Process Synchronization, Background, The Critical Section Problem, Peterson's solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization in Linux and Windows.

UNIT - III

Memory Management and Virtual Memory – Memory Management Strategies- Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table, IA-32 Segmentation, IA-32 Paging.

Virtual Memory Management-Background, Demand Paging, Copy-on-Write, Page Replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing, Virtual memory in Windows..

UNIT - IV

Storage Management-File System- Concept of a File, System calls for file operations - open (), read (), write (), close (), seek (), unlink (), Access methods, Directory and Disk Structure, File System Mounting, File Sharing, Protection.

File System Implementation - File System Structure, File System Implementation, Directory Implementation, Allocation methods, Free-space Management, Efficiency, and Performance.

Mass Storage Structure – Overview of Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap space Management

UNIT - V

Deadlocks - System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock.

Protection – System Protection, Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems, Language-Based Protection.

TEXT BOOKS:

1. Operating System Concepts , Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 9th Edition, Wiley, 2016 India Edition
2. Operating Systems – Internals and Design Principles, W. Stallings, 7th Edition, Pearson.

REFERENCE BOOKS:

1. Modern Operating Systems, Andrew S Tanenbaum, 3rd Edition, PHI
2. Operating Systems A concept-based Approach, 2nd Edition, D.M. Dhamdhere, TMH.
3. Principles of Operating Systems, B. L. Stuart, Cengage learning, India Edition.
4. An Introduction to Operating Systems, P.C.P. Bhatt, PHI.
5. Principles of Operating systems, Naresh Chauhan, Oxford University Press.

B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY
DATABASE MANAGEMENT SYSTEMS
(OPEN ELECTIVE – I)

	L	T	P	C
B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: CS512OE	**3**	**0**	**0**	**3**

Course Objectives:
- To understand the basic concepts and the applications of database systems.
- To master the basics of SQL and construct queries using SQL.
- To understand the relational database design principles.
- To become familiar with the basic issues of transaction processing and concurrency control.
- To become familiar with database storage structures and access techniques.

Course Outcomes:
- Demonstrate the basic elements of a relational database management system.
- Ability to identify the data models for relevant problems.
- Ability to design entity relationship model and convert entity relationship diagrams into RDBMS and formulate SQL queries on the data.
- Apply normalization for the development of application software.

UNIT - I
Introduction: Database System Applications, Purpose of Database Systems, View of Data, Database Languages – DDL, DML, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information Retrieval, Specialty Databases, Database Users and Administrators, History of Database Systems.
Introduction to Data base design: Database Design and ER diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Conceptual Design for Large enterprises.
Relational Model: Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design: ER to Relational, Introduction to Views, Destroying /Altering Tables and Views.

UNIT - II
Relational Algebra and Calculus: Preliminaries, Relational Algebra, Relational calculus – Tuple relational Calculus, Domain relational calculus, Expressive Power of Algebra and calculus.
SQL: Queries, Constraints, Triggers: Form of Basic SQL Query, UNION,INTERSECT, and EXCEPT, Nested Queries, Aggregate Operators, NULL values Complex Integrity Constraints in SQL, Triggers and Active Data bases, Designing Active Databases..

UNIT - III

Schema Refinement and Normal Forms: Introduction to Schema Refinement, Functional Dependencies - Reasoning about FDs, Normal Forms, Properties of Decompositions, Normalization, Schema Refinement in Database Design, Other Kinds of Dependencies.

UNIT - IV

Transaction Management: Transactions, Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity Transaction Isolation Levels, Implementation of Isolation Levels.

Concurrency Control: Lock–Based Protocols, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols, Multiversion Schemes.

Recovery System-Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with loss of nonvolatile storage, Early Lock Release and Logical Undo Operations, Remote Backup systems.

UNIT - V

Storage and Indexing: Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing, Index Data Structures, Comparison of File Organizations.

Tree-Structured Indexing: Intuition for tree Indexes, Indexed Sequential Access Method (ISAM), B+ Trees: A Dynamic Index Structure, Search, Insert, Delete.

Hash- Based Indexing: Static Hashing, Extendible hashing, Linear Hashing, Extendible vs. Linear Hashing.

TEXT BOOKS:

1. Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Education (India) Private Limited, 3rd Edition. **(Part of UNIT-I, UNIT-II, UNIT-III, UNIT-V)**
2. Data base System Concepts, A. Silberschatz, Henry. F. Korth, S. Sudarshan, McGraw Hill Education(India) Private Limited l, 6th edition.**(Part of UNIT-I, UNIT-IV)**

REFERENCE BOOKS:

1. Database Systems, 6th edition, R Elmasri, Shamkant B.Navathe, Pearson Education.
2. Database System Concepts, Peter Rob & Carlos Coronel, Cengage Learning.
3. Introduction to Database Management, M. L. Gillenson and others, Wiley Student Edition.
4. Database Development and Management, Lee Chao, Auerbach publications, Taylor & Francis Group.
5. Introduction to Database Systems, C. J. Date, Pearson Education.

B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY
JAVA PROGRAMMING
(OPEN ELECTIVE – II)

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: CS621OE	**3**	**0**	**0**	**3**

Course Objectives:

- To understand object oriented programming concepts, and apply them in problem solving.
- To learn the basics of java Console and GUI based programming.

Course Outcomes:

- Understanding of OOP concepts and basics of java programming (Console and GUI based).
- The skills to apply OOP and Java programming in problem solving.
- Should have the ability to extend his/her knowledge of Java programming further on his/her own.

UNIT- I

OOP concepts – Data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, classes and objects, Procedural and object oriented programming paradigms

Java programming - History of Java, comments, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow - block scope, conditional statements, loops, break and continue statements, simple java stand alone programs, arrays, console input and output, formatting output, constructors, methods, parameter passing, static fields and methods, access control, this reference, overloading methods and constructors, recursion, garbage collection, building strings, exploring string class.

UNIT- II

Inheritance - Inheritance hierarchies, super and sub classes, Member access rules, super keyword, preventing inheritance: final classes and methods, the Object class and its methods

Polymorphism- dynamic binding, method overriding, abstract classes and methods.

Interfaces – Interfaces vs. Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interface.

Inner classes – Uses of inner classes, local inner classes, anonymous inner classes, static inner classes, examples.

Packages-Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

UNIT- III

Exception handling – Dealing with errors, benefits of exception handling, the classification of exceptions- exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, re-throwing exceptions, exception specification, built in exceptions, creating own exception sub classes.

Multithreading - Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads, thread priorities, synchronizing threads, inter-thread communication, producer consumer pattern.

UNIT- IV

Collection Framework in Java – Introduction to Java Collections, Overview of Java Collection frame work, Generics, Commonly used Collection classes– Array List, Vector, Hash table, Stack, Enumeration, Iterator, String Tokenizer, Random, Scanner, calendar and Properties

Files – streams- byte streams, character streams, text Input/output, binary input/output, random access file operations, File management using File class.

Connecting to Database - JDBC Type 1 to 4 drivers, connecting to a database, querying a database and processing the results, updating data with JDBC.

UNIT- V

GUI Programming with Java - The AWT class hierarchy, Introduction to Swing, Swing vs. AWT, Hierarchy for Swing components, Containers – JFrame, JApplet, JDialog, JPanel, Overview of some swing components- Jbutton, JLabel, JTextField, JTextArea, simple swing applications, Layout management - Layout manager types – border, grid and flow

Event h**andling** - Events, Event sources, Event classes, Event Listeners, Relationship between Event sources and Listeners, Delegation event model, Examples: handling a button click, handling mouse events, Adapter classes.

Applets – Inheritance hierarchy for applets, differences between applets and applications, life cycle of an applet, passing parameters to applets, applet security issues.

TEXT BOOK:

1. Java Fundamentals – A comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.

REFERENCE BOOKS:

1. Java for Programmers, P.J.Deitel and H.M.Deitel, Pearson education (OR) Java: How to Program P.J.Deitel and H.M.Deitel, PHI.
2. Object Oriented Programming through Java, P.Radha Krishna, Universities Press.
3. Thinking in Java, Bruce Eckel, Pearson Education
4. Programming in Java, S.Malhotra and S.Choudhary, Oxford Univ. Press.

B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY
SOFTWARE TESTING METHODOLOGIES
(OPEN ELECTIVE – II)

	L	T	P	C
B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: CS622OE	**3**	**0**	**0**	**3**

Course Objectives:
To understand the software testing methodologies such as flow graphs and path testing, transaction flows testing, data flow testing, domain testing and logic base testing.

Course Outcomes:
- Ability to apply the process of testing and various methodologies in testing for developed software.
- Ability to write test cases for given software to test it before delivery to the customer.

UNIT - I
Introduction:- Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs.
Flow graphs and Path testing:- Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT - II
Transaction Flow Testing:-transaction flows, transaction flow testing techniques.
Dataflow testing:- Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.

UNIT - III
Domain Testing:-domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

UNIT-IV
Paths, Path products and Regular expressions:- path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection.
Logic Based Testing:- overview, decision tables, path expressions, kv charts, specifications.

UNIT - V
State, State Graphs and Transition testing:- state graphs, good & bad state graphs, state testing, Testability tips.
Graph Matrices and Application:-Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like JMeter or Win-runner).

TEXT BOOKS:

1. Software Testing techniques – Boris Beizer, Dreamtech, second edition.
2. Software Testing Tools – Dr.K.V.K.K.Prasad, Dreamtech.

REFERENCE BOOKS:

1. The craft of software testing - Brian Marick, Pearson Education.
2. Software Testing,3rd edition,P.C. Jorgensen, Aurbach Publications (Dist.by SPD).
3. Software Testing, N.Chauhan, Oxford University Press.
4. Introduction to Software Testing, P.Ammann&J.Offutt, Cambridge Univ.Press.
5. Effective methods of Software Testing, Perry, John Wiley, 2nd Edition, 1999.
6. Software Testing Concepts and Tools, P.Nageswara Rao, dreamtech Press.
7. Software Testing, M.G.Limaye, TMH.
8. Software Testing, S.Desikan, G.Ramesh, Pearson.
9. Foundations of Software Testing, D.Graham & Others, Cengage Learning.
10. Foundations of Software Testing, A.P.Mathur, Pearson.

B.TECH COMPUTER SCIENCE AND ENGINEERING / B.TECH INFORMATION TECHNOLOGY
CYBER SECURITY
(OPEN ELECTIVE – II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: CS623OE	**3 0 0 3**

UNIT- I
Introduction to Cybercrime: Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

UNIT - II
Cyber Offenses: How Criminals Plan Them: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

UNIT - III
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

UNIT IV
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

UNIT V
Cyber Security: Organizational Implications
Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

TEXT BOOK:

1. **Cyber Security:** *Understanding Cyber Crimes, Computer Forensics and Legal Perspectives,* Nina Godbole and Sunil Belapure, Wiley INDIA.

REFERENCE BOOK:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group

B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY
LINUX PROGRAMMING
(OPEN ELECTIVE – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: CS831OE	**3 0 0 3**

Course Objectives:

- To understand and make effective use of Linux utilities and Shell scripting language (bash) to solve Problems.
- To implement in C some standard Linux utilities such as ls, mv, cp etc. using system calls.
- To develop the skills necessary for systems programming including file system programming, process and signal management, and interprocess communication.
- To develop the basic skills required to write network programs using Sockets.

Course Outcomes:

- Work confidently in Linux environment.
- Work with shell script to automate different tasks as Linux administration.

UNIT- I

Linux Utilities - File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities and Backup utilities.

Sed-Scripts, Operation, Addresses, Commands, Applications, awk-Execution, Fields and Records, Scripts, Operation, Patterns, Actions, Associative Arrays, String and Mathematical functions, System commands in awk, Applications.

Shell programming with Bourne again shell (bash) - Introduction, shell responsibilities, pipes and Redirection, here documents, running a shell script, the shell as a programming language, shell meta characters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples, interrupt processing, functions, debugging shell scripts.

UNIT- II

Files and Directories - File Concept, File types, File System Structure, file metadata-Inodes, kernel support for files, system calls for file I/O operations- open, creat, read, write, close, lseek, dup2, file status information-stat family, file and record locking- fcntl function, file permissions - chmod, fchmod, file ownership-chown, lchown, fchown, links-soft links and hard links – symlink, link, unlink. **Directories** - Creating, removing and changing Directories-mkdir, rmdir, chdir, obtaining current working directory-getcwd, Directory contents, Scanning Directories-opendir, readdir, closedir, rewinddir functions.

UNIT- III

Process – Process concept, Layout of a C program image in main memory, Process environment-environment list, environment variables, getenv, setenv, Kernel support for process, process identification, process control - process creation, replacing a process image, waiting for a process, process termination, zombie process, orphan process, system call interface for process management-fork, vfork, exit, wait, waitpid, exec family, Process Groups, Sessions and Controlling Terminal, Differences between threads and processes.

Signals – Introduction to signals, Signal generation and handling, Kernel support for signals, Signal function, unreliable signals, reliable signals, kill, raise, alarm, pause, abort, sleep functions.

UNIT- IV

Interprocess Communication - Introduction to IPC, IPC between processes on a single computer system, IPC between processes on different systems, pipes-creation, IPC between related processes using unnamed pipes, FIFOs-creation, IPC between unrelated processes using FIFOs (Named pipes), differences between unnamed and named pipes, popen and pclose library functions. **Message Queues** - Kernel support for messages, APIs for message queues, client/server example. **Semaphores** - Kernel support for semaphores, APIs for semaphores, file locking with semaphores.

UNIT- V

Shared Memory - Kernel support for shared memory, APIs for shared memory, shared memory example. **Sockets** - Introduction to Berkeley Sockets, IPC over a network, Client-Server model, Socket address structures (Unix domain and Internet domain),Socket system calls for connection oriented protocol and connectionless protocol, example-client/server programs-Single Server-Client connection, Multiple simultaneous clients, Socket options-setsockopt and fcntl system calls, Comparison of IPC mechanisms.

TEXT BOOKS:

1. Unix System Programming using C++, T. Chan, PHI.
2. Unix Concepts and Applications, 4th Edition, Sumitabha Das, TMH.
3. Unix Network Programming, W. R. Stevens, PHI.

REFERENCE BOOKS:

1. Beginning Linux Programming, 4th Edition, N. Matthew, R. Stones, Wrox, Wiley India Edition.
2. Unix for programmers and users, 3rd Edition, Graham Glass, King Ables, Pearson.
3. System Programming with C and Unix, A. Hoover, Pearson.
4. Unix System Programming, Communication, Concurrency and Threads, K. A. Robbins and S. Robbins, Pearson Education.
5. Unix shell Programming, S. G. Kochan and P. Wood, 3rd edition, Pearson Education.
6. Shell Scripting, S. Parker, Wiley India Pvt. Ltd.

7. Advanced Programming in the Unix Environment, 2nd edition, W. R. Stevens and S. A. Rago, Pearson Education.
8. Unix and Shell programming, B. A. Forouzan and R. F. Gilberg, Cengage Learning.
9. Linux System Programming, Robert Love, O'Reilly, SPD.
10. C Programming Language, Kernighan and Ritchie, PHI

B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY
R PROGRAMMING
(OPEN ELECTIVE – III)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: CS832OE	**3**	**0**	**0**	**3**

Course Objectives:
- Understanding and being able to use basic programming concepts
- Automate data analysis
- Working collaboratively and openly on code
- Knowing how to generate dynamic documents
- Being able to use a continuous test-driven development approach

Course Outcomes:
- be able to use and program in the programming language R
- be able to use R to solve statistical problems
- be able to implement and describe Monte Carlo the technology
- be able to minimize and maximize functions using R

UNIT – I
Introduction: Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

UNIT – II
Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes
Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

UNIT – III
Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, DATA FRAMES, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations

UNIT - IV

FACTORS AND TABLES, Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables , Extracting a Subtable, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

UNIT - V

OBJECT-ORIENTED PROGRAMMING: S Classes, S Generic Functions, Writing S Classes, Using Inheritance, S Classes, Writing S Classes, Implementing a Generic Function on an S Class, visualization, Simulation, code profiling, Statistical Analysis with R, data manipulation

TEXT BOOKS:

1. R Programming for Data Science by Roger D. Peng
2. The Art of R Programming by Prashanth singh, Vivek Mourya, Cengage Learning India**.**

B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY
PHP PROGRAMMING
(OPEN ELECTIVE – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: CS833OE	**3 0 0 3**

Course Objectives:

- Gain the PHP programming skills needed to successfully build interactive, data-driven sites
- Use the MVC pattern to organize code
- Test and debug a PHP application
- Work with form data
- Use cookies and sessions
- Work with regular expressions, handle exceptions, and validate data

Course Outcomes:

- Be able to develop a form containing several fields and be able to process the data provided on the form by a user in a PHP-based script.
- Understand basic PHP syntax for variable use and standard language constructs, such as conditionals and loops.
- Understand the syntax and use of PHP object-oriented classes.
- Understand the syntax and functions available to deal with file processing for files on the server as well as processing web URLs.
- Understand the paradigm for dealing with form-based data, both from the syntax of HTML forms, and how they are accessed inside a PHP-based script.

Unit - I:

INTRODUCTION TO PHP: History of PHP, Apache Web Server, MySQL and Open Source, Relationship between Apache, MySQL and PHP (AMP Module), PHP configuration in IIS, Apache Web server

BASICS OF PHP: PHP structure and syntax, Creating the PHP pages, Rules of PHP syntax, Integrating HTML with PHP, Constants, Variables : static and global variable, Conditional Structure & Looping, PHP Operators, Arrays, for each constructs, User defined function, argument function, Variable function, Return Function, default argument, variable length argument.

Unit - II:

WORKING WITH FUNCTIONS: Variable Function, String Function, Math Function, Date Function, Array Function, and File Function. User defined function, Systems defined function, Parameterized function, Non parameterized function, Dynamic parameter in function, Variable scope, Passing Argument in function, Static function.

Unit - III:

WORKING WITH DATA: FORM element, INPUT elements, Processing the form, User Input, Adding items, Validating the user input, Passing variables between pages. Files, Creating and deleting file, Reading and writing file, Working with file, Creating and deleting folder, Working with regular Expression Basic regular expression, Matching patterns, Finding match, Replace match,

Unit - IV:

ERROR HANDLING: Error types in PHP, Generating PHP errors, Exceptions, Parse errors, State Management: - Cookies Session, Destroying cookies and session Http management, Sent mail

Images with PHP: Working with GD Library, File types with GD and PHP, Compiling PHP with GD, Creating the image table, uploading the image.

Unit - V:

INTRODUCTION TO MYSQL: MySQL structure and syntax, Types of MySQL tables and storages engines, MySQL commands, Integration of PHP with MySQL, Connection to the MySQL server, Working with PHP and arrays of data, Referencing two tables, Joining two tables.

WORKING WITH DATABASE: Creating a table, manipulating the table, editing the database, inserting a record, deleting a record, editing data

Understand process of executing a PHP-based script on a webserver.

TEXT BOOKS:

1. **Beginning PHP, Apache, MySQL Web Development** - Elizabeth Naramore, Jason Gerner, Yann Le, Scouarnec, Jeremy Stolz, Michael K. Glass, Gary Mailer - By Wrox Publication.
2. **PHP, MySQL and Apache** - Julie C. Melone By Pearson Education

REFERENCE BOOKS:

1. **Beginning PHP 5.3,** by Matt Doyle - By Wrox Publication
2. **PHP and MySQL Bible** – Tim Converse and Joyce Park with Clark Morgam By Wiley INDIA

B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING / B.TECH ELECTRONICS AND TELEMATICS ENGINEERING

PRINCIPLES OF ELECTRONIC COMMUNICATIONS

(OPEN ELECTIVE - I)

	L	T	P	C
B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: EC511OE	**3**	**0**	**0**	**3**

Course Objectives: The objective of this subject is to:

- Introduce the students to modulation and various analog and digital modulation schemes.
- They can have a broad understanding of satellite, optical, cellular, mobile, wireless and telecom concepts.

Course Outcomes: By completing this subject, the student can

- Work on various types of modulations.
- Should be able to use these communication modules in implementation.
- Will have a basic understanding of various wireless and cellular, mobile and telephone communication systems.

UNIT - I

Introduction: Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

UNIT - II

Simple description on Modulation: Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

UNIT - III

Telecommunication Systems: Telephones Telephone system, Paging systems, Internet Telephony.

Networking and Local Area Networks: Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

UNIT - IV

Satellite Communication: Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.

Optical Communication: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT - V

Cellular and Mobile Communications: Cellular telephone systems, AMPS, GSM, CDMA, and WCDMA.

Wireless Technologies: Wireless LAN, PANs and Bluetooth, Zig Bee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

Text Books:

1. Principles of Electronic Communication Systems, Louis E. Frenzel, 3e, McGraw Hill publications, 2008.
2. Electronic Communications systems, Kennedy, Davis 4e, MC GRAW HILL EDUCATION, 1999

Reference Books:

1. Theodore Rapp port, Wireless Communications - Principles and practice, Prentice Hall, 2002.
2. Roger L. Freeman, Fundamentals of Telecommunications, 2e, Wiley publications.
3. Introduction to data communications and networking, Wayne Tomasi, Pearson Education, 2005.

B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING / B.TECH ELECTRONICS AND TELEMATICS ENGINEERING PRINCIPLES OF COMPUTER COMMUNICATIONS AND NETWORKS (OPEN ELECTIVE - II)

	L	T	P	C
B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: EC621OE	**3**	**0**	**0**	**3**

Course Objectives:

1. To understand the concept of computer communication.
2. To learn about the networking concept, layered protocols.
3. To understand various communications concepts.
4. To get the knowledge of various networking equipment.

Course Outcomes:

1. The student can get the knowledge of networking of computers, data transmission between computers.
2. Will have the exposure about the various communication concepts.
3. Will get awareness about the structure and equipment of computer network structures.

UNIT - I

Overview of Computer Communications and Networking: Introduction to Computer Communications and Networking, Introduction to Computer Network, Types of Computer Networks, Network Addressing, Routing, Reliability, Interoperability and Security, Network Standards, The Telephone System and Data Communications.

UNIT - II

Essential Terms and Concepts: Computer Applications and application protocols, Computer Communications and Networking models, Communication Service Methods and data transmission modes, analog and Digital Communications , Speed and capacity of a Communication Channel, Multiplexing and switching, Network architecture and the OSI reference model.

UNIT - III

Analog and Digital Communication Concepts: Representing data as analog signals, representing data as digital signals, data rate and bandwidth reduction, Digital Carrier Systems.

UNIT - IV

Physical and data link layer Concepts: The Physical and Electrical Characteristics of wire, Copper media, fiber optic media, wireless Communications. Introduction to data link Layer , the logical link control and medium access control sub-layers.

UNIT - V

Network Hardware Components: Introduction to Connectors, Transreceivers and media convertors, repeaters, network interference cards and PC cards, bridges, switches, switches Vs Routers.

TEXT BOOKS:

1. Computer Communications and Networking Technologies, Michel A. Gallo and William H. Hancock, Thomson Brooks / Cole.
2. Data Communications and Networking – Behrouz A. Forouzan, Fourth Edition MC GRAW HILL EDUCATION, 2006.

REFERENCE BOOKS:

1. Principles of Computer Networks and Communications, M. Barry Dumas, Morris Schwartz, Pearson.
2. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education.

B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING / B.TECH ELECTRONICS AND TELEMATICS ENGINEERING

ELECTRONIC MEASURING INSTRUMENTS

(OPEN ELECTIVE - III)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: EC831OE	**3**	**0**	**0**	**3**

Note: No detailed mathematical treatment is required.

Course Objectives:

- It provides an understanding of various measuring systems functioning and metrics for performance analysis.
- Provides understanding of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
- Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

Course Outcomes: On completion of this course student can be able to

- Identify the various electronic instruments based on their specifications for carrying out a particular task of measurement.
- Measure various physical parameters by appropriately selecting the transducers.
- Use various types of signal generators, signal analyzers for generating and analyzing various real-time signals.

UNIT - I

Block Schematics of Measuring Systems and Performance Metrics: Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag.

UNIT - II

Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, and Specifications.

UNIT - III

Measuring Instruments: DC Voltmeters, D’ Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments. CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes.

UNIT - IV

Recorders: X-Y Plotter, Curve tracer, Galvanometric Recorders, Servo transducers, pen driving mechanisms, Magnetic Recording, Magnetic recording techniques.

UNIT - V

Transducers: Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers.

TEXT BOOKS:

1. Electronic Measurements and Instrumentation: B.M. Oliver, J.M. Cage TMH Reprint 2009.
2. Electronic Instrumentation: H.S.Kalsi – TMH, 2nd Edition 2004.

REFERENCES:

1. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
2. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI 5th Edition 2003.
3. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.
4. Industrial Instrumentation: T.R. Padmanabham Springer 2009.

B.TECH. ELECTRONICS AND COMPUTER ENGINEERING
SCRIPTING LANGUAGES
(Open Elective – I)

B.Tech. III Year I Sem.	**L T P C**
Course Code: EM511OE	**3 0 0 3**

Course Objectives: The goal of the course is to study:

- The principles of scripting languages.
- Motivation for and applications of scripting.
- Difference between scripting languages and non- scripting languages.
- Types of scripting languages.
- Scripting languages such as PERL, TCL/TK, python and BASH.
- Creation of programs in the Linux environment.
- Usage of scripting languages in IC design flow.

Course Outcomes:
Upon learning the course, the student will have the:

- Ability to create and run scripts using PERL/TCl/Python in IC design flow.
- Ability to use Linux environment and write programs for automation of scripts in VLSI tool design flow.

UNIT –I:
Linux Basics:
Introduction to Linux , File System of the Linux, General usage of Linux kernel & basic commands, Linux users and group, Permissions for file, directory and users, searching a file & directory, zipping and unzipping concepts.

UNIT –II :
Linux Networking:
Introduction to Networking in Linux, Network basics & Tools, File Transfer Protocol in Linux, Network file system, Domain Naming Services, Dynamic hosting configuration Protocol & Network information Services.

UNIT –III :
Perl Scripting:
Introduction to Perl Scripting, working with simple values, Lists and Hashes, Loops and Decisions, Regular Expressions, Files and Data in Perl Scripting, References & Subroutines, Running and Debugging Perl, Modules, Object – Oriented Perl.

UNIT –IV:

Tcl / Tk Scripting:

Tcl Fundamentals, String and Pattern Matching, Tcl Data Structures, Control Flow Commands, Procedures and Scope, Evel, Working with Unix, Reflection and Debugging, Script Libraries, Tk Fundamentals, Tk by examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple Tk Widgets, Entry and List box Widgets Focus, Grabs and Dialogs.

UNIT –V :

Python Scripting:

Introduction to Python, using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output, Errors and Exceptions, Classes, Brief Tour of the Standard Library.

TEXT BOOKS:

1. Python Tutorial by Guido Van Rossum, Fred L. Drake Jr. editor , Release 2.6.4
2. Practical Programming in Tcl and Tk by Brent Welch, Updated for Tcl 7.4 and Tk 4.0.
3. Teach Yorself Perl in 21 days by David Till.
4. Red Hat Enterprise Linux 4 : System Administration Guide Copyright, 2005 Red Hat Inc.

REFERENCE BOOKS:

1. Learning Python – 2nd Ed., Mark Lutz and David Ascher, 2003, O’Reilly.
2. Perl in 24 Hours – 3rd Ed., Clinton Pierce, 2005, Sams Publishing.
3. Learning Perl – 4th Ed. Randal Schwartz, Tom Phoenix and Brain d foy. 2005.
4. Jython Essentials – Samuele Pedroni and Noel Pappin.2002. O’Reilly.
5. Programming Perl – Larry Wall, Tom Christiansen and John Orwant, 3rd Edition, O’Reilly, 2000. (ISBN 0596000278)

B.TECH. ELECTRONICS AND COMPUTER ENGINEERING
SOFT COMPUTING TECHNIQUES
(Open Elective – II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: EM621OE	**3 0 0 3**

Prerequisite: Nil.

Course Objectives: This course makes the students to Understand

- Fundamentals of Neural Networks & Feed Forward Networks.
- Associative Memories & ART Neural Networks.
- Fuzzy Logic & Systems.
- Genetic Algorithms and Hybrid Systems.

Course Outcomes: On completion of this course the students will be able to

- Identify and employ suitable soft computing techniques in classification and optimization problems.
- Design hybrid systems to suit a given real – life problem.

UNIT –I:

Fundamentals of Neural Networks & Feed Forward Networks:

Basic Concept of Neural Networks, Human Brain, Models of an Artificial Neuron, Learning Methods, Neural Networks Architectures, Single Layer Feed Forward Neural Network :The Perceptron Model, Multilayer Feed Forward Neural Network :Architecture of a Back Propagation Network (BPN), The Solution, Back propagation Learning, Selection of various Parameters in BPN. Application of Back propagation Networks in Pattern Recognition & Image Processing.

UNIT –II:

Associative Memories & ART Neural Networks:

Basic concepts of Linear Associator, Basic concepts of Dynamical systems, Mathematical Foundation of Discrete-Time Hop field Networks(HPF), Mathematical Foundation of Gradient-Type Hopfield Networks, Transient response of Continuous Time Networks, Applications of HPF in Solution of Optimization Problem: Minimization of the Traveling salesman tour length, Summing networks with digital outputs, Solving Simultaneous Linear Equations, Bidirectional Associative Memory Networks; Cluster Structure, Vector Quantization, Classical ART Networks, Simplified ART Architecture.

UNIT –III:

Fuzzy Logic & Systems:

Fuzzy sets, Crisp Relations, Fuzzy Relations, Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule based system, Defuzzification Methods, Applications: Greg Viot’s Fuzzy Cruise Controller, Air Conditioner Controller.

UNIT –IV:

Genetic Algorithms:

Basic Concepts of Genetic Algorithms (GA), Biological background, Creation of Offsprings, Working Principle, Encoding, Fitness Function, Reproduction, Inheritance Operators, Cross Over, Inversion and Deletion, Mutation Operator, Bit-wise Operators used in GA, Generational Cycle, Convergence of Genetic Algorithm.

UNIT –V:

Hybrid Systems:

Types of Hybrid Systems, Neural Networks, Fuzzy Logic, and Genetic Algorithms Hybrid, Genetic Algorithm based BPN: GA Based weight Determination, Fuzzy Back Propagation Dept. of ECE, JNTUHCEH M.Tech. (SSP) (FT) w.e.f. 2015-16 56 Networks: LR-type fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BPN, Inference by fuzzy BPN.

TEXT BOOKS:

1. Introduction to Artificial Neural Systems - J.M.Zurada, Jaico Publishers
2. Neural Networks, Fuzzy Logic & Genetic Algorithms: Synthesis & Applications - S.Rajasekaran, G.A. Vijayalakshmi Pai, July 2011, PHI, New Delhi.
3. Genetic Algorithms by David E. Gold Berg, Pearson Education India, 2006.
4. Neural Networks & Fuzzy Sytems- Kosko.B., PHI, Delhi,1994.

REFERENCE BOOKS:

1. Artificial Neural Networks - Dr. B. Yagananarayana, 1999, PHI, New Delhi.
2. An introduction to Genetic Algorithms - Mitchell Melanie, MIT Press, 1998
3. Fuzzy Sets, Uncertainty and Information- Klir G.J. & Folger. T. A., PHI, Delhi, 1993

B.TECH. ELECTRONICS AND COMPUTER ENGINEERING
DATA ANALYTICS
(Open Elective – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: EM831OE	**3 0 0 3**

Prerequisite: Nil

Course Objectives: The student should be made to :
- Be exposed to conceptual frame work of big data.
- Understand different techniques of Data Analysis.
- Be familiar with concepts of data streams.
- Be exposed to item sets, Clustering, frame works and Visualization.

Course Outcomes: Upon completion of this course the students will be able to
- Understand Big data fundamentals.
- Learn various Data Analysis Techniques
- Implement various Data streams.
- Understand item sets, Clustering, frame works & Visualizations.

UNIT – I
Introduction to Big Data: Introduction to Big Data Platform – Challenges of Conventional systems – Web data – Evolution of Analytic scalability , analytic process and tools , Analysis vs Reporting – Modern data analytic tools, stastical concepts : Sampling distributions, resampling , statistical inference, prediction error.

UNIT – II
Data Analysis: Regression modeling , Multivariate analysis, Bayesian modeling , inference and Bayesian networks , Support vector and Kernel methods, Analysis of time series : Linear systems analysis , nonlinear dynamics – Rule induction – Neural networks : Learning and and Generalisation, competitive learning, Principal component analysis and neural networks ; Fuzzy Logic : extracting fuzzy models from data , fuzzy decision trees, Stochastic search methods.

UNIT – III
Mining Data Streams: Introduction to Streams Concepts – Stream data model and architecture – Stream Computing , Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a Window – Decaying window – Real time Analytics Platform (RTAP) applications – case studies – real time sentiment analysis, stock market predictions.

UNIT – IV

Frequent Itemsets and clustering: Mining Frequent itemsets – Market based Modeling – Apriori Algorithm – Handling large data sets in Main Memory – Limited Pass Algorithm – Counting frequent itemsets in a Stream – Clustering Techniques – Hierarchical – K-Means – Clustering high dimensional data – CLIQUE and ProCLUS – Frequent pattern based clustering methods – Clustering in non-euclidean space – Clustering for streams and Parallelism.

UNIT – V

Frame Works and Visualization: MapReduce – Hadoop, Hive , MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed file systems – Visualizations – Visual data analysis techniques, interaction techniques : systems and Applications .

TEXT BOOKS:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

REFERENCE BOOKS:

1. Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.
2. Glenn J. Myatt, Making Sense of Data, John Wiley & sons, 2007 Pete Warden, Big Data Glossary, O'Reilly, 2011.
3. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
NON-CONVENTIONAL POWER GENERATION
(OPEN ELECTIVE – I)

B.Tech. III Year I Sem.	**L T P C**
Course Code: EE511OE	**3 0 0 3**

Prerequisite: Nil.

Course Objectives:
- To introduce various types of renewable energy technologies
- To understand the technologies of energy conversion from the resources and their quantitative analysis.

Course Outcomes: After completion of this course, the student will be able to
- Analyze solar thermal and photovoltaic systems and related technologies for energy conversion.
- Understand Wind energy conversion and devices available for it.
- Understand Biomass conversion technologies, Geo thermal resources and energy conversion principles and technologies.
- Realize Power from oceans (thermal, wave, tidal) and conversion devices.
- Understand fundamentals of fuel cells and commercial batteries.

UNIT - I
Fundamentals of Solar Energy-Solar spectrum- Solar Radiation on Earth's surface-Solar radiation geometry-Solar radiation measurements- Solar radiation data- Solar radiation on horizontal and tilted surfaces. Solar Thermal conversion- Flat plate collectors- concentrated collectors- construction and thermal analysis- Solar applications- Solar ponds- Heliostat systems-water heater-air heater-solar still.

UNIT - II
Solar-Electric Power generation- Photovoltaic cells- Equivalent circuit- V-I Characteristics-Photovoltaic modules – constructional details- design considerations- Tracking- Maximum power point tracking - Solar Thermo electric conversion.

UNIT - III
Wind Energy- Fundamentals of wind energy-power available in wind- Betz Limit-Aerodynamics of wind turbine- Wind turbines- Horizontal and vertical axis turbines –their configurations- Wind Energy conversion systems.

UNIT - IV
Energy from Bio Mass- Various fuels- Sources-Conversion technologies-Wet Processes – Dry Processes- Bio Gas generation – Aerobic and anaerobic digestion - Factors affecting

generation of bio gas - Classification of bio gas plants-Different Indian digesters- Digester design considerations - Gasification process - Gasifiers – Applications. Geothermal Energy - sources- Hydrothermal convective - Geo-pressure resources - Petro-thermal systems (HDR) - Magma Resources-Prime Movers.

UNIT - V

OTEC Systems- Principle of operation - Open and closed cycles, Energy from Tides - Principle of Tidal Power - Components of tidal Power plants - Operation Methods - Estimation of Energy in Single and double basin systems - Energy and Power from Waves-Wave energy conversion devices - Fuel Cells - Design and Principle of operation - Types of Fuel Cells - Advantages and disadvantages - Types of Electrodes – Applications - Basics of Batteries - Constructional details of Lead acid batteries - Ni-Cd Batteries.

TEXT BOOKS:

1. “John Twidell & Wier”, “Renewable Energy Resources”, CRC Press, 2009.
2. “G. D. Rai”, “Non Conventional Energy sources”, Khanna publishers, 2004

REFERENCE BOOKS:

1. “D. P .Kothari, Singal, Rakesh and Ranjan”, “Renewable Energy sources and Emerging Technologies”, PHI, 2009.
2. “F. C. Treble”, Generating Electricity from Sun, Pergamon Press, 1st Edition 1991
3. “C. S. Solanki”, “Solar Photovoltaics - Fundamentals- Principles and Applications”, PHI, 2009
4. “S. P. Sukhatme”, “Solar Energy Principles and Application”, TMH, 2009.

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
ELECTRICAL ENGINEERING MATERIALS
(OPEN ELECTIVE – I)

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: EE512OE	**3**	**0**	**0**	**3**

Prerequisite: Engineering chemistry and Engineering Physics - II

Course Objective:

- To understand the importance of various materials used in electrical engineering and obtain a qualitative analysis of their behavior and applications.

Course Outcomes: After completion of this course, the student will be able to

- Understand various types of dielectric materials, their properties in various conditions.
- Evaluate magnetic materials and their behavior.
- Evaluate semiconductor materials and technologies.
- Acquire Knowledge on Materials used in electrical engineering and applications.

UNIT- I

Dielectric Materials: Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT – II

Magnetic Materials: Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and hysteresis

UNIT – III

Semiconductor Materials: Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI)

UNIT – IV

Materials for Electrical Applications: Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT – V

Special Purpose Materials: Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials, Processing of electronic materials, Insulating varnishes and coolants, Properties and applications of mineral oils, Testing of Transformer oil as per ISI

Text Books:

1. "R K Rajput", " A course in Electrical Engineering Materials", Laxmi Publications, 2009
2. "T K Basak", " A course in Electrical Engineering Materials", New Age Science Publications 2009

Reference Books:

1. TTTI Madras, "Electrical Engineering Materials", McGraw Hill Education, 2004.
2. "AdrianusJ.Dekker", Electrical Engineering Materials, PHI Publication, 2006.
3. S. P. Seth, P. V. Gupta "A course in Electrical Engineering Materials", Dhanpat Rai & Sons, 2011.

B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING
NANOTECHNOLOGY
(OPEN ELECTIVE – I)

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: EE513OE	**3**	**0**	**0**	**3**

Course Objectives: Nano Technology is one of the core subjects of multidisciplinary nature. This has extensive applications in the field of energy, electronics, Biomedical Engg. Etc. Built to specifications by manufacturing matter on the atomic scale, the Nano products would exhibit an order of magnitude improvement in strength, toughness, and efficiency. The objective here is imparting the basic knowledge in Nano Science and Technology.

Course Outcomes: The present syllabus of "Introduction to Nano Technology" will give insight into many aspects of Nanoscience, technology and their applications in the prospective of materials science.

UNIT - I

Introduction: History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges, and Future Prospects.

UNIT - II

Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations,

Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility.

Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties, and Mechanical Properties.

UNIT- III

Synthesis Routes: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method ,Self-assembly, **Top down approaches:** Mechanical alloying, Nano-lithography, **Consolidation of Nanopowders**: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

UNIT - IV

Tools to Characterize nanomaterials: X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope

(STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.

UNIT - V

Applications of Nanomaterials: Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water-Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology.

TEXT BOOKS:

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

REFERENCES BOOKS:

1. Nano: The Essentials by T. Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek.
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S., S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
DESIGN ESTIMATION AND COSTING OF ELECTRICAL SYSTEMS
(OPEN ELECTIVE – II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: EE621OE	**3 0 0 3**

Prerequisite: Power systems - I & Power Systems - II

Course Objectives:

- To emphasize the estimation and costing aspects of all electrical equipment, installation and designs on the cost viability.
- To design and estimation of wiring
- To design overhead and underground distribution lines, substations and illumination

Course Outcomes: After Completion of this course, student will be able to

- Understand the design considerations of electrical installations.
- Design electrical installation for buildings and small industries.
- Identify and design the various types of light sources for different applications.

UNIT - I

Design Considerations of Electrical Installations: Electric Supply System, Three phase four wire distribution system, Protection of Electric Installation against over load, short circuit and Earth fault, Earthing, General requirements of electrical installations, testing of installations, Indian Electricity rules, Neutral and Earth wire, Types of loads, Systems of wiring, Service connections , Service Mains, Sub-Circuits, Location of Outlets, Location of Control Switches, Location of Main Board and Distribution board, Guide lines for Installation of Fittings, Load Assessment, Permissible voltage drops and sizes of wires, estimating and costing of Electric installations.

UNIT - II

Electrical Installation for Different Types of Buildings and Small Industries: Electrical installations for residential buildings – estimating and costing of material, Electrical installations for commercial buildings, Electrical installations for small industries.

UNIT - III

Overhead and Underground Transmission and Distribution Lines: Introduction, Supports for transmission lines, Distribution lines – Materials used, Underground cables, Mechanical Design of overhead lines, Design of underground cables.

UNIT - IV

Substations: Introduction, Types of substations, Outdoor substation – Pole mounted type, Indoor substations – Floor mounted type.

UNIT - V

Design of Illumination Schemes: Introduction, Terminology in illumination, laws of illumination, various types of light sources, Practical lighting schemes LED, CFL and OCFL differences.

Text Books:

1. “K. B. Raina, S. K. Bhattacharya”, “Electrical Design Estimating and Costing”, New Age International Publisher, 2010.
2. “Er. V. K. Jain, Er. Amitabh Bajaj”, “Design of Electrical Installations”, University Science Press.

Reference Books:

1. Code of practice for Electrical wiring installations,(System voltage not exceeding 650 volts), Indian Standard Institution, IS: 732-1983.
2. Guide for Electrical layout in residential buildings, Indian Standard Institution, IS: 4648-1968.
3. Electrical Installation buildings Indian Standard Institution, IS: 2032.
4. Code of Practice for selection, Installation of Maintenance of fuse (voltage not exceeding 650 V), Indian Standard Institution, IS: 3106-1966.
5. Code of Practice for earthling, Indian Standard Institution, IS: 3043-1966.
6. Code of Practice for Installation and Maintenance of induction motors, Indian Standard Institution, IS: 900-1965.
7. Code of Practice for electrical wiring, Installations (system voltage not exceeding 650 Volts), Indian Standard Institution, IS: 2274-1963.
8. “Gupta J. B., Katson, Ludhiana”, “Electrical Installation, estimating and costing”, S. K. Kataria and sons, 2013.

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
ENERGY STORAGE SYSTEMS
(OPEN ELECTIVE – II)

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: EE622OE	**3**	**0**	**0**	**3**

Prerequisite: Electro chemistry
Course Objective:

- To enable the student to understand the need for energy storage, devices and technologies available and their applications

Course Outcomes: After completion of this course, the student will be able to

- analyze the characteristics of energy from various sources and need for storage
- classify various types of energy storage and various devices used for the purpose
- Identify various real time applications.

UNIT - I
Electrical Energy Storage Technologies: Characteristics of electricity, Electricity and the roles of EES, High generation cost during peak-demand periods, Need for continuous and flexible supply, Long distance between generation and consumption, Congestion in power grids, Transmission by cable.

UNIT - II
Needs for Electrical Energy Storage: Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT - III
Features of Energy Storage Systems: Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES),Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2),Synthetic natural gas (SNG).

UNIT - IV
Types of Electrical Energy Storage systems: Electrical storage systems, Double-layer capacitors (DLC) ,Superconducting magnetic energy storage (SMES),Thermal storage systems ,Standards for EES, Technical comparison of EES technologies.

UNIT - V

Applications: Present status of applications, Utility use (conventional power generation, grid operation & service) , Consumer use (uninterruptable power supply for large consumers), New trends in applications ,Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management and control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems , Aggregating EES systems and distributed generation (Virtual Power Plant), Battery SCADA– aggregation of many dispersed batteries.

Text Books:

1. "James M. Eyer, Joseph J. Iannucci and Garth P. Corey ", "Energy Storage Benefits and Market Analysis", Sandia National Laboratories, 2004.
2. The Electrical Energy Storage by IEC Market Strategy Board.

Reference Book:

1. "Jim Eyer, Garth Corey", Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
INTRODUCTION TO MECHATRONICS
(OPEN ELECTIVE – II)

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: EE623OE	**3**	**0**	**0**	**3**

Pre-requisites: Basic Electronics Engineering

Course Objectives:

- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Course Outcomes: At the end of the course, the student will be able to, Model, analyze and control engineering systems. Identify sensors, transducers and actuators to monitor and control the behavior of a process or product. Develop PLC programs for a given task. Evaluate the performance of mechatronic systems.

UNIT – I

Introduction: Definition – Trends - Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface , Simulation) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.

Signal Conditioning : Introduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering

UNIT – II

Precision Mechanical Systems : Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.

Electronic Interface Subsystems : TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

UNIT – III

Electromechanical Drives : Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

Microcontrollers Overview : 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C (LED Blinking, Voltage measurement using ADC).

UNIT – IV

Programmable Logic Controllers : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

UNIT – V

Programmable Motion Controllers : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

TEXT BOOKS:

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson.
2. Introduction to Mechatronics / Appukuttan /Oxford

REFERENCE BOOKS:

1. Mechatronics Principles concepts & Applications / N.P.Mahalik/ Mc Graw Hill
2. "Designing Intelligent Machines". open University, London.

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
ENTREPRENEUR RESOURCE PLANNING
(OPEN ELECTIVE – III)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: EE831OE	**3**	**0**	**0**	**3**

(Students must read text book. Faculty is free to choose any other cases)

Course Objectives: It enables the student to understand the foundations of Enterprise planning and ERP System Options.

Course Outcome: The student understands the challenges in implementation of ERP system, ERP System Implementation options, and functional modules of ERP.

1. Introduction to ERP- Foundation for Understanding ERP systems-Business benefits of ERP-The challenges of implementing ERP system-ERP modules and Historical Development.

Case: Response top RFP for ban ERP system (Mary Sumner).

2. ERP system options & Selection methods-Measurement of project Inpact-information Technology Selection-ERP proposal evaluation-Project Evaluation Technique.(David L. olson).

Case: Atlantic Manufacturing (Mary Sumner).

3. ERP system Installation Options- IS/IT Management results-Risk Identification analysis-System Projects- Demonstration of the system-Failure method-system Architecture & ERP (David L. Olson)

Case: Data Solutions & Technology Knowledge (Mary Sumner).

4. ERP - sales and Marketing- Management control process in sales and marketing - ERP customer relationship management - ERP systems- Accounting & Finance control processes. Financial modules in ERP systems.

Case: Atlantic manufacturing (Mary Sumner).

5. ERP – Production and Material Management-Control process on production and manufacturing - Production module in ERP- supply chain Management & e-market place-e-business & ERP-e supply chain & ERP- Future directions for ERP.

Case: HR in Atlantic manufacturing. (Mary Sumner).

UNIT - I

ERP and Technology: Introduction – Related Technologies – Business Intelligence – E-Commerce and E Business – Business Process Reengineering – Data Warehousing – Data Mining – OLAP – Product life Cycle management – SCM – CRM

UNIT - II

ERP Implementation: Implementation Challenges – Strategies – Life Cycle – Pre-implementation Tasks –Requirements Definition – Methodologies – Package selection –

Project Teams –Process Definitions – Vendors and Consultants – Data Migration – Project management – Post Implementation Activities.

UNIT - III

ERP In Action & Business Modules: Operation and Maintenance – Performance – Maximizing the ERP System – Business Modules – Finance – Manufacturing – Human Resources – Plant maintenance –Materials Management – Quality management – Marketing – Sales, Distribution and service.

UNIT - IV

ERP Market: Marketplace – Dynamics – SAP AG – Oracle – PeopleSoft – JD Edwards – QAD Inc –SSA Global – Lawson Software – Epicor – Intutive.

UNIT - V

Enterprise Application Integration – ERP and E-Business – ERP II – Total quality management – Future Directions – Trends in ERP.

TEXT BOOKS:

1. Alexis Leon, “ERP DEMYSTIFIED”, Tata McGraw Hill, Second Edition, 2008.
2. Mary Sumner, “Enterprise Resource Planning”, Pearson Education, 2007.

REFERENCE BOOKS:

1. Jim Mazzullo, “SAP R/3 for Everyone”, Pearson, 2007.
2. Jose Antonio Fernandz, “The SAP R /3 Handbook”, Tata McGraw Hill, 1998.
3. Biao Fu, “SAP BW: A Step-by-Step Guide”, First Edition, Pearson Education, 2003.

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
MANAGEMENT INFORMATION SYSTEM (MIS)
(OPEN ELECTIVE – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: EE832OE	**3 0 0 3**

Course Objective:

- To provide the basic concepts of Enterprise Resource Planning and Management of Information System.
- Explain to students why information systems are so important today for business and management;
- Evaluate the role of the major types of information systems in a business
- Assess the impact of the Internet and Internet technology on business-electronic commerce and electronic business;
- Identify the major management challenges to building and using information systems and learn how to find appropriate solutions to those challenges

Course Outcomes: The completion of the subject, the student will be able to

- Understand the usage of MIS in organizations and the constituents of the MIS
- Understand the classifications of MIS, understanding of functional MIS and the different functionalities of these MIS. This would be followed by case study on Knowledge management.
- Assess the requirement and stage in which the organization is placed. Nolan model is expected to aid such decisions
- Learn the functions and issues at each stage of system development. Further different ways in which systems can be developed are also learnt.

UNIT – I

Introduction to IS Models and Types of Information systems: – Nolan Stage Hypothesis, IS Strategic Grid, Wards Model, Earl's Multiple Methodology, Critical Success Factors, Soft Systems Methodology, Socio-Technical Systems Approach (Mumford), System Develop Life Cycle, Prototype and End User Computing, Application Packages, Outsourcing, Deciding Combination of Methods. Types of Information Systems

UNIT – II

IS Security, Control and Audit– System Vulnerability and Abuse, business value of security and control, Need for Security, Methods of minimizing risks IS Audit, ensuring system quality.

UNIT – III

Induction to ERP: Overview of ERP, MRP, MRPII and Evolution of ERP, Integrated Management Systems, Reasons for the growth of ERP, Business Modeling, Integrated Data

Model, Foundations of IS in Business, Obstacles of applying IT, ERP Market- ERP Modules: Finance, Accounting Systems, Manufacturing and Production Systems, Sales and Distribution Systems, , Human Resource Systems, Plant Maintenance System, Materials Management System, Quality Management System, ERP System Options and Selection, ERP proposal Evaluation.

UNIT – IV

Benefits of ERP: Reduction of Lead Time, On-Time Shipment, Reduction in Cycle Time, Improved Resource Utilisation, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design Making Capabilities.

UNIT – V

ERP Implementation and Maintenance: Implementation Strategy Options, Features of Successful ERP Implementation, Strategies to Attain Success, User Training, Maintaining ERP & IS**.** Case Studies.

TEXT BOOKS:

1. Gordon B. Davis & Margrethe H. Olson: Management Information Systems, TMH, 2009.
2. C Laudon and Jane P. Laudon, et al: Management Information Systems, Pearson Education, 2009.
3. Alexis Leon: ERP (Demystified), 5/E, Tata McGraw-Hill, 2009.
4. C. S. V. Murthy: Management Information System, Himalaya, 2009
5. James A. Obrein: Management Information Systems, TMH, 2009
6. David L Olson: Managerial Issues of Enterprise Resource Planning Systems, McGraw Hill, International Edition-2009.
7. Rainer, Turban, Potter: Introduction to Information Systems, WILEY-India, 2009.
8. Vaman, ERP in Practice, TMH, 2009

REFERENCE BOOKS:

1. Dharminder and Sangeetha: Management Information Systems, Excel, 2009
2. Gerald V. Post, David L Anderson: Management Information Systems, Irvin McGraw Hill, 2009.
3. Monk: Concepts in ERP, Cengage, 2009
4. Olson: Managerial Issues of ERO, TMH, 2009
5. Motiwala: Enterprise Resource Planning, Pearson 2009
6. Miller: MIS—Cases, Pearson, 2009

B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
ORGANIZATIONAL BEHAVIOUR
(OPEN ELECTIVE – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: EE833OE	**3 0 0 3**

Course Objective:

- To provide the students with the conceptual framework and the theories underlying Organisational Behaviour.

Course Outcomes: Upon the completion of the subject, the student will be able to

- Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour.
- Assess the potential effects of organizational level factors (such as structure, culture and change) on organizational behaviour.
- Critically evaluate the potential effects of important developments in the external environment (such as globalization and advances in technology) on organizational behaviour.
- Analyse organizational behavioural issues in the context of organizational behaviour theories, models and concepts.

UNIT – I

Introduction to OB - Definition, Nature and Scope –Environmental and organizational context – Impact of IT, globalization, Diversity, Ethics, culture, reward systems and organizational design on Organisational Behaviour. Cognitive Processes-I : Perception and Attribution: Nature and importance of Perception – Perceptual selectivity and organization - Social perception – Attribution Theories – Locus of control –Attribution Errors –Impression Management.

UNIT – II

Cognitive Processes-II: Personality and Attitudes - Personality as a continuum – Meaning of personality - Johari Window and Transactional Analysis - Nature and Dimension of Attitudes – Job satisfaction and organisational commitment-Motivational needs and processes- Work-Motivation Approaches Theories of Motivation- Motivation across cultures - Positive organizational behaviour: Optimism – Emotional intelligence – Self-Efficacy.

UNIT – III

Dynamics of OB-I: Communication – types - interactive communication in organizations – barriers to communication and strategies to improve the follow of communication - Decision Making: Participative decision making techniques – creativity and group decision making . Dynamics of OB –II Stress and Conflict: Meaning and types of stress –Meaning and types of conflict - Effect of stress and intra-individual conflict - strategies to cope with stress and conflict.

UNIT – IV

Dynamics of OB –III Power and Politics: Meaning and types of power – empowerment - Groups Vs. Teams – Nature of groups –dynamics of informal groups – dysfunctions of groups and teams – teams in modern work place.

UNIT – V

Leading High performance: Job design and Goal setting for High performance- Quality of Work Life- Socio technical Design and High performance work practices - Behavioural performance management: reinforcement and punishment as principles of Learning –Process of Behavioural modification - Leadership theories - Styles, Activities and skills of Great leaders.

TEXT BOOKS:

1. Luthans, Fred: Organizational Behaviour 10/e, McGraw-Hill, 2009
2. Mc Shane: Organizational Behaviour, 3e, TMH, 2008
3. Nelson: Organizational Behaviour, 3/e, Thomson, 2008.
4. New strom W. John& Davis Keith, Organisational Behaviour-- Human Behaviour at Work, 12/e, TMH, New Delhi, 2009.
5. Pierce and Gardner: Management and Organisational Behaviour: An Integrated perspective, Thomson, 2009.
6. Robbins, P. Stephen, Timothy A. Judge: Organisational Behaviour, 12/e, PHI/Pearson, New Delhi, 2009.
7. Pareek Udai: Behavioural Process at Work:, Oxford & IBH, New Delhi, 2009.

REFERENCE BOOKS:

1. Schermerhorn: Organizational Behaviour 9/e, Wiley, 2008.
2. Hitt: Organizational Behaviour, Wiley, 2008
3. Aswathappa: Organisational Behaviour, Himalaya, 2009
4. Mullins: Management and Organisational Behaviour, Pearson, 2008.
5. McShane, Glinow: Organisational Behaviour--Essentials, TMH, 2009.
6. Ivancevich: Organisational Behaviour and Management, 7/e, TMH, 2008.

B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING
ELECTRONIC MEASUREMENTS AND INSTRUMENTATION
(Open Elective – I)

B.Tech. III Year I Sem.	**L T P C**
Course Code: EI511OE	**3 0 0 3**

Prerequisite: Nil

Course Objectives:
- It provides an understanding of various measuring systems functioning and metrics for performance analysis.
- Provides understanding of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
- Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

Course Outcomes: On completion of this course student can be able to
- Identify the various electronic instruments based on their specifications for carrying out a particular task of measurement.
- Measure various physical parameters by appropriately selecting the transducers.
- Use various types of signal generators, signal analyzers for generating and analyzing various real-time signals.

UNIT - I
Block Schematics of Measuring Systems: Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag ;Measuring Instruments: DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

UNIT - II
Signal Analyzers: AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, Video Signal Generators, and Specifications

UNIT - III

Oscilloscopes: CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications.

Special Purpose Oscilloscopes: Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.

UNIT - IV

Transducers: Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers.

UNIT - V

Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

Measurement of Physical Parameters: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure – High Pressure, Vacuum level, Temperature -Measurements, Data Acquisition Systems.

TEXT BOOKS:

1. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.
2. Electronic Instrumentation: H.S.Kalsi – TMH, 2nd Edition 2004.

REFERENCE BOOKS:

1. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
2. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI 5th Edition 2003.
3. Electronic Measurements and Instrumentation: B.M. Oliver, J.M. Cage TMH Reprint 2009.
4. Industrial Instrumentation: T.R. Padmanabham Springer 2009.

B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING
INDUSTRIAL ELECTRONICS
(Open Elective – II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: EI621OE	**3 0 0 3**

Pre-requisites: Basic Electrical and Electronics Engineering or Electronic Devices and Circuits.

UNIT - I

DC Amplifiers: Need for DC amplifiers, DC amplifiers - Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Differential amplifiers - Chopper stabilization, Operational Amplifiers, Ideal specifications of Operational Amplifiers, Instrumentation Amplifiers.

UNIT - II

Regulated Power Supplies: Block diagram, Principle of voltage regulation, Series and Shunt type Linear Voltage Regulators, Protection Techniques - Short Circuit, Over voltage and Thermal Protection.

Switched Mode & IC Regulators: Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators - Current boosting .

UNIT - III

SCR and Thyristor: Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors - Classes A, B, C, D, E and F, Ratings of SCR.

UNIT - IV

Applications of SCR in Power Control: Static circuit breaker, Protection of SCR, Inverters - Classification, Single Phase inverters, Converters –single phase Half wave and Full wave.

DIAC, TRIAC and Thyristor Applications: Chopper circuits – Principle, methods and Configurations, DIAC AND TRIAC, TRIACS – Triggering modes, Firing Circuits, Commutation.

UNIT - V

Industrial Applications - I: Industrial timers -Classification, types, Electronic Timers – Classification, RC and Digital timers, Time base Generators.

Electric Welding Classification, types and methods of Resistance and ARC wielding, Electronic DC Motor Control.

Industrial Applications - II: High Frequency heating – principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating – principle, material properties, Electrodes and their Coupling to RF generator, Thermal losses and Applications. Ultrasonics – Generation and Applications.

TEXTBOOKS:

1. Industrial and Power Electronics – G. K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003.
2. Integrated Electronics – J. Millman and C.C Halkias, McGraw Hill, 1972.

REFERENCE BOOKS:

1. Electronic Devices and circuits – Theodore. H. Bogart, Pearson Education, 6^{th} Edn., 2003.
2. Thyristors and applications – M. Rammurthy, East-West Press, 1977.3.
3. Integrated Circuits and Semiconductor Devices – Deboo and Burroughs, ISE

B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING
SENSORS AND TRANSDUCERS
(Open Elective – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: EI831OE	**3 0 0 3**

Pre-requisites: Nil

Course Objectives: To enable the students to select and design suitable instruments to meet the requirements of industrial applications and various transducers used for the measurement of various physical quantities and the following:

- Various types of Sensors & Transducers and their working principle
- Resistive, Capacitive and Inductive transducers
- Some of the miscellaneous transducers
- Characteristics of transducers

Course Outcomes: Upon completion of this course the student shall be able to understand the working of basic sensors and transducers used in any industries.

UNIT – I

Measurements and Instrumentation of Transducers: Measurements – Basic method of measurement – Generalized scheme for measurement systems – Units and standards – Errors – Classification of errors, error analysis – Statistical methods – Sensor – Transducer – Classification of transducers – Basic requirement of transducers.

UNIT – II

Characteristics of Transducers: Static characteristics – Dynamic characteristics – Mathematical model of transducer – Zero, first order and second order transducers – Response to impulse, step, ramp and sinusoidal inputs

UNIT – III

Resistive Transducers: Potentiometer –Loading effect – Strain gauge – Theory, types, temperature compensation – Applications – Torque measurement – Proving Ring – Load Cell – Resistance thermometer – Thermistors materials – Constructions, Characteristics – Hot wire anemometer

UNIT – IV

Inductive and Capacitive Transducer: Self inductive transducer – Mutual inductive transducers – Linear Variable Differential Transformer – LVDT Accelerometer – RVDT – Synchros – Microsyn – Capacitive transducer – Variable Area Type – Variable Air Gap type – Variable Permittivity type – Capacitor microphone.

UNIT – V

Miscellaneous Transducers: Piezoelectric transducer – Hall Effect transducers – Smart sensors – Fiber optic sensors – Film sensors – MEMS – Nano sensors, Digital transducers

TEXT BOOKS:

1. Sawhney. A.K, "A Course in Electrical and Electronics Measurements and Instrumentation", 18th Edition, Dhanpat Rai & Company Private Limited, 2007.
2. Patranabis. D, "Sensors and Transducers", Prentice Hall of India, 2003.

REFERENCE BOOKS:

1. Renganathan. S, "Transducer Engineering", Allied Publishers, Chennai, 2003.
2. Doebelin. E.A, "Measurement Systems – Applications and Design", Tata McGraw Hill, New York, 2000.
3. John. P, Bentley, "Principles of Measurement Systems", III Edition, Pearson Education, 2000.
4. Murthy. D. V. S, "Transducers and Instrumentation", Prentice Hall of India, 2001.
5. Sensor Technology Hand Book – Jon Wilson, Newne 2004.
6. Instrument Transducers – An Introduction to their Performance and design – by Herman K. P. Neubrat, Oxford University Press.

B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING
PC BASED INSTRUMENTATION
(Open Elective – III)

	L	T	P	C
B.Tech. IV Year II Sem.				
Course Code: EI832OE	**3**	**0**	**0**	**3**

Course Objective: To introduce interfacing data acquisition systems to PC and introducing PLCs with their classification, operation, and programming.

UNIT – I

Introduction to Computer Instrument Communication: Personal Computer, overview of operating System, I/O Ports, Plug-in-slots, PCI bus, Operators Interface. Computer Interfacing for Data Acquisition and Control – Interfacing Input Signals, Output system with continuous actuators. Data Acquisition and Control using Standard Cards: PC expansion systems, Plug-in Data Acquisition Boards; Transducer to Control room, Backplane bus – VXI.

UNIT – II

Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies, and isolators.

Basic PLC programming: Programming On-Off inputs/ outputs. Creating Ladder diagrams Basic PLC functions PLC Basic Functions, register basics, timer functions, counter functions.

UNIT – III

PLC intermediate and advanced functions: Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Analog PLC operation, networking of PLC.

UNIT – IV

Application of PLC: Controlling of Robot using PLC, PID control of continuous processes, Continuous Bottle-filling system, Batch mixing system, 3-stage air conditioning system, Automatic frequency control of Induction heating

UNIT – V

Related Topics: Alternate programming languages. Auxiliary commands and functions. PLC installation, troubleshooting, and maintenance. Field bus: Introduction, concept. HART protocol: Method of operation, structure, and applications. Smart transmitters, smart valves, and smart actuators.

TEXT BOOKS

1. Programmable Logic Controllers – Principles and Applications, John. W .Webb Ronald A Reis , Fourth edition, Prentice Hall Inc., New Jersey, 1998.
2. Computer Control of Processes – M.Chidambaram. Narosa 2003.

REFERENCES

1. PC Based Instrumentation and Control Third Edition by Mike Tooley ; Elsevier.
2. PC Interfacing and Data Acquisition Techniques for Measurement, Instrumentation, and Control. By Kevin James; Elsevier.
3. Practical Data Acquisition for Instrumentation and Control Systems by John Park and Steve Mackay.
4. Distributed Control Systems, Lukcas M.P, Van Nostrand Reinhold Co., New York, 1986.
5. 5. Programmable Logic Controllers, Second edition, Frank D. Petruzella, Mc Graw Hill, New York, 1997.
6. Programmable Logic Controllers Programming methods and applications-Prentice Hall by John R. Hackworth and Frederick D. Hackworth, Jr.

B.TECH. MECHANICAL ENGINEERING
OPTIMIZATION TECHNIQUES
(Open Elective – I)

B.Tech. III Year I Sem.	**L T/P/D C**
Course Code: **ME511OE**	**3 0/0/0 3**

Prerequisite: Mathematics –I & Mathematics –II
Course Objectives:
- To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming
- Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.
- To explain the concept of Dynamic programming and its applications to project implementation.

Course Outcomes: After completion of this course, the student will be able to
- explain the need of optimization of engineering systems
- understand optimization of electrical and electronics engineering problems
- apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
- apply unconstrained optimization and constrained non-linear programming and dynamic programming
- Formulate optimization problems.

UNIT – I
Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.
Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.
Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

UNIT – II
Linear Programming: Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.
Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.

UNIT – III

Unconstrained Nonlinear Programming: One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method

Unconstrained Optimization Techniques: Univariant method, Powell's method and steepest descent method.

U**NIT – IV**

Constrained Nonlinear Programming: Characteristics of a constrained problem - classification - Basic approach of Penalty Function method - Basic approach of Penalty Function method - Basic approaches of Interior and Exterior penalty function methods - Introduction to convex programming problem.

UNIT – V

Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

TEXT BOOKS:

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4th edition, 2009.
2. H. S. Kasene & K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 2004

REFERENCE BOOKS:

1. George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series in operations research 3rd edition, 2003.
2. H.A. Taha, "Operations Research: An Introduction", 8th Edition, Pearson/Prentice Hall, 2007.
3. Kalyanmoy Deb, "Optimization for Engineering Design – Algorithms and Examples", PHI Learning Pvt. Ltd, New Delhi, 2005.

B.TECH. MECHANICAL ENGINEERING
COMPUTER GRAPHICS
(Open Elective - I)

B.Tech. III Year I Sem.	**L T/P/D C**
Course Code: **ME512OE**	**3 0/0/0 3**

Course Objectives:

- To make students understand about fundamentals of Graphics to enable them to design animated scenes for virtual object creations.
- To make the student present the content graphically.

Course Outcomes:

- Students can animate scenes entertainment.
- Will be able work in computer aided design for content presentation..
- Better analogy data with pictorial representation.

UNIT - I

Introduction: Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices

Output primitives: Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms.

UNIT - II

2-D Geometrical transforms: Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems.

2-D Viewing: The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm.

UNIT - III

3-**D Object representation**: Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-spline curves, Bezier and B-spline surfaces, sweep representations, octrees BSP Trees,

3-D Geometric transformations: Translation, rotation, scaling, reflection and shear transformations, composite transformations, 3-D viewing: Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.

UNIT - IV

Visible surface detection methods: Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods

Illumination Models and Surface rendering Methods: Basic illumination models, polygon rendering methods

UNIT- V

Computer animation: Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications

TEXT BOOKS:

1. "Computer Graphics C version", Donald Hearn and M. Pauline Baker, Pearson education.
2. "Computer Graphics Second edition", Zhigand xiang, Roy Plastock, Schaum's outlines, Tata Mc Graw hill edition.

REFERENCE BOOKS:

1. "Computer Graphics Principles & practice", second edition in C, Foley, Van Dam, Feiner and Hughes, Pearson Education.
2. "Procedural elements for Computer Graphics", David F Rogers, Tata Mc Graw hill, 2nd edition.
3. "Principles of Interactive Computer Graphics", Neuman and Sproul, TMH.
4. "Principles of Computer Graphics", Shalini, Govil-Pai, Springer.
5. "Computer Graphics", Steven Harrington, TMH
6. Computer Graphics, F. S. Hill, S. M. Kelley, PHI.
7. Computer Graphics, P. Shirley, Steve Marschner & Others, Cengage Learning.
8. Computer Graphics & Animation, M. C. Trivedi, Jaico Publishing House.
9. An Integrated Introduction to Computer Graphics and Geometric Modelling, R. Goldman, CRC Press, Taylor&Francis Group.
10. Computer Graphics, Rajesh K.Maurya, Wiley India.

B.TECH. MECHANICAL ENGINEERING
INTRODUCTION TO MECHATRONICS
(Open Elective - I)

B.Tech. III Year I Sem.	**L**	**T/P/D**	**C**
Course Code: **ME513OE**	**3**	**0/0/0**	**3**

Pre-requisites: Basic Electronics Engineering

Course Objectives:
- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Course Outcomes: At the end of the course, the student will be able to, Model, analyze and control engineering systems. Identify sensors, transducers and actuators to monitor and control the behavior of a process or product. Develop PLC programs for a given task. Evaluate the performance of mechatronic systems.

UNIT – I
Introduction: Definition – Trends - Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface , Simulation) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.
Signal Conditioning : Introduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering

UNIT – II
Precision Mechanical Systems : Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.
Electronic Interface Subsystems : TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC’s - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

UNIT – III

Electromechanical Drives : Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

Microcontrollers Overview : 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C (LED Blinking, Voltage measurement using ADC).

UNIT – IV

Programmable Logic Controllers : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

UNIT – V

Programmable Motion Controllers : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

TEXT BOOKS:

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson.
2. Introduction to Mechatronics / Appukuttan /Oxford

REFERENCE BOOKS:

1. Mechatronics Principles concepts & Applications / N.P.Mahalik/ Mc Graw Hill
2. "Designing Intelligent Machines". open University, London.

B.TECH. MECHANICAL ENGINEERING
FUNDAMENTALS OF MECHANICAL ENGINEERING
(Open Elective - I)

B.Tech. III Year I Sem.	**L T/P/D C**
Course Code: **ME514OE**	**3 0/0/0 3**

Pre-Requisites: None
Course Objectives: Understanding of basic principles of Mechanical Engineering is required in various field of engineering.

Course Outcomes: After learning the course the students should be able to
- To understand the fundamentals of mechanical systems.
- To understand and appreciate significance of mechanical engineering in different Fields of engineering.

UNIT - I
Introduction: Prime movers and its types, Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth Law and First law.
Energy: Introduction and applications of Energy sources like Fossil fuels, Nuclear fuels, Hydel, Solar, wind, and bio-fuels, Environmental issues like Global warming and Ozone depletion.

UNIT - II
Properties of gases: Gas laws, Boyle's law, Charle's law, Combined gas law, Gas constant, Relation between Cp and Cv, Various non-flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Poly-tropic process
Properties of Steam: Steam formation, Types of Steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables, steam calorimeters.
Steam Boilers: Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox boiler, functioning of different mountings and accessories.

UNIT - III
Heat Engines: Heat Engine cycle and Heat Engine, working substances, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles.
Internal Combustion Engines: Introduction, Classification, Engine details, four- stroke/ two-stroke cycle Petrol/Diesel engines, Indicated power, Brake Power, Efficiencies.

UNIT - IV
Pumps: Types and operation of Reciprocating, Rotary and Centrifugal pumps, Priming
Air Compressors: Types and operation of Reciprocating and Rotary air compressors, significance of Multistage.

Refrigeration & Air Conditioning: Refrigerant, Vapor compression refrigeration system, vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners.

UNIT - V

Couplings, Clutches and Brakes: Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc).

Transmission of Motion and Power: Shaft and axle, Belt drive, Chain drive, Friction drive, Gear drive.

Engineering Materials: Types and applications of Ferrous & Nonferrous metals, Timber, Abrasive material, silica, ceramics, glass, graphite, diamond, plastic and polymer.

TEXT BOOKS:

1. Basic Mechanical Engineering / Pravin Kumar/ Pearson
2. Introduction to Engineering Materials / B.K. Agrawal/ Mc Graw Hill

REFERENCE BOOKS:

1. Fundamental of Mechanical Engineering/ G.S. Sawhney/PHI
2. Thermal Science and Engineering / Dr. D.S. Kumar/ Kataria

B.TECH. MECHANICAL ENGINEERING
WORLD CLASS MANUFACTURING
(Open Elective – II)

B.Tech. III Year II Sem.	**L T/P/D C**
Course Code: **ME621OE**	**3 0/0/0 3**

Pre-requisites: None

Course Objectives: To understand the concept of world class manufacturing, dynamics of material flow, OPT and Lean manufacturing.

Course Outcomes: Students should be able to compare the existing industry with WCM companies.

UNIT - I
Information Age and Global Competitiveness: The Emergence of Information Age; Competition and Business Challenge; Operating Environment; Globalization and International Business; Global Competitiveness and Manufacturing Excellence; World Class Manufacturing and Information Age Competition; Manufacturing Challenges, Problems in Manufacturing Industry.

UNIT - II
Cutting Edge Technology: Value Added Engineer in - Hall's Framework; Schonberger's Framework of WCM; Gunn's Model; Maskell's Model.
Philosophy of World Class Manufacturing: Evolution of WCM; Ohno's View on WCM; Principles and Practices; Quality in WCM; Deming's & Shingo's Approach to Quality Management; Culmination of WCM.

UNIT - III
System and Tools for World Class Manufacturing: The Integration Imperative; Overview of Systems and Tools; Information Management Tools - Product and Process Design Tools, Bar Code Systems, Kanban: A Lean Production Tool, Statistical Quality Control (SQC), Material Processing, and Handling Tools; Assessment of Manufacturing Systems and Tools.
Labor and HRD Practices in WCM: Human Resource Dimensions in WCM; Morale and Teamwork; High Employee Involvement; Cross Functional Teams; Work Study Methods; Human Integration Management.

UNIT - IV
Competitive Indian Manufacturing: Manufacturing Performance and Competitiveness - Indian Firms: Manufacturing Objectives and Strategy; Usage of Management Tools and Technologies; Manufacturing Management Practices; IT Infrastructure and Practices; Strategic Intent Framework; Breadth and Integration of IT Infrastructure.

Globalization and World Class Manufacturing: Generic Manufacturing Strategies for Information Age; Planning Methodology and Issues in Strategic Planning of WCM; Performance Measurement - PO-P System, TOPP System and Ambite System.

UNIT - V

The Future WCM: Manufacturing Strategy: Futile Search for an Elusive Link, Manufacturing Strategic Intent Classification, Translating Intent into Action.
Case Studies: Accelerated Fermentation Process – Using World Class Enzymes; Birla Cellulosic Kharach.

TEXT BOOKS:

1. World Class Manufacturing- A Strategic Perspective / BS Sahay, KBS Saxena & Ashish Kumar / Macmillan
2. Making Common Sense Common Practice – Models for Manufacturing Excellence / Ron Moore / Butter Worth Heinemann

REFERENCE BOOKS:

1. Managing Technology and Innovation for Competitive Advantage / V. K. Narayanan/ Prentice Hall
2. World Class Manufacturing - The Lesson of Simplicity / Richard J Schonberger / Free Press

B.TECH. MECHANICAL ENGINEERING
FUNDAMENTALS OF ROBOTICS
(Open Elective – II)

B.Tech. III Year II Sem.	**L T/P/D C**
Course Code: **ME622OE**	**3 0/0/0 3**

Course Objectives: The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

- Make the students acquainted with the theoretical aspects of Robotics
- Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
- Make the students to understand the importance of robots in various fields of engineering.
- Expose the students to various robots and their operational details.

Course outcomes: After this completion of this course, the student should be able to

- Understand the basic components of robots.
- Differentiate types of robots and robot grippers.
- Model forward and inverse kinematics of robot manipulators.
- Analyze forces in links and joints of a robot.
- Programme a robot to perform tasks in industrial applications.
- Design intelligent robots using sensors.

UNIT - I

Robotics-Introduction-classification with respect to geometrical configuration (Anatomy), Controlled system & chain type: Serial manipulator & Parallel Manipulator. Components of Industrial robotics-precession of movement-resolution, accuracy & repeatability-Dynamic characteristics- speed of motion, load carrying capacity & speed of response-Sensors-Internal sensors: Position sensors,& Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, & Force or Torque sensors.

UNIT - II

Grippers - Mechanical Gripper-Grasping force-Engelberger-g-factors-mechanisms for actuation, Magnetic gripper , vaccume cup gripper-considerations in gripper selection & design . Industrial robots specifications. Selection based on the Application .

UNIT - III

Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix, D-H transformation matrix, D-H method of assignment of frames. Direct and Inverse Kinematics for industrial robots. Differential Kinematics for planar serial robots

UNIT - IV

Trajectory planning: Joint space scheme- Cubic polynomial fit-Obstacle avoidance in operation space-cubic polynomial fit with via point, bleding scheme. Introduction Cartesian space scheme.

Control- Interaction control, Rigid Body mechanics, Control architecture- position, path velocity, and force control systems, computed torque control, adaptive control, and Servo system for robot control.

UNIT - V

Programming of Robots and Vision System-Lead through programming methods- Teach pendent- overview of various textual programming languages like VAL etc.

Machine (robot) vision:

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Robotics / John J. Craig/ Pearson

REFERENCE BOOKS:

1. Theory of Applied Robotics /Jazar/Springer.
2. Robotics / Ghosal / Oxford

B.TECH. MECHANICAL ENGINEERING
FABRICATION PROCESSES
(Open Elective –II)

B.Tech. III Year II Sem.	**L T/P/D C**
Course Code: **ME623OE**	**3 0/0/0 3**

Course Objectives: Understand the philosophies of various Manufacturing process.

Course Outcomes: For given product, one should be able identify the manufacturing process.

UNIT – I
Casting: Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.
Methods of Melting - Crucible melting and cupola operation – Defects in castings;
Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

UNIT – II
Welding: Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.
Inert Gas Welding - TIG Welding, MIG welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

UNIT – III
Hot working, cold working, strain hardening, recovery, recrystallisation, and grain growth.
Stamping, forming, and other cold working processes. Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning. Types of presses and press tools. Forces and power requirement in the above operations.

UNIT – IV
Extrusion of Metals: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

UNIT – V

Forging Processes: Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

TEXT BOOKS:

1. Manufacturing Technology / P.N. Rao / Mc Graw Hill
2. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson.

REFERENCE BOOKS:

1. Metal Casting / T.V Ramana Rao / New Age
2. Métal Fabrication Technology/ Mukherjee/PHI

B.TECH. MECHANICAL ENGINEERING
TOTAL QUALITY MANAGEMENT
(Open Elective - III)

B.Tech. IV Year II Sem.	**L T/P/D C**
Course Code: **ME831OE**	**3 0/0/0 3**

UNIT - I

Introduction, The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems.

Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT -II

Customer Focus and Satisfaction: Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships.

Bench Marking: Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure, pitfalls of bench marketing.

UNIT- III

Organizing for TQM: The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Stratification, check sheet, Scatter diagram, lshikawa diagram, paneto diagram, Kepner &Tregoe Methodology.

UNIT- IV

The Cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

UNIT -V

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQC Q- 90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

TEXT BOOK:

1. Total Quality Management / Joel E. Ross/Taylor and Franscis Limited
2. Total Quality Management/P. N. Mukherjee/PHI

REFERENCE BOOKS:

1. Beyond TQM / Robert L.Flood
2. Statistical Quality Control / E.L. Grant.
3. Total Quality Management:A Practical Approach/H. Lal
4. Quality Management/Kanishka Bedi/Oxford University Press/2011
5. Total Engineering Quality Management/Sunil Sharma/Macmillan

B.TECH. MECHANICAL ENGINEERING
INDUSTRIAL SAFETY, HEALTH, AND ENVIRONMENTAL ENGINEERING
(Open Elective - III)

B.Tech. IV Year II Sem.	**L T/P/D C**
Course Code: ME832OE	**3 0/0/0 3**

Pre-requisites: None

Course Objectives:
- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
- To familiarize students with powers of inspectorate of factories.
- To help students to learn about Environment act 1948 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.

Course Outcomes:
- To list out important legislations related to Health , Safety and Environment
- To list out requirements mentioned in factories act for the prevention of accidents. To understand the health and welfare provisions given in factories act.
- To understand the statutory requirements for an Industry on registration, license and its renewal.
- To prepare onsite and offsite emergency plan.

UNIT - I

Factories Act – 1948 : Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Telangana Factories Rules 1950 under Safety and health chapters of Factories Act 1948

UNIT II

Environment Act – 1986: General Powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.

UNIT - III

Manufacture, Storage and Import of Hazardous

Chemical Rules 1989 : Definitions – duties of authorities – responsibilities of occupier – notification of major accidents –information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets.

UNIT - IV

Other Acts and Rules : Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management7 and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cyclinder rules-Explosives Act 1983-Pesticides Act

UNIT - V

International Acts and Standards: Occupational Safety and Health act of USA (The Williames-Steiger Act of 1970) – Helath and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).

TEXT BOOKS:

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
3. Industrial Safety, Health and Environment Management Systems / R. K. Jain, Sunil S. Rao / Khanna Publishers.

REFERENCE BOOKS:

1. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt. Ltd., New Delhi.
2. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
3. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.
4. The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.
5. The manufacture, storage, and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

B.TECH. MECHANICAL ENGINEERING
BASICS OF THERMODYNAMICS
(Open Elective - III)

B.Tech. IV Year II Sem.	**L**	**T/P/D**	**C**
Course Code: **ME833OE**	**3**	**0/0/0**	**3**

Pre-requisite: Engineering Chemistry and Physics

Course Objective: To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics to engineering applications

Course Outcomes: At the end of the course, the student should be able to:
- Understand and differentiate between different thermodynamic systems and processes
- Understand and apply the laws of Thermodynamics to different types of systems undergoing various processes
- Understand and analyze the Thermodynamic cycles

UNIT – I

Introduction: Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle, Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility

UNIT - II

Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

UNIT – III

First and Second Laws of Thermodynamics: First Law: Cycle and Process, Specific Heats (cp and cv), Heat interactions in a Closed System for various processes, Limitations of First Law, Concept of Heat Engine (H.E.) and Reversed H.E. (Heat Pump and Refrigerator), Efficiency/COP, Second Law: Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, Statement of Clausius Inequality, Property of Entropy, T-S and P-V Diagrams

UNIT - IV

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas const.

Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, , Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation ,Psychrometric chart.

UNIT - V

Power Cycles: Otto, Diesel cycles - Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis

Refrigeration Cycles: Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

TEXT BOOKS:

1. Basic Engineering Thermodynamics / PK Nag / Mc Graw Hill
2. Engineering Thermodynamics / chattopadhyay/ Oxford

REFERENCE BOOKS:

1. Thermodynamics for Engineers / Kenneth A. Kroos , Merle C. Potter/ Cengage
2. Thermodynamics /G.C. Gupta /Pearson

B.TECH. MECHANICAL ENGINEERING
RELIABILITY ENGINEERING
(Open Elective - III)

B.Tech. IV Year II Sem.	**L**	**T/P/D**	**C**
Course Code: **ME834OE/AM852PE/EI862PE**	**3**	**0/0/0**	**3**

Prerequisite: Mathematics III

Course Objectives:
- To introduce the basic concepts of reliability, various models of reliability
- To analyze reliability of various systems
- To introduce techniques of frequency and duration for reliability evaluation of repairable systems.

Course Outcomes: After completion of this course, the student will be able to
- model various systems applying reliability networks
- evaluate the reliability of simple and complex systems
- estimate the limiting state probabilities of repairable systems
- apply various mathematical models for evaluating reliability of irrepairable systems

UNIT – I
Basic Probability Theory: Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.
Definition of Reliability: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time Between Failures.

UNIT – II
Network Modeling and Evaluation Of Simple Systems: Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems- Series-Parallel systems- Partially redundant systems- Examples.
Network Modeling and Evaluation of Complex systems: Conditional probability method- tie set, Cutset approach- Event tree and reduced event tree methods- Relationships between tie and cutsets- Examples.

UNIT – III
Time Dependent Probability: Basic concepts- Reliability function f(t). F(t), R(t) and h(t) - Relationship between these functions.

Network Reliability Evaluation Using Probability Distributions: Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

UNIT – IV

Discrete Markov Chains: Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Examples

Continuous Markov Processes: Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems

UNIT – V

Frequency and Duration Techniques: Frequency and duration concepts, application to multi state problems, Frequency balance approach.

Approximate System Reliability Evaluation: Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

TEXT BOOKS:

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press, 1983.
2. E. Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited, 2002.

REFERENCE BOOK:

1. K. K. Agarwal, Reliability Engineering-Kluwer Academic Publishers, 1993**.**

B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)
FABRICATION PROCESSES
(Open Elective - I)

B.Tech. III Year I Sem.	**L T P C**
Course Code: NT511OE	**3 0 0 3**

Course Objectives: Understand the philosophies of various Manufacturing process.

Course Outcomes: For given product, one should be able identify the manufacturing process.

UNIT – I

Casting: Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.

Methods of Melting - Crucible melting and cupola operation – Defects in castings;

Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

UNIT – II

Welding: Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

Inert Gas Welding - TIG Welding, MIG welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

UNIT – III

Hot working, cold working, strain hardening, recovery, recrystallisation, and grain growth.

Stamping, forming, and other cold working processes. Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning. Types of presses and press tools. Forces and power requirement in the above operations.

UNIT – IV

Extrusion of Metals: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

UNIT – V

Forging Processes: Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

TEXT BOOKS:

1. Manufacturing Technology / P.N. Rao / Mc Graw Hill
2. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson.

REFERENCE BOOKS:

1. Metal Casting / T. V Ramana Rao / New Age
2. Métal Fabrication Technology/ Mukherjee/PHI

B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)
NON DESTRUCTIVE TESTING METHODS
(Open Elective - I)

	L	T	P	C
B.Tech. III Year I Sem.				
Course Code: NT512OE	**3**	**0**	**0**	**3**

Course overview: The aim is to introduce students the overview of the non destructive testing methods of materials. The course covers NDE, Ultrasonic, MPI testing of metal parts. It gives an idea about selection of the testing criteria. It briefly describe the thermo-graph and radio graph methods of testing and provide selection properties for different tests.

Course Objectives: This course has the basic idea of the properties of steal and ferrous metals. The objectives aim to:

1. Identify the basic methods of testing.
2. Understand the concept of non destructive testing.
3. Describe the various types of NDT tests carried out on components.
4. Describe ultrasonic method of testing the materials.
5. Analyze the different types of test carried out on components and surfaces.
6. Understand the properties of materials suitable for NDT test.
7. Understand the radiography uses in engineering.

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Course Outcomes: At the end of the course the students are able to:

1. Identify the requirements of testing criteria as per material composition.
2. Understand the theory of non destructive testing methods is used.
3. Determine the type of requirement of non destructive test.
4. Distinguish between the various NDT test as Ultrasonic and Eddy current methods.
5. Understand the properties of radiation used in engineering.
6. Describe the various types of non destructive test used to determine the surface cracks.

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UNIT - I

Overview of NDT - NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, various physical characteristics of materials and their applications in NDT, Visual inspection.

UNIT - II

Surface NDE Methods: Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT - III

Thermography and Eddy Current Testing - Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT - IV

Ultrasonic Testing and Acoustic Emission - Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique IV Principle, AE parameters, Applications

UNIT - V

Radiography - Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

TEXT BOOKS:

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu, Practical Non-Destructive Testing¡¨, Narosa Publishing House, 2009.
2. Ravi Prakash, Non-Destructive Testing Techniques¨, 1st revised edition, New Age International Publishers, 2010

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REFERENCES:

1. ASM Metals Handbook, ¨Non-Destructive Evaluation and Quality Control¨, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier, Handbook of Non-destructive evaluation”, McGraw Hill, New York 2001.

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B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)
FUNDAMENTALS OF ENGINEERING MATERIALS
(Open Elective - I)

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: NT513OE	**3**	**0**	**0**	**3**

Course Overview:
The aim is to introduce students the overview of the properties of materials used in engineering manufacturing process. The course covers basic concept of ferrous, non-ferrous metals and its alloys. It emphasizes on transformation of iron at various temperatures. It briefly describes the heat treatment given to iron and its alloys. It gives the general overview idea of composite materials.

Course Objectives: This course has the basic idea of the properties of steal and ferrous metals. The objectives aim to:

- ~~1.~~ Identify the basic crystalline structure of steal.
- ~~2.~~ Understand the concept of TTT.
- ~~3.~~ Describe the various heat treatment methods to obtain the desired properties.
- ~~4.~~ Describe the composition of carbon contents in steel.
- ~~5.~~ Analyze the different forms of iron obtained during heating of steel.
- ~~6.~~ Understand the properties of non-ferrous alloys.
- ~~7.~~ Understand requirement.

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Course Outcomes: At the end of the course the students are able to:

- ~~3.~~ This subject gives student a technical knowledge about behavior of metals.
- ~~4.~~ Identify the crystalline structure of steel.
- ~~5.~~ Understand the theory of time temperature and transformation.
- ~~6.~~ Determination of different uses of heat treatment in steel.
- ~~7.~~ Distinguish between the various forms of steel.
- ~~8.~~ Understand the properties of non-ferrous alloys.
- ~~9.~~ Describe the various uses of composite materials.

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UNIT – I
Structure of Metals: Crystallography, Miller's indices, Packing Efficiency, Density calculations. Grains and Grain Boundaries. Effect of grain size on the properties. Determination of grain size by different methods. Constitution of Alloys: Necessity of alloying, Types of solid solutions, Hume - Rothery rules, Intermediate alloy phases.

UNIT –II
Phase Diagrams: Construction and interpretation of phase diagrams, Phase rule. Lever rule. Binary phase Diagrams, Isomorphous, Eutectic and Eutectoid transformations with examples.

UNIT – III

Steels: Iron-Carbon Phase Diagram and Heat Treatment: Study of Fe-Fe3C phase diagram. Construction of TTT diagrams. Annealing, Normalizing, Hardening and Tempering of steels, Hardenability. Alloy steels.

UNIT – IV

Cast Irons: Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron. Engineering Materials-III: Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Al-Cu phase diagram, Titanium and its alloys.

UNIT – V

Ceramics, Polymers and Composites: Crystalline ceramics, glasses, cermets: structure, properties and applications. Classification, properties and applications of composites. Classification, Properties and applications of Polymers.

TEXT BOOKS:

1. Material Science and Metallurgy/ Kodgire
2. Essentials of Materials Science and engineering / Donald R. Askeland / Thomson.

REFERENCE BOOKS:

1. Introduction to Physical Metallurgy / Sidney H. Avner.
2. Materials Science and engineering / William and callister.
3. Elements of Material science / V. Rahghavan

B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)
INTRODUCTION TO MATERIALS HANDLING
(Open Elective – II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: NT621OE	**3 0 0 3**

Course Overview

Course covers a systems approach to managing activities associated with traffic, transportation, inventory management, warehousing, packaging, order processing, and materials handling. This course is designed to give students a comprehensive understanding of the issues involved in the design of an industrial production system. It will cover the problems in plant location, product analysis, process design, equipment selection, materials handling, and plant layout.

Course Objectives:

- ~~3.~~ To develop competency for system visualization and design.
- ~~4.~~ To enable student to design cylinders and pressure vessels and to use IS code.
- ~~5.~~ To enable student select materials and to design internal engine components.
- ~~6.~~ To introduce student to optimum design and use optimization methods to design mechanical components.
- ~~7.~~ To enable student to design machine tool gearbox.
- ~~8.~~ To enable student to design material handling systems.
- ~~9.~~ Ability to apply the statistical considerations in design and analyze the defects and failure modes in

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Course Outcomes:

- Demonstrate ability to successfully complete Fork Lift Certification to safely and effectively operate in the manufacturing environment.
- Demonstrate proficiency in supply chain operations, utilizing appropriate methods to plan and implement processes necessary for the purchase and conveyance of goods in a timely and cost-effective manner
- It explains about the different types of material handling, advantages and disadvantages. It also suggests the selection procedure for the material handling along with its specifications.
- Need for Material handling also explained with different techniques like Automated Material handling Design Program, Computerized material handling Planning will be dealt.
- The Material handling is explained with models, selection procedure of material handling is depending on different function oriented systems. This also related with plant layout by which the minimization of the handling charges will come down.
- The ergonomics related to material handling equipment about design and miscellaneous equipments.

UNIT – I

Types of intraplant transporting facility, principal groups of material handling equipments, choice of material handling equipment, hoisting equipment, screw type, hydraulic and pneumatic conveyors, general characteristics of hoisting machines, surface and overhead equipments, general characteristics of surface and overhead equipments and their applications. Introduction to control of hoisting equipments.

UNIT – II

Flexible hoisting appliances like ropes and chains, welded load chains, roller chains, selection of chains hemp rope and steel wire rope, selection of ropes, fastening of hain sand ropes , different types of load suspension appliances, fixed and movable pulleys, different types of pulley systems, multiple pulley systems . Chain and rope sheaves and sprockets.

UNIT – III

Load handling attachments, standard forged hook, hook weights, hook bearings, cross piece and casing of hook, crane grab for unit and piece loads, carrier beams and clamps, load platforms and side dump buckets, electric lifting magnets, grabbing attachments for loose materials, crane attachments for handling liquid materials.

UNIT – IV

Arresting gear, ratchet type arresting gear, roller ratchet, shoe brakes and its different types like electromagnetic, double shoe type, thruster operated, controller brakes, shoe brakes, thermal calculations of shoe brakes and life of linings, safety handles, load operated constant force and variable force brakes general theory of band brakes, its types and construction.

UNIT – V

Different drives of hosting gears like individual and common motor drive for several mechanisms, traveling gear, traveling mechanisms for moving trolleys and cranes on runway rails, mechanisms for trackless, rubber-tyred and crawler cranes motor propelled trolley hoists and trolleys, rails and traveling wheels, slewing, jib and luffing gears. Operation of hoisting gear during transient motion, selecting the motor rating and determining braking torque for hoisting mechanisms, drive efficiency calculations, selecting the motor rating and determining braking torque for traveling mechanisms, slewing mechanisms, jib and luffing mechanisms. (Elementary treatment is expected)

TEXT BOOKS:

~~5.~~1. Materials Handling Equipment – N. Rudenko , Envee Publishers, New Delhi
~~6.~~2. Materials Handling Equipment – M.P. Alexandrov. Mie publications, Moscow

REFERENCE BOOKS:

~~5.~~1. Aspects of Material handling - Arora
~~6.~~2. Introduction to Material Handling- Ray
~~7.~~3. Plant Layout and Material Handling- Chowdary RB

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B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)
NON-CONVENTIONAL ENERGY SOURCES
(Open Elective – II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: NT622OE	**3 0 0 3**

Course Overview:
Non Conventional resources include solar energy, wind, falling water, the heat of the earth (geothermal), plant materials (biomass), waves, ocean currents, temperature differences in the oceans and the energy of the tides. Non Conventional energy technologies produce power, heat or mechanical energy by converting those resources either to electricity orto motive power. The policy maker concerned with development of the national grid system will focus on those resources that have established themselves commercially and are cost effective for on grid applications. Such commercial technologies include hydroelectric power, solar energy, fuels derived from biomass, wind energy and geothermal energy. Wave, ocean current, ocean thermal and other technologies that are in the research or early commercial stage, as well as non-electric Non Conventional energy technologies, such as solar water heaters and geothermal heat pumps, are also based on Non Conventional resources, but outside the scope of this Manual.

Course Objectives:
- ~~3.~~ Graduates will demonstrate the ability to use basic knowledge in mathematics, science and engineering and apply them to solve problems specific to mechanical engineering (Fundamental engineering analysis skills).
- ~~4.~~ Graduates will demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results (Information retrieval skills).
- ~~5.~~ Graduates should be capable of self-education and clearly understand the value of life-long learning (Continuing education awareness).
- ~~6.~~ Graduates will develop an open mind and have an understanding of the impact of engineering on society and demonstrate awareness of contemporary issues (Social awareness).
- ~~7.~~ Graduate will be able to design a system to meet desired needs within environmental, economic, political, ethical health and safety, manufacturability and management knowledge and techniques to estimate time, resources to complete project (Practical engineering analysis skills).

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Course Outcomes:
- ~~3.~~ Introduction to Renewable Energy Sources, Principles of Solar Radiation, Different Methods of Solar Energy Storage and its Applications, Concepts of Solar Ponds, Solar Distillation and Photo Voltaic Energy Conversion

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- ~~4.~~ Introduction to Flat Plate and Concentrating Collectors ,Classification of Concentrating Collectors
- ~~5.~~ Introduction to Wind Energy, Horizontal and Vertical Access Wind Mills, Bio-Conversion
- ~~6.~~ Types of Bio-Gas Digesters and Utilization for Cooking Geothermal Energy Resources
- ~~7.~~ Types of Wells and Methods of Harnessing the Energy, Ocean Energy and Setting of OTEC Plants
- ~~8.~~ Tidal and Wave Energy and Mini Hydel Power Plant, Need and Principles of Direct Energy Conversion
- ~~9.~~ Concepts of Thermo-Electric Generators and MHD Generators

UNIT - I

Statistics on conventional energy sources and supply in developing countries, Definition-Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES - Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

UNIT - II

Solar Energy-Energy available form Sun, Solar radiation data, Solar energy conversion into heat, Flat plate and Concentrating collectors, Mathematical analysis of Flat plate collectors and collector efficiency, Principle of Natural and Forced convection, Solar engines-Stirling, Brayton engines, Photovoltaic, p-n junction, solar cells, PV systems, Stand-alone, Grid connected solar power satellite.

UNIT - II

Wind energy conversion, General formula -Lift and Drag- Basis of wind energy conversion - Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors-Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle.

UNIT - IV

Nature of Geothermal sources, Definition and classification of resources, Utilization for electric generation and direct heating, Well Head power generating units, Basic features-Atmospheric exhaust and condensing, exhaust types of conventional steam turbines.

Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Biomass gasification, Constructional details of gasifier, usage of biogas for chulhas, various types of chulhas for rural energy needs.

UNIT - V

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation, Principles of tidal and wave power generation, OTEC power plants, Operational of small cycle experimental facility, Design of 5 Mw OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC. Status of multiple product OTEC systems.

TEXT BOOKS:

~~3.~~1. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 2003

~~4.~~2. K M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, New Delhi, 2003.

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REFERENCE BOOKS:

~~3.~~1. Ramesh R & Kumar K U, *Renewable Energy Technologies,* Narosa Publishing House, New Delhi, 2004

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~~4.~~2. Wakil MM, *Power Plant Technology,* Mc Graw Hill Book Co, New Delhi, 2004.

~~5.~~3. Non - Conventional Energy Sources. Rai

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B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)
ROBOTICS
(Open Elective – II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: NT623OE	**3 0 0 3**

Pre-requisites: Basic principles of Kinematics and mechanics

Course Objectives: The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

- Make the students acquainted with the theoretical aspects of Robotics
- Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
- Make the students to understand the importance of robots in various fields of engineering.
- Expose the students to various robots and their operational details.

Course Outcomes: At the end of the course, the student will be able to understand the basic components of robots. Differentiate types of robots and robot grippers. Model forward and inverse kinematics of robot manipulators. Analyze forces in links and joints of a robot. Programme a robot to perform tasks in industrial applications. Design intelligent robots using sensors.

UNIT – I

Introduction: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications.

Components of the Industrial Robotics: common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNIT – II

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.

Manipulator Kinematics-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulation.

UNIT – III

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion – straight line motion.

UNIT IV

Robot actuators and Feedback components:

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors.

UNIT V

Robot Application in Manufacturing:

Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

REFERENCE BOOKS:

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada , Slotine / Wiley Inter-Science

B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)
CONCEPTS OF NANO SCIENCE AND TECHNOLOGY
(**Open Elective - III**)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: NT831OE	**3**	**0**	**0**	**3**

Course Objectives:

- ~~1.~~ Beginners will be able to acquaint themselves with the excited subject though they are novice, whereas advanced learners will equip themselves to solve the complicated issues further.
- ~~2.~~ To know the importance of the synthesis method addressed in the material properties and give practical experience of nanomaterials synthesis/properties and characterization; investigations into the various factors influence the properties of nanomaterials, optimizing the procedures, and implementations to the new designs
- ~~3.~~ To provide a sound understanding of the various concepts involved in fabrication of device architectures' and able to evaluate them in advance

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Course Outcome: The intended course covers the whole spectrum of nanomaterials ranging from introduction, classification, synthesis, properties, and characterization tools of nanophase materials to application including some new developments in various aspects.

UNIT - I

Introduction to Nano: Importance, Definition and scope, Nano size, challenges, applications. Electrons**,** Other Materials**,** Nano magnetism as a case study; Fundamental terms (Physics & Chemistry) in nano-science and technology; Feynman's perspective; Scaling laws pertaining to mechanics, optics, electromagnetism; Importance of Quantum mechanics, statistical mechanics and chemical kinetics in nano-science and technology;

UNIT - II

Classification of nano materials: Scientific basis for top-down and bottom-up approaches to synthesize Nanomaterials; How to characterize Nanomaterials?

UNIT - III

Tools for Nanoscience and Technology: Tools for measuring properties of Nanostructures, Tools to Make Nanostructures. Nano scale Bio-structures, modelling

UNIT - IV

Nano-Biotechnology: Bio-molecules; Biosensors; Nanomaterials in drug delivery; Working in clean room environments; Safety and related aspects of Nanomaterials;

UNIT – V

Carbon Nanomaterials and Applications: Carbon Nano structures and types of Carbon Nano tubes, growth mechanisms of carbon nanotubes. Carbon clusters and Fullerenes, Lithium & Hydrogen adsorption & storages, Fuel cell applications and energy storage, Chemical Sensors applications of CNTs

TEXT BOOKS AND REFERENCES:

1. Textbook of Nanoscience and Nanotechnology – B. S. Murthy, P. Shankar, Baldev Raj, B. B. Rath and James Murday, University Press-IIM Series in Metallurgy and Materials Science.
2. A Textbook of Nanoscience and Nanotechnology – T. Pradeep, Tata McGraw Hill edition.
3. Nanotechnology Fundamentals and Applications- by Manasi Karkare I. K International
4. Nanoscience and Nanotechnology in engineering – by Vijay K Varadan A Sivathanu pillai Word scientific
5. Nanotechnology Applications To Telecommunications And Networking By Daniel Minoli, Wiley Interscience
6. Nanotechnology Principles and Applications by Sulabha Kulkarni

B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)
SYNTHESIS OF NANOMATERIALS
(**Open Elective - III**)

B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: NT832OE	**3**	**0**	**0**	**3**

Course Objectives:

- To provide knowledge about top-down and bottom-up approaches for the synthesis of nanomaterials.
- To enhance the various nanosynthesis techniques and to identify and solve problems
- To design and conduct experiments relevant to nanochemistry, as well as to analyze the results.
- To improve usage of synthesis methods for modern technology

Course Outcome: To provide abundant knowledge on various synthesis methods of nanomaterials.

UNIT - I
Introduction, Bottom-up approach: Sol-gel method, emulsion and Top-down: ball milling approach with examples.

UNIT - II
Physical methods: Inert gas condensation, Arc discharge, plasma synthesis, electric explosion of wires, molecular beam epitaxy, Physical Vapour Deposition, thermal evaporation, lithography and sputtering.

UNIT - III
Chemical methods: Nanocrystals by chemical reduction, photochemical synthesis, electrochemical synthesis, co-precipitation method. Semiconductor nanocrystals by arrested precipitation, sonochemical routes

UNIT - IV
Biological methods – use of bacteria, fungi, actinomycetes for nano-particle synthesis nano-particles Solvated metal atom dispersion, Template based synthesis of nanomaterials.

UNIT - V
Thermolysis route - spray pyrolysis, solvothermal and hydrothermal routes, solution combustion synthesis, Chemical vapor deposition

TEXTBOOKS:

1. Textbook of Nanoscience and Nanotechnology – B. S. Murthy, P. Shankar, Baldev Raj, B. B .Rath and James Murday, University Press-IIM Series in Metallurgy and Materials Science.
2. A Textbook of Nanoscience and Nanotechnology – T. Pradeep, Tata McGraw Hill edition.
3. Nanostructures and Nanomaterials by Guozhong Cao
4. Inorganic Materials Synthesis and Fabrication by J.N. Lalena, D.A. Cleary, E.E. Carpenter, N.F. Dean, John Wiley & Sons Inc.
5. Introduction to Nano Technology by Charles P. Poole Jr and Frank J. Owens. Wiley India Pvt Ltd.
6. The Chemistry of nanomaterials: Synthesis, Properties and Applications, Vol-I by C.N.R. Rao, A. Muller and A.K. Cheetham
7. The Physics of Micro/Nano- Fabrication by Ivor Brodie and Julius J.Muray

REFERENCE BOOKS:

1. Encyclopedia of Nanotechnology by M. Balakrishna Rao and K. Krishna Reddy, Vol I to X, Campus books.
2. Encyclopedia of Nanotechnology by H.S. Nalwa
3. Nano: The Essentials – Understanding Nano Science and Nanotechnology – by T. Pradeep, Tata McGraw Hill

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B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)
CHARACTERIZATION OF NANOMATERIALS
(**Open Elective - III**)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: NT833OE	**3 0 0 3**

Course Objectives:

- To develop ability to understand modern characterization techniques especially utilized to probe in nanoscopic regime
- To elucidate on application of standard spectroscopy, microscopy techniques for element analysis, structure analysis, depth profiling, topography imaging, as well as surface and interface analysis
- To provide overview of principles underlying the characterization methods and basic theory for analysis of the data obtained from the instrument
- The objective of this course is to make the students understand the principles underlying various spectroscopies and instrumentations specific to nanomaterials

UNIT - I

Fundamentals of Electron Microscopy: Advantages of Electron Microscope over Optical Microscope (Magnification, Resolution, Depth of field). Theory and principle of Electron Microscope, Electron sources, Electron lenses (Electrostatic and Electromagnetic).

UNIT - II

Scanning Electron Microscopy: SEM: Theory of operation, Specimen-Beam interactions Importance of beam spot size, Machine variables, Scanning Electron Microscope (SEM). **Specimen Preparation in SEM**: Special methods for various sample types – Biological sample preparation, Applications of SEM

UNIT - III

Transmission Electron Microscopy: TEM: Theory of operation, Modes of operation, Transmission Electron Microscope (TEM),Bright field Imaging, Electron diffraction, Dark field imaging, High Resolution TEM (HRTEM), Applications of TEM.

UNIT - IV

Atomic Force Microscopy: AFM: Basic concepts – Interactive forces, Principle and instrumentation, Force curves and force measurements, Modes of imaging: Tapping, contact and non-contact, Probes, Tip functionalization,

UNIT - V

X-Ray Diffraction and Spectroscopic methods:

X-ray diffraction–Powder method, Single crystal diffraction technique -Determination of crystal strucures – Nanostructural analysis – Profile analysis (peak broadening and micro strain) – Crystallite size analysis using Scherer formula and Williamson – Hall equation. UV Spectroscopy, IR Spectroscopy and Raman Spectroscopy

TEXT BOOKS:

1. Nanotechnology: Principles and Practices – Sulabha K. Kulkarni – Capital Publishing Company
2. 2. Nano: The Essentials – Understanding Nanoscience and Nanotechnology by T. Pradeep. Tata McGraw Hill
3. 3. Introduction to Nano Technology by Charles. P. Poole Jr and Frank J. Owens, Wiley India Pvt Ltd.
4. A practical approach to X-Ray diffraction analysis by C. Suryanarayana

REFERENCES:

1. Haynes. R, Woodruff. D. P. and Talchar, T.A., optical Microscopy of Materials Cambridge University press, 1986.
2. Flegler, S.L., Heckman, J.W. and Klomparens, K.L., scanning and Transmission Electron Microscopy: A Introduction WH Freeman & Co, 1993.
3. Paul E. West, introduction to Atomic Force Microscopy Theory Practice Applications
4. Julian Chen N, C., introduction to Scanning Tunneling Microscopy, Oxford University Press, Inc., 1993.
5. Magonov, S.M., and Whangbo, M-H., surface Analysis with STM and AFM: Experimental and Theoretical Aspects of Image Analysis VCH Publishers, Inc., New York 1996.
6. Goldstein, J., Newbury, D.E., Joy, D.C., and Lym, C.E., scanning Electron Microscopy and X-ray Microanalysis, 2003.

B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
ANALOG AND DIGITAL IC APPLICATIONS
(OPEN ELECTIVE – I)

B.Tech. III Year I Sem.	**L T P C**
Course Code: MT511OE	**3 0 0 3**

UNIT - I

Integrated Circuits : Classification, chip size and circuit complexity, basic information of Op amp, ideal and practical Op-amp, internal circuits, Op-amp characteristics, DC and AC characteristics, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential.

OP-AMP Applications: Basic application of Op-amp, instrumentation amplifier, ac amplifier, V to I and I to V converters, sample & hold circuits, multipliers and dividers, Differentiators and Integrators, Comparators.

UNIT - II

Schmitt trigger, Multivibrators, introduction to voltage regulators, features of 723.

Active Filters & Oscillators: Introduction, 1st order LPF, HPF filters. Band pass, Band reject, and all pass filters. Oscillator types and principle of operation – RC, Wien, and quadrature type, waveform generators – triangular, saw tooth, square wave and VCO.

UNIT - III

Timers & Phase Locked Loops: Introduction to 555 timer, functional diagram, monostable and astable operations, and applications, Schmitt Trigger. PLL - introduction, block schematic, principles, and description of individual blocks of 565.

D-A and A- D Converters : Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs - parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC. DAC and ADC specifications.

UNIT - IV

Classification of Integrated circuits, comparison of various logic families, standard TTL NAND Gate- Analysis& characteristics, TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tristate outputs, CMOS transmission gate, IC interfacing- TTL driving CMOS & CMOS driving TTL.

Design using TTL-74XX & CMOS 40XX series, code converters, decoders, Demultiplexers, decoders, & drives for LED & LCD display. Encoder, priority Encoder, multiplexers, & their applications, priority generators/checker circuits. Digital arithmetic circuits-parallel binary adder/subtractor circuits using 2’s, Complement system. Digital comparator circuits.

UNIT - V

Sequential Circuits: Flip-flops & their conversions. Design of synchronous counters. Decade counter, shift registers, & applications, familiarities with commonly available 74XX & CMOS 40XX series of IC counters.

Memories: ROM architecture, types, & applications, RAM architecture, Static & Dynamic RAMs, synchronous DRAMs.

TEXT BOOKS:

1. Linear Integrated Circuits –D. Roy Choudhury, New Age International (p) Ltd, 2nd Ed., 2003.
2. Op-Amps & Linear ICs – Ramakanth A. Gayakwad, PHI, 1987.

REFERENCES:

1. Operational Amplifiers & Linear Integrated Circuits – R.F. Coughlin & Fredrick F. Driscoll, PHI, 1977.
2. Operational Amplifiers & Linear Integrated Circuits: Theory & Applications –Denton J. Daibey, TMH.
3. Design with Operational Amplifiers & Analog Integrated Circuits-Sergio Franco, McGraw Hill, 3rd Ed., 2002.
4. Digital Fundamentals – Floyd and Jain, Pearson Education, 8th Edition, 2005.

B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
INTELLECTUAL PROPERTY RIGHTS
(Open Elective – I)

B.Tech. III Year I Sem.	**L**	**T**	**P**	**C**
Course Code: MT512OE	**3**	**0**	**0**	**3**

UNIT – I

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III

Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights, and transfer

UNIT – IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT BOOKS & REFERENCES:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata Mc Graw Hill Publishing company ltd.,

B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
COMPUTER ORGANIZATION
(Open Elective – I)

B.Tech. III Year I Sem.	**L T P C**
Course Code: MT513OE	**3 0 0 3**

Course Objectives:
- To understand basic components of computers.
- To understand the architecture of 8086 processor.
- To understand the instruction sets, instruction formats and various addressing modes of 8086.
- To understand the representation of data at the machine level and how computations are performed at machine level.
- To understand the memory organization and I/O organization.
- To understand the parallelism both in terms of single and multiple processors.

Course Outcomes:
- Able to understand the basic components and the design of CPU, ALU and Contr**ol** Unit.
- Ability to understand memory hierarchy and its impact on computer cost/performance.
- Ability to understand the advantage of instruction level parallelism and pipelining for high performance Processor design.
- Ability to understand the instruction set, instruction formats and addressing modes of 8086.
- Ability to write assembly language programs to solve problems.

UNIT - I
Digital Computers: Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture.
Basic Computer Organization and Design: Instruction codes, Computer Registers, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Complete Computer Description.
Micro Programmed Control: Control memory, Address sequencing, micro program example, design of control unit.

UNIT - II
Central Processing Unit: The 8086 Processor Architecture, Register organization, Physical memory organization, General Bus Operation, I/O Addressing Capability, Special Processor Activities, Minimum and Maximum mode system and timings.
8086 Instruction Set and Assembler Directives-Machine language instruction formats, Addressing modes, Instruction set of 8086, Assembler directives and operators.

UNIT - III

Assembly Language Programming with 8086- Machine level programs, Machine coding the programs, Programming with an assembler, Assembly Language example programs.

Stack structure of 8086, Interrupts and Interrupt service routines, Interrupt cycle of 8086, Interrupt programming, Passing parameters to procedures, Macros, Timings and Delays.

UNIT - IV

Computer Arithmetic: Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating - point Arithmetic operations.

Input-Output Organization: Peripheral Devices**,** Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt, Direct memory Access, Input –Output Processor (IOP),Intel 8089 IOP.

UNIT - V

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.

Pipeline and Vector Processing: Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processors.

Multi Processors: Characteristics of Multiprocessors, Interconnection Structures, Inter processor arbitration, Inter processor communication, and synchronization.

TEXT BOOKS:

1. Computer System Architecture, M. Moris Mano, Third Edition, Pearson. **(UNITS- I , IV , V)**
2. Advanced Microprocessors and Peripherals, K M Bhurchandi, A.K Ray ,3rd edition, McGraw Hill India Education Private Ltd. **(UNITS - II, III).**

REFERENCES:

1. Microprocessors and Interfacing, D V Hall, SSSP Rao, 3rd edition, McGraw Hill India Education Private Ltd.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002
3. Computer Organization and Architecture, William Stallings, 9th Edition, Pearson.
4. David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4th Edition, Elsevier, 2009.

B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
DATA STRUCTURES
(Open Elective – II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: EM614PE/MT621OE	**3 0 0 3**

Course Objectives:

- To understand the basic concepts such as Abstract Data Types, Linear, and Non Linear Data structures.
- To understand the notations used to analyze the Performance of algorithms.
- To understand the behavior of data structures such as stacks, queues, trees, hash tables, search trees, Graphs and their representations.
- To choose the appropriate data structure for a specified application.
- To understand and analyze various searching and sorting algorithms.
- To write programs in C to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, graphs, hash tables, search trees.

Course Outcomes:

- Learn how to use data structure concepts for realistic problems.
- Ability to identify appropriate data structure for solving computing problems in respective language.
- Ability to solve problems independently and think critically.

UNIT - I

Basic concepts- Algorithm Specification-Introduction, Recursive algorithms, Data Abstraction Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega, and Theta notations, Introduction to Linear and Non Linear data structures.

Singly Linked Lists-Operations-Insertion, Deletion, Concatenating singly linked lists, circularly linked lists-Operations for Circularly linked lists, Doubly Linked Lists- Operations- Insertion, Deletion.

Representation of single, two dimensional arrays, sparse matrices-array and linked representations.

UNIT - II

Stack ADT, definition, operations, array and linked implementations in C, applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue ADT, definition and operations ,array and linked Implementations in C, Circular queues-Insertion and deletion operations, Deque (Double ended queue)ADT, array and linked implementations in C.

UNIT - III

Trees – Terminology, Representation of Trees, Binary tree ADT, Properties of Binary Trees, Binary Tree Representations-array and linked representations, Binary Tree traversals, threaded binary trees, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap.

Graphs – Introduction, Definition, Terminology, Graph ADT, Graph Representations-Adjacency matrix, Adjacency lists, Graph traversals - DFS and BFS.

UNIT - IV

Searching - Linear Search, Binary Search, Static Hashing-Introduction, hash tables, hash functions, Overflow Handling. Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Comparison of Sorting methods.

UNIT - V

Search Trees-Binary Search Trees, Definition, Operations- Searching, Insertion and Deletion, AVL Trees-Definition and Examples, Insertion into an AVL Tree ,B-Trees, Definition, B-Tree of order m, operations-Insertion and Searching, Introduction to Red-Black and Splay Trees(Elementary treatment-only Definitions and Examples), Comparison of Search Trees.

Pattern matching algorithm- The Knuth-Morris-Pratt algorithm, Tries (examples only).

TEXT BOOKS:

1. Fundamentals of Data structures in C, 2nd Edition, E. Horowitz, S. Sahni and Susan Anderson-Freed, Universities Press.
2. Data structures A Programming Approach with C, D. S. Kushwaha and A.K. Misra, PHI.

REFERENCE BOOKS:

1. Data structures: A Pseudo code Approach with C, 2nd edition, R. F. Gilberg And B. A. Forouzan, Cengage Learning.
2. Data structures and Algorithm Analysis in C, 2nd edition, M. A. Weiss, Pearson.
3. Data Structures using C, A.M. Tanenbaum, Y. Langsam, M. J. Augenstein, Pearson.
4. Data structures and Program Design in C, 2nd edition, R. Kruse, C. L. Tondo and B. Leung, Pearson.
5. Data Structures and Algorithms made easy in JAVA, 2nd Edition, Narsimha Karumanchi, Career Monk Publications.
6. Data Structures using C, R. Thareja, Oxford University Press.
7. Data Structures, S. Lipscutz, Schaum’s Outlines, TMH.
8. Data structures using C, A. K. Sharma, 2nd edition, Pearson..
9. Data Structures using C & C++, R. Shukla, Wiley India.
10. Classic Data Structures, D. Samanta, 2nd edition, PHI.
11. Advanced Data structures, Peter Brass, Cambridge.

B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
ARTIFICIAL NEURAL NETWORKS
(Open Elective – II)

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: MT622OE	**3**	**0**	**0**	**3**

Course Objectives:
- To understand the biological neural network and to model equivalent neuron models.
- To understand the architecture, learning algorithm and issues of various feed forward and feedback neural networks.

Course Outcomes: By completing this course the student will be able to:
- Create different neural networks of various architectures both feed forward and feed backward.
- Perform the training of neural networks using various learning rules.
- Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.

UNIT - I
Introduction: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks
Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process

UNIT - II
Single Layer Perceptron: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment
Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

UNIT - III
Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

UNIT - IV
Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

UNIT - V

Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm

Hopfield Models – Hopfield Models, Computer Experiment

TEXT BOOKS:

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.

REFERENCE BOOKS:

1. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
INDUSTRIAL MANAGEMENT
(Open Elective – II)

B.Tech. III Year II Sem.	**L**	**T**	**P**	**C**
Course Code: MT623OE	**3**	**0**	**0**	**3**

UNIT - I

Introduction to Management: Entrepreneurship and organization - Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

UNIT - II

Designing Organizational Structures: Departmentation and Decentralization, Types of Organization structures - Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT - III

Operations Management: Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production),-Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts-Design of product layout- Line balancing(RPW method)

Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

UNIT - IV

Work Study: Introduction – definition – objectives – steps in work study – Method study – definition – objectives – steps of method study. Work Measurement – purpose – types of study – stop watch methods – steps – key rating – allowances – standard time calculations – work sampling.

Statistical Quality Control: variables-attributes, Shewart control charts for variables- $\overline{X}$ chart, R chart, - Attributes-Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

UNIT - V

Job Evaluation: methods of job evaluation – simple routing objective systems – classification method – factor comparison method – point method – benefits of job evaluation and limitations.

Project Management (PERT/CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

TEXT BOOKS:

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers
2. Industrial Engineering and Management Science/T.R. Banga and S. C. Sarma/Khanna Publishers

REFERENCE BOOKS:

1. Motion and Time Study by Ralph M Barnes/ John Willey & Sons Work Study by ILO
2. Human factors in Engineering & Design/Ernest J McCormick / TMH
3. Production & Operation Management /Paneer Selvam /PHI
4. Industrial Engineering Management/NVS Raju/Cengage Learning
5. Industrial Engineering Hand Book /Maynard
6. Industrial Engineering Management / Ravi Shankar/ Galgotia

B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
RENEWABLE ENERGY SOURCES
(Open Elective – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: MT831OE/ME853PE	**3 0 0 3**

Course Objectives:
- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

Course Outcomes:
- Understanding of renewable energy sources
- Knowledge of working principle of various energy systems
- Capability to carry out basic design of renewable energy systems

UNIT-I
Global and National Energy Scenario: Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO_2 reduction potential of renewable energy- concept of Hybrid systems.

UNIT-II
Solar Energy: Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

UNIT-III
Wind Energy: Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

UNIT-IV

Biogas: Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

UNIT-V

Ocean Energy: Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy**: Geothermal power plants, various types, hot springs and steam ejection.

REFERENCE BOOKS:

1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
4. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
PRODUCTION PLANNING AND CONTROL
(Open Elective – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: MT832OE/ME854PE	**3 0 0 3**

Pre-requisites: Management Science & Productivity.

Course Objectives: Understand the importance of Production planning & control. Learning way of carrying out various functions it so as to produce right product, right quantity at right time with minimum cost.

Course Outcomes: At the end of the course, the student will be able to, Understand production systems and their characteristics. Evaluate MRP and JIT systems against traditional inventory control systems. Understand basics of variability and its role in the performance of a production system. Analyze aggregate planning strategies. Apply forecasting and scheduling techniques to production systems. Understand theory of constraints for effective management of production systems.

UNIT – I

Introduction: Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.

Forecasting – Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques. Measures of forecasting errors.

UNIT – II

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment only. **Aggregate planning –** Definition – aggregate-planning strategies – aggregate planning methods – transportation model.

UNIT – III

Line Balancing: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method.

Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

UNIT – IV

Scheduling –Definition – Scheduling Policies – types of scheduling methods – differences with loading – flow shop scheduling **–** job shop scheduling, line of balance (LOB) – objectives - steps involved.

UNIT – V

Dispatching: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

Follow up: definition – types of follow up – expediting – definition – expediting procedures- Applications of computers in planning and control.

TEXT BOOKS:

1. Operations management – Heizer- Pearson.
2. Production and Operations Management / Ajay K Garg / Mc Graw Hill.

REFERENCE BOOKS:

1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2. Production Planning and Control- Jain & Jain – Khanna publications

B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)
ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES
(Open Elective – III)

B.Tech. IV Year II Sem.	**L T P C**
Course Code: CE833OE	**3 0 0 3**

Course Objective: The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

Course Outcome: It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

Unit – 1: Entrepreneurial Perspectives:
Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.
Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

Unit – 2: New Venture Creation:
Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

Unit – 3: Management of MSMEs and Sick Enterprises
Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

Units – 4: Managing Marketing and Growth of Enterprises:
Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

Units – 5: Strategic perspectives in Entrepreneurship:
Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

TEXT BOOKS:

1. Entrepreneurship Development and Small Business Enterprises, Poornima M.Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D.F.Kuratko and T.V.Rao, 3e, Cengage, 2012.

REFERENCES:

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

B.TECH. METALLURGICAL AND MATERIALS ENGINEERING
MATERIAL CHARACTERIZATION TECHNIQUES
(OPEN ELECTIVE –I)

B.Tech. III Year I Sem.	**L T P C**
Course Code: MM511OE	**3 0 0 3**

Course Objective: This course is intended to give an exposure to evaluation of special characteristics of materials (Structural, Mechanical & Thermal etc.) in order to understand their suitability in Engineering Applications

Course Outcome: At the end of the course the student will be able to characterize, identify, and apply the material to the concerned application.

UNIT-I

X-Ray Diffraction: Introduction, Production and properties of x-rays, Bragg's law of diffraction. Experimental Methods of Diffraction, Intensity of Diffracted beams - Scattering by an electron by an atom, by a unit cell, structure-factor calculations; factors affecting Diffraction Intensities.

Application of XRD: Orientation of single crystals, Effect of plastic deformation, the structure of polycrystalline Aggregates, Determination of crystal structure, Precise lattice parameter measurements, Phase - diagram determination, Order-disorder transformation, Chemical analysis by Diffraction, Stress measurement

UNIT-II

Elements of Quantitative Metallography and Image Processing.

Scanning Electron Microscopy: Principle, Interaction of electron beams with matter, Construction and Working principle Scanning Electron Microscopy, Working Distance, Depth of field, Depth of focus and Spot Size, Specimen preparation for Scanning Electron Microscopy, Different types of modes used in Scanning Electron Microscopy (Secondary Electron and Backscatter Electron) and their applications, Advantages, limitations and applications of Scanning Electron Microscopy, Electron Backscattered Diffraction.

UNIT-III

Transmission Electron Microscopy: Principle, Construction and Working principle of Transmission Electron Microscopy, Resolving power and Magnification, Depth of field and Depth of focus, Bright and dark field, Specimen preparation for the Transmission Electron Microscopy: Selected Area Diffraction, Applications of Transmission Electron Microscopy, Advantage and Limitations of Transmission Electron Microscopy.

UNIT-IV

Spectroscopy – Energy Dispersive Spectroscopy, Wavelength Dispersive Spectroscopy, Electron Probe Microanalyzer**,**

UNIT-V

Principles, Instrumentation, operation and application of thermal analysis, Thermogravimetric Analysis, TGA, Differential Scanning Calorimetry, Differential thermal analysis**,** Dynamic Mechanical Analysis, Dialatometry.

TEXT BOOKS:

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2008
2. Microstructural Characterization of Materials - David Brandon, Wayne D Kalpan, John Wiley & Sons Ltd., 2008.

REFERENCES:

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity & Stuart R Stocks, Prentice Hall , 2001 – Science

B.TECH. METALLURGICAL AND MATERIALS ENGINEERING
SCIENCE AND TECHNOLOGY OF NANO MATERIALS
(OPEN ELECTIVE - II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: MM621OE	**3 0 0 3**

Course Objective: This course is intended to expose the students to the most exciting area of nano materials. This would emphasize the classification, synthesis and applications of these materials.

Course Outcome: The student will be able to design a component/material that would provide us a 'better tomorrow' via nanotechnology.

UNIT-I
Introduction: History and Scopy, classification of nanostructural materials, Applications, Challenges and future prospects

UNIT-II
Unique properties of nano-materials, microstrucutre and defects in nano-crystalline materials, effect of nano-dimension on material behaviours

UNIT-III
Synthesis Routes: Bottom up approaches, top down approaches, consolidation of nano-powders.

UNIT-IV
Application of nano-materials: Nano-electronics, Micro and Nano-electromechanical systems, nano-sensors, Nano-catalyst, Structure and engineering, Automotive, Nano-medical, water and environment treatment, energy, defence and space, textile and paints**.**

UNIT-V
Nanostructured materials with high application potential: Quantum dots, Carbon nanotubes, GaN Nanowires, Nanocrystalline Zno, Nanocrystalline Tio_2, Multilayered films

TEXT BOOKS:
1. Text book of Nano Science and Technology: B S Murthy, Universities press-IIM series in Metallurgy and Material Sciene
2. Nano Essentials: T Pradeep / TMH

REFERENCES:
1. Springer Handbook of Nanotechnology
2. Nano Materials Synthersis, Properties and applications, 1996 Edlstein and Cammarate.
3. Nano Materials A.K. Bandyopadyay/ New age Publications

B.TECH. METALLURGICAL AND MATERIALS ENGINEERING
METALLURGY FOR NON METALLURGISTS
(OPEN ELECTIVE - II)

B.Tech. III Year II Sem.	**L T P C**
Course Code: MM622OE	**3 0 0 3**

Course Objectives:

- To describe the basic principles of metallurgy and the importance of metallurgy in various discipline of engineering.
- Gain a thorough knowledge about heat treatment of steels.
- Gain knowledge about properties and uses of cast irons and non ferrous metals.
- Gain a working knowledge of basic testing methods for metals.

Course Outcomes: At the end of the course Student would be able

- To use and apply metallurgy in his own branch of engineering.
- The student will be able to justify the various testing methods adopted for metals.

UNIT-I
Introduction: Crystal structure and defects, Crystal structure of metals, Classification of steels, Carbon steels

UNIT-II
Heat Treatment of Steels: The Iron carbon systems, Common phases in steels, Annealing, Normalizing, Hardening and tempering

UNIT-III
Cast irons: Properties and applications of Ductile irons, Malleable irons, Compacted graphite iron.

UNIT-IV
Non Ferrous Metals: Properties and applications of Light Metals (Al, Be, Mg, Ti), Super alloys

UNIT-V
Testing of Metals: Hardness testing, Tensile Testing, Impact Testing, Fatigue Testing.

TEXT BOOKS:

1. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007
2. Introduction to Physical Metallurgy – SH Avner, TATA Mc GRAW HILL ,1997
3. Mechanical Metallurgy – G. E. Dieter

REFERENCES:

1. Engineering Physical Metallurgy and Heat treatment – Y Lakhtin
2. C. Suryanarayana, Experimental Techniques in Mechanics and Materials, John Wiley, John Wiley, NJ, USA, 2006
3. Foundations of Materials Science and Engineering – WF Smith

B.TECH. METALLURGICAL AND MATERIALS ENGINEERING
DESIGN AND SELECTION OF ENGINEERING MATERIALS
(OPEN ELECTIVE - III)

	L	T	P	C
B.Tech. IV Year II Sem.	**L**	**T**	**P**	**C**
Course Code: MM831OE	**3**	**0**	**0**	**3**

Course Objective: This course aims at making student to understand and design a material for a given application considering the composition, manufacturing process and properties that are required in service.

Course Outcome: Understand the Relationship between materials selection, processing and applications.

UNIT-I
Materials selection process: Criteria for selection of materials

UNIT-II
Effect of composition, processing and structure on materials properties: Concepts in the design of industrial components

UNIT-III
Properties vs Performance materials: Aerospace and defense applications: design and alloy based on LCF, TMF, Creep fatigue interaction, hot corrosion resistance, role of DBTT for Naval applications, Intermetallics, Aluminides

UNIT-IV
Nuclear Material: Manufacturing aspects of design
Nuclear application: radiation damage, effect of radiation damage on YS, UTS, DBTT, design of alloy for fission and fusion reactors

UNIT-V
Special Materials: Manufacturing aspects of design
Selection and design of ceramics composites and polymers for specific applications,

TEXT BOOKS

1. M.F. Ashby, Materials Selection in Mechanical Design, Pergamon Press, 1992
2. G.E. Dieter, Engineering Design, A Materials and Processing Approach, 2nd ed., McGraw-Hill, 1991

REFERENCES

1. T.H. Courtney, *Mechanical Behavior of Materials*, McGraw-Hill, 1990
2. J.R. Dixon and C. Poli, *Engineering Design and Design for Manufacturing,* Field Stone Publishers, 1995

B.TECH. MINING ENGINEERING
INTRODUCTION TO MINING TECHNOLOGY
(Open Elective - I)

B.Tech. III Year I Sem	**L T P C**
Course Code: MN511OE	**3 0 0 3**

Course Objectives: The student is expected to learn the fundamentals of mining engineering so as to encourage multi-disciplinary research and application of other branches of engineering to mining technology.

Course Outcomes: Upon completion of the course, the student shall be able to understand various stages in the life of the mine, drilling , blasting and shaft sinking**.**

UNIT-I
Introduction: Distribution of mineral deposits in India and other countries, mining contributions to civilization, mining terminology,

UNIT-II
Stages in the life of the mine - prospecting, exploration, development, exploitation, and reclamation. Access to mineral deposit- selection, location, size and shape (incline, shaft and adit), brief overview of underground and surface mining methods.

UNIT-III
Drilling: Types of drills, drilling methods, electric, pneumatic and hydraulic drills, drill steels and bits, drilling rigs, and jumbos.

UNIT-IV
Explosives: Classification, composition, properties and tests, fuses, detonators, blasting devices and accessories, substitutes for explosives, handling and storage, transportation of explosives.; Rock blasting: Mechanism of rock blasting, blasting procedure, and pattern of shot holes.

UNIT-V
Shaft sinking: Ordinary and special methods, problems, and precautions, shaft supports and lining.

TEXT BOOKS:

1. R. P. Pal, Rock blasting effect and operation, A. A. Balkema, 1st Ed, 2005.
2. D. J. Deshmukh, Elements of mining technology, Vol. 1, Central techno, 7th Ed, 2001

REFERENCE BOOKS:

1. C. P. Chugh, Drilling technology handbook, Oxford and IBH, 1st Ed, 1977.
2. R. D. Singh, Principles and practices of modern coal mining, New age international, 1st Ed, 1997.

B.TECH. MINING ENGINEERING
COAL GASIFICATION, COAL BED METHANE AND SHALE GAS
(Open Elective - II)

B.Tech. III Year II Sem	**L T P C**
Course Code: MN621OE	**3 0 0 3**

Course Objectives: To specialize the students with additional knowledge on geological and technological factors of coal gasification industry mining methods of underground coal gasification, linkage techniques etc.

Course Outcomes; Student can get specialized in the underground coal gasification concepts, application and future scope in various geomining conditions.

UNIT-I
Underground Coal Gasification (UCG) Concept; Chemistry, conditions suitable for UCG, Principles of UCG., Merits and Demerits.

UNIT-II
UCG Process Component factors: Technology of UCG, opening up of coal seam for UCG.

UNIT-III
Mining methods of UCG: Chamber method, Stream method, Borehole procedure method, Blind bore hole method.

UNIT-IV
Non-Mining methods of UCG: Level seams, Inclined seams.

UNIT-V
Linkage Techniques: Pekcolation linkage, Electro linkage, Boring linkage, compressed-air-linkage, Hydraulic fracture linkage. Future Scope and Development: Innovations.

TEXT BOOKS:
1. Underground Coal Mining Methods – J.G. SINGH
2. Winning and Working Coal in India Vol.II- R. T. Deshmukh and D.J.Deshmukh.

REFERENCE BOOK:
1. Principles and Practices of Modern Coal Mining – R.D. SINGH

B.TECH. MINING ENGINEERING
SOLID FUEL TECHNOLOGY
(Open Elective - III)

B.Tech. IV Year II Sem	**L T P C**
Course Code: MN831OE	**3 0 0 3**

Pre-requisites: Under graduate Physics and Chemistry

Course Objectives: Understand coal formation, properties, and their evaluation along with various issues of coal washing

Course Outcomes: Students can understand the fundamentals of
Processes of formation of coal, properties and evaluation and coal preparation and washability characteristics of coal

UNIT-I
Introduction: Processes of formation of coal, Theories of origin of coal, Eras of coal formation, Indian Coalfields and its subsidiaries: Occurrence and distribution, coal bearing formations, coal type and rank variation, Characteristics of major coalfields, Coal production from different sectors.

UNIT-II
Coal petrography: Macro and micro lithotypes, Composition of macerals, application of coal petrography, Mineral matter in coal: Origin and chemical composition, Impact of mineral matter in coal process industry.

UNIT-III
Coal properties and their evaluation: proximate and ultimate analysis, calorific value, crossing and ignition point temperature, plastic properties (free swelling index, Caking index, Gray King Low Temperature Assay, Roga index, plastometry, dilatometry).

UNIT-IV
Physical properties like specific gravity, hard groove grindability index, heat of wetting, crossing point temperature of coal, Behavior of coal at elevated temperatures and products of thermal decomposition, Classification of coal - International and Indian classification, grading of Indian coals.

UNIT-V
Coal Washing: Principles, objectives, coal preparation, washability characteristics; Selection, testing, storage and utilization of coking and non-coking coal, Use of coal by different industries.

TEXT BOOKS:

1. S. Sarkar, Fuels and Combustion, Orient Longman Private Ltd., 2nd edition, 1990
2. O. P. Gupta, Elements of Fuels, Furnaces and Refractories, Khanna Publication, 3rd Edition, 1996.

REFERENCE BOOKS:

1. M. A. Elliot, Chemistry of Coal Utilization, Wiley, 1981.
2. D. Chandra, R. M. Singh, and M. P. Singh, Text Book of Coal, Tara Book Agency, 2000.

B.TECH. MINING ENGINEERING
HEALTH AND SAFETY IN MINES
(Open Elective - III)

B.Tech. IV Year II Sem	**L T P C**
Course Code: MN832OE	**3 0 0 3**

Course Objectives: To brief mining students in health and safety engineering concepts, causes of accident, training, human behavioral approach in safety etc.

Course Outcomes: student will gain knowledge and able to understand the importance of health and safety including the role of safety risk assessment in mining industry

UNIT-I

Introduction to accidents, prevention, health and safety in industry : Terminology, reason for preventing accidents – moral and legal.
Safety scenario in Indian mines, Accidents in Indian mines, Measurement of safety performance. Classification of accidents as per Mining legislation/law and general classification of accidents.

UNIT-II

Causes and preventive measures of accidents in underground and opencast mines i.e., due to fall of roof and sides, transportation of machinery, haulage and winding, drilling and blasting, movement of machinery in opencast mines and electricity etc., ; accident analysis and report, cost of accidents, statistical analysis of accidents and their importance for promotion of safety.

UNIT-III

System engineering approach to safety, techniques used in safety analysis, generic approach to loss control within mining operations. Concept of ZAP and MAP.

UNIT-IV

Risk management, Risk identification, Risk estimation and evaluation, Risk minimization techniques in mines. Risk analysis using FTA, HAZOP, ETA etc; health risk assessment and occupational diseases in mining.

UNIT-V

Development of safety consciousness, publicity and propaganda for safety; training of workmen, Human Behavioral approach in safety, safety polices and audio-visual aids, safety drives campaigns, safety audit. Safety management and organization; Internal safety organization

TEXT BOOKS:

1. Occupational Safety and Health in Industries and Mines by C.P. Singh
2. S.K. Das, Mine Safety and Legislation. Lovely Prakashan, Dhanbad, 2002

REFERENCE BOOKS:

1. N.J. Bahr, System Safety Engineering, and Risk Assessment: A Practical Approach, Taylor and Francis, NY, 1997.
2. Indian Mining Legislation – A Critical Appraisal by Rakesh & Prasad

B.TECH. PETROLEUM ENGINEERING
MATERIALS SCIENCE AND ENGINEERING
(Open Elective - I)

B.Tech. III Year I Sem.	**L**	**T/P/D**	**C**
Course Code: **PE511OE**	**3**	**0/0/0**	**3**

Course Objectives: This subject is intended to:

- Provide all the technical/engineering inputs to the learner to choose or select suitable materials of construction of chemical/petrochemical process equipment, piping and internals.
- Import expertise to the material so that it meets the specific life expectancy, by reducing the shutdown frequency.
- Learn the techniques in minimizing equipment breakdown and increasing the on-stream factor.
- To gain knowledge in choosing/selecting the material such that it withstands the severe process operating conditions such as cryogenic, high temperature, high pressure, acidic, basic, stress induced chemical/petrochemical environments keeping view the reliability and safety of the process equipment.

Course Outcome: After the course, the students will be to

- Equipped with knowledge to prepare material selection diagram, evaluation of equipment life and prediction of life of the equipment.
- Acquiring the abilities to carryout reliability studies.
- Ready to carryout equipment failure analysis and propose the remedial measures.

UNIT - I

Classification of engineering materials, Levels of Structure, Structure-Property relationships in materials, Crystal Geometry and non-crystalline(amorphous) states. Lattice –Bravais lattices, crystal systems with examples. Lattice co-ordinates, Miller and Miller- Bravais Indices for directions and places: ionic, covalent and metallic solids; packing factors and packing efficiency, ligancy and coordination number. Structure determination by Brag’s X-ray diffraction method.

UNIT - II

Crystal Imperfections-classification-point defects-estimation of point defects-Dislocations-classification(edge and screw)-surface defects -dislocation motion and its relevance to mechanical and chemical properties –stress-strain relationship and diagrams for different materials(metals, non-metals, rubbers and plastics and polymers)-elastic and plastic deformation-slip -stress required to move a dislocation. Multiplication of dislocations – dislocation reactions, effect on mechanical behavior of materials. Strain hardening/work hardening –dynamic recovery and recrystallization.

UNIT - III

Fracture and failure of materials: ductile fracture analysis-brittle fracture analysis-fracture toughness-ductile-brittle transition-fatigue fracture-theory, creep and mechanism –methods to postpone the failure and fracture of materials and increase the life of the engineering components /structures.

UNIT - IV

Solid –liquid and solid-solid Equilibria for metals and alloys. Phase rule-phase diagram for pure metals (single component system),alloys(binary systems)-micro structural changes during cooling-Lever rule and its applications-typical phase diagrams-homogeneous and heterogeneous systems, formation of Eutectic, Eutectoid mixtures- non-equilibrium cooling. Binary Systems(phase diagrams) for study: Cu-Ni/Bi-Cd/Pb-Sn/ Fe-C /Al-Cu
Materials for chemical and petrochemical industrial process equipment- Effect of alloying on mechanical and chemical behavior of materials, applications of heat treatment methods for strengthening of engineering materials.

UNIT - V

Composite structures and their advantages over conventional materials–Matrix-reinforcement properties and evaluation of strength properties with different orientation of reinforcement-applications –Nano materials –synthesis and characterization.
Stability criteria of materials in chemical/petrochemical industrial environments. Corrosion and Oxidation of materials –basic mechanisms-types of corrosion, Corrosion testing and evaluation Prevailing methods to combat corrosion. Coatings –metallic non-metallic, passivity, cathodic protection.

TEXT BOOKS:

1. Materials Science and Engineering, Raghavan, V., 5th Edition, PHI, New Delhi, 2009.
2. Material Science and Engineering, Ravi Prakash, William F. Smith, and Javed Hashemi, 4th Edition, Tata-McGraw Hill, 2008.

REFERENCE BOOKS:

1. Elements of Material Science and Engineering, Lawrence H. Van Vlack, 6th Edition, Pearson, 2002.
2. Materials Science and Engineering, Balasubramaniam, R., Callister’s, Wiley, 2010.
3. Corrosion Engineering, Mars G. Fontana, Tata-McGraw Hill, 2005.

B.TECH. PETROLEUM ENGINEERING
RENEWABLE ENERGY SOURCES
(Open Elective - I)

B.Tech. III Year I Sem.	**L**	**T/P/D**	**C**
Course Code: **PE512OE**	**3**	**0/0/0**	**3**

Course Objectives:

- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

Course Outcomes:

- Understanding of renewable energy sources
- Knowledge of working principle of various energy systems
- Capability to carry out basic design of renewable energy systems

UNIT-I

Global and National Energy Scenario: Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO_2 reduction potential of renewable energy- concept of Hybrid systems.

UNIT-II

Solar Energy: Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

UNIT-III

Wind Energy: Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

UNIT-IV

Biogas: Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

UNIT-V

Ocean Energy: Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy**: Geothermal power plants, various types, hot springs and steam ejection.

REFERENCE BOOKS:

1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
4. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

B.TECH. PETROLEUM ENGINEERING
ENVIRONMENTAL ENGINEERING
(Open Elective - I)

B.Tech. III Year I Sem.	**L T/P/D C**
Course Code: **PE513OE**	**3 0/0/0 3**

Course Objectives: This subject provides the knowledge of water sources, water treatment, design of distribution system waste water treatment, and safe disposal methods. The topics of characteristics of waste water, sludge digestion are also included.

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

- Analyze characteristics of water and wastewater
- Estimate the quantity of drinking water and domestic wastewater generated
- Design components of water supply systems Design sewerage system

UNIT – I

Introduction: Waterborne diseases – protected water supply – Population forecasts, design period – types of water demand – factors affecting – fluctuations – fire demand – water quality and testing – drinking water standards: sources of water - Comparison from quality and quantity and other considerations – intakes – infiltration galleries.

UNIT – II

Layout and general outline of water treatment units – sedimentation – principles – design factors – coagulation-flocculation clarifier design – coagulants - feeding arrangements. Filtration – theory – working of slow and rapid gravity filters – multimedia filters – design of filters – troubles in operation - comparison of filters – disinfection – theory of chlorination, chlorine demand - other disinfection practices- Miscellaneous treatment methods.

UNIT – III

Distribution systems requirement –method and layouts -Design procedures- Hardy Cross and equivalent pipe methods pipe – joints, valves such as sluice valves, air valves, scour valves and check valves water meters – laying and testing of pipe lines – pump house - Conservancy and water carriage systems – sewage and storm water estimation – time of concentration – storm water overflows combined flow

UNIT - IV

characteristics of sewage – cycles of decay – decomposition of sewage, examination of sewage – B.O.D. Equation – C.O.D. Design of sewers – shapes and materials – sewer appurtenances manholes – inverted siphon – catch basins – flushing tanks – ejectors, pumps and pump houses – house drainage – components requirements – sanitary fittings-traps – one pipe and two pipe systems of plumbing – ultimate disposal of sewage – sewage farming – dilution.

UNIT – V

Waste water treatment plant – Flow diagram - primary treatment Design of screens – grit chambers – skimming tanks – sedimentation tanks – principles of design – Biological treatment – trickling filters – standard and high rate – Construction and design of oxidation ponds. Sludge digestion – factors effecting – design of Digestion tank – Sludge disposal by drying – septic tanks working principles and design – soak pits.

TEXT BOOKS:

1. Environmental Engineering by H.S Peavy, D. R. Rowe, G. Tchobanog lous, McGraw Hill Education (India) Pvt Ltd, 2014
2. Environmental Engineering by D. P. Sincero and G.A Sincero, Pearson 2015.
3. Water Supply & Environmental Engineering by A.K. Chatterjee.
4. Water Supply and sanitary Engineering by G.S. Bindi, Dhanpat Rai & Sons Publishers.

REFERENCES:

1. Water and Waste Water Technology by Steel, Wiley
2. Waste water engineering by Metcalf and Eddy, McGraw Hill, 2015.
3. Water and Waste Water Engineering by Fair Geyer and Okun, Wiley, 2011
4. Water and Waste Water Technology by Mark J Hammar and Mark J. Hammar Jr.Wiley, 2007.

B.TECH. PETROLEUM ENGINEERING
ENERGY MANAGEMENT AND CONSERVATION
(Open Elective - II)

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
Course Code: **PE621OE**	**3**	**0/0/0**	**3**

Course Objectives: To acquaint the student with the conventional energy sources and their utilization. To understand the importance of heat recovery and energy conservation methods and energy audit.

Course Outcomes: Students would have a good knowledge about conventional energy sources and their audit. Ability to apply the fundamentals of energy conservation and management.

UNIT-I
Global & Indian Energy Scenario-Classification of Energy sources-Energy needs of growing economy-Energy sector reform, Energy and Environment: Global Environmental Concerns , Basics of Energy and its various forms.

UNIT-II
Energy Audit**:** Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments. Material and Energy balance**:** Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams,

UNIT-III
Energy Action Planning, Financial Management**:** Financial analysis techniques- Risk and sensitivity analysis- Financing options, Energy performance contracts and role of ESCOs-Energy Monitoring and Targeting**:** Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM).

UNIT-IV
Building Envelope – principles of analysis – Envelope performance -Envelope analysis of Existing and new buildings – Building standards for new and Existing constructions.
HVAC Systems types – Energy conservation opportunities – cooling equipment – Domestic hot water Estimating HVAC Energy consumption.

UNIT-V
Principles of Electric Energy Management, Energy Management control systems – Energy systems maintenance. Energy management in water and waste water treatment – solid waste treatment- air pollution control systems .

Energy Management in Boilers and Fired systems – Steam and condensate systems – cogeneration – Waste Heat recovery. Energy Management in Process Industries, Energy Security, Codes, Standards, Electricity Act, Energy Conservation Act.

TEXT BOOKS:

1. Energy Management by Murfy
2. General Aspects of Energy Management and Audit, National Productivity Council of India, Chennai (Course Material- National Certification Examination for Energy Management)

REFERENCE BOOKS:

1. Energy Management Handbook, W.C. Turner, 5th Edition, Marcel Dekker, Inc, New York, 2005.
2. Guide to Energy Management, B. L. Capehart, W. C. Turner, W. J. Kennedy, CRC Press, New York, 2005.
3. Energy Management by O.P. Collagan

B.TECH. PETROLEUM ENGINEERING
OPTIMIZATION TECHNIQUES
(Open Elective - II)

B.Tech. III Year II Sem.	**L**	**T/P/D**	**C**
Course Code: **PE622OE**	**3**	**0/0/0**	**3**

Prerequisite: Mathematics –I & Mathematics –II

Course Objectives:

- To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming
- Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.
- To explain the concept of Dynamic programming and its applications to project implementation.

Course Outcomes: After completion of this course, the student will be able to

- explain the need of optimization of engineering systems
- understand optimization of electrical and electronics engineering problems
- apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
- apply unconstrained optimization and constrained non-linear programming and dynamic programming
- Formulate optimization problems.

UNIT – I

Introduction and Classical Optimization Techniques: Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

Classical Optimization Techniques: Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.

Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

UNIT – II

Linear Programming: Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

Transportation Problem: Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.

UNIT – III

Unconstrained Nonlinear Programming: One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method

Unconstrained Optimization Techniques: Univariant method, Powell's method and steepest descent method.

UNIT – IV

Constrained Nonlinear Programming: Characteristics of a constrained problem - classification - Basic approach of Penalty Function method - Basic approach of Penalty Function method - Basic approaches of Interior and Exterior penalty function methods - Introduction to convex programming problem.

UNIT – V

Dynamic Programming: Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

TEXT BOOKS:

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4th edition, 2009.
2. H. S. Kasene & K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 2004

REFERENCE BOOKS:

1. George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series in operations research 3rd edition, 2003.
2. H.A. Taha, "Operations Research: An Introduction", 8th Edition, Pearson/Prentice Hall, 2007.
3. Kalyanmoy Deb, "Optimization for Engineering Design – Algorithms and Examples", PHI Learning Pvt. Ltd, New Delhi, 2005.

B.TECH. PETROLEUM ENGINEERING
ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES
(Open Elective – II)

B.Tech. III Year II Sem.	**L T/P/D C**
Course Code: **PE623OE**	**3 0/0/0 3**

Course Objective: The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

Course Outcome: It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

Unit – 1: Entrepreneurial Perspectives:
Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.
Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

Unit – 2: New Venture Creation:
Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

Unit – 3: Management of MSMEs and Sick Enterprises
Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

Units – 4: Managing Marketing and Growth of Enterprises:
Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

Units – 5: Strategic perspectives in Entrepreneurship:
Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

TEXT BOOKS:

1. Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D. F. Kuratko and T.V. Rao, 3e, Cengage, 2012.

REFERENCES:

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

B.TECH. PETROLEUM ENGINEERING
DISASTER MANAGEMENT
(Open Elective – III)

B.Tech. IV Year II Sem.	**L T/P/D C**
Course Code: **PE831OE**	**3 0/0/0 3**

Course Objectives: The subject provides different disasters, tools, and methods for disaster management.

Course Outcomes: At the end of the course, the student will be able to:
- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

UNIT - I
Understanding Disaster: Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)
Hazards and Vulnerabilities: Natural and man-made hazards; response time, frequency and forewarning levels of different hazards - Characteristics and damage potential or natural hazards; hazard assessment - Dimensions of vulnerability factors; vulnerability assessment - Vulnerability and disaster risk - Vulnerabilities to flood and earthquake hazards

UNIT - II
Disaster Management Mechanism: Concepts of risk management and crisis managements - Disaster Management Cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness - Planning for Relief

UNIT - III
Capacity Building: Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

UNIT - IV
Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

UNIT - V
Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India -

Organizational structure for disaster management in India - Preparation of state and district disaster management plans

TEXT BOOKS:

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

REFERENCES:

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

B.TECH. PETROLEUM ENGINEERING
FUNDAMENTALS OF LIQUEFIED NATURAL GAS
(Open Elective – III)

B.Tech. IV Year II Sem.	**L**	**T/P/D**	**C**
Course Code: **PE832OE**	**3**	**0/0/0**	**3**

Course Objectives: The students will be able to:

- Gain basic knowledge of LNG and its prospective.
- Learn different liquefaction technologies of LNG.
- Have knowledge on different functional units on receiving terminals
- Analyze transportation of LNG and regasification.
- Understand HSE of LNG industry.

Course Outcomes: Upon successful completion of this course, the student will be able to:

- Have good knowledge on LNG process.
- Classify different liquefaction techniques.
- Understand different units in LNG processing and transportation.
- Have knowledge associated with safety aspects of LNG.

UNIT-I
Introduction: Overview of LNG industry: History of LNG industry – Base load LNG – Developing an LNG Project – World and Indian Scenario – Properties of LNG.

UNIT-II
Liquefaction Technologies: Propane precooled mixed refrigerant process – Description of Air products C_3MR LNG process – Liquefaction – LNG flash and storage.
Cascade process: Description of ConocoPhillips optimized cascade (copoc) process – Liquefaction – LNG flash and storage.
Other Liquefaction Processes: Description of Linde MFC LNG process- Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and subcooling- Trends in LNG train capacity – strategy for grassroots plant- offshore LNG production.

UNIT-III
Supporting Functional Units in LNG Plants: Gas pretreatment: Slug catcher – NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit – Mercury and sulphur removal unit – NGL recovery – Nitrogen rejection – Helium recovery.

UNIT-IV
Receiving Terminals: Receiving terminals in India – Main components and description of marine facilities – storage capacity – Process descriptions.
Integration with adjacent facilities – Gas inter changeability – Nitrogen injection – Extraction of C_2^+ components.

LNG Shipping Industry & Major Equipment in LNG Industry: LNG Shipping Industry: LNG fleet – Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations

UNIT-V

Major equipment in LNG industry: Cryogenic heat exchangers: Spiral – Wound heat exchangers – Plate-fin heat exchangers – Cold boxes; Centrifugal compressors – Axial compressors – Reciprocating compressors. LNG pumps and liquid expanders – Loading Arms and gas turbines.

Vaporizers: Submerged combustion vaporizers- Open rack vaporizers – Shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater. Ambient air vaporizers: Direct heating with ambient air – Indirect heating with ambient air.; LNG tanks.

Safety, Security and Environmental Issues: Safety design of LNG facilities – Security issues for the LNG industry – Environmental issues – Risk based analysis of an LNG plant.

TEXT BOOK:

1. LNG: Basics of Liquefied Natural Gas, I st Edition, Stanley Huang, Hwa Chiu and Doug Elliot, PETEX, 2007.

(https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/HTML/index.html.)

REFERENCE BOOKS:

1. Marine Transportation of LNG (Liquefied) and related products, Richard G. Wooler, Gornell Marine Press, 1975.
2. Marine Transportation of Liquefied Natural Gas, Robert P Curt, Timothy D. Delaney, National Maritime Research Centre, 1973.
3. Natural Gas: Production, Processing and Transport, Alexandre Rojey, Editions OPHRYS, 1997.

B.TECH. PETROLEUM ENGINEERING
HEALTH, SAFETY AND ENVIRONMENT IN PETROLEUM INDUSTRY
(Open Elective - III)

B.Tech. IV Year II Sem.	**L**	**T/P/D**	**C**
Course Code: **PE833OE**	**3**	**0/0/0**	**3**

Course Objectives:

- Knowledge of environment issues and all related Acts.
- Knowledge of drilling fluids and its toxic effects with environment.
- Proper disposal of drilling cutting after appropriate treatment.
- Treatment of produced water and makeup water and its disposal as per state pollution control board norms.
- Knowledge of oil mines regulations and proper implementation in drilling & production mines as per Act.
- Knowledge of Hazop in drilling rigs & production installations.
- Knowledge of disaster management to fight any fire accident at drilling rig/ production installation/production platform.

Course Outcomes:

- The student can have the knowledge of various Acts related to safety, Health and environment in petroleum industry.
- The student can have the knowledge of various drilling fluids handling and safe disposal such toxic products.
- Knowledge of disaster management to fight any crisis.
- Knowledge of Hazard studies and occupational health hazards in the industry.

UNIT - I

Introduction to environmental control in the petroleum industry: Overview of environmental issues- A new attitude.

Drilling and production operations: Drilling- Production- Air emissions.

UNIT - II

The impact of drilling and production operations: Measuring toxicity- Hydrocarbons- Salt- Heavy metals- Production chemicals- Drilling fluids- Produced water- Nuclear radiation- Air pollution- Acoustic impacts- Effects of offshore platforms- Risk assessment.

Environmental transport of petroleum wastes: Surface paths- Subsurface paths- Atmospheric paths. Planning for Environmental protection.

Waste treatment methods: Treatment of water- Treatment of solids- Treatment of air emissions-Waste water disposal: surface disposal.

UNIT - III

Oil mines regulations: Introduction-Returns, Notices and plans- Inspector, management and duties- Drilling and workover- Production- Transport by pipelines- Protection against gases and fires- Machinery, plants and equipment- General safety provisions- Miscellaneous- Remediation of contaminated sites- Site assessment-Remediation process.

UNIT- IV

Toxicity, physiological, asphyxiation, respiratory, skin effect of petroleum hydrocarbons and their mixture- Sour gases with their threshold limits- Guidelines for occupational health monitoring in oil and gas industry. Corrosion in petroleum industry- Additives during acidizing, sand control and fracturing.

UNIT - V

Hazard identification- Hazard evaluation- Hazop and what if reviews- Developing a safe process and safety management- Personal protection systems and measures.

Guidelines on internal safety audits (procedures and checklist)- Inspection & safe practices during electrical installations- Safety instrumentation for process system in hydrocarbon industry- Safety aspects in functional training-Work permit systems.

Classification of fires- The fire triangle- Distinction between fires and explosions- Flammability characteristics of liquids and vapors- Well blowout fires and their control- Fire fight equipment- Suppression of hydrocarbons fires.

TEXT BOOKS:

1. Environmental Control in Petroleum Engineering, John C. Reis, Gulf Publishing Company, 1996.
2. Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries, Dennis P. Nolan, Noyes Publications, 1994.
3. Oil Industry Safety Directorate (OISD) Guidelines, Ministry of Petroleum & Natural Gas, Government of India and Oil Mines Regulations-1984, Directorate General of Mines Safety, Ministry of Labor and Employment, Government of India.

REFERENCE BOOKS:

1. Guidelines for Process Safety Fundamentals in General Plant Operations Centre for Chemical Process Safety, American Institute of Chemical Engineers, 1995.
2. Guidelines for Fire Protection in Chemical, Petrochemical and Hydrocarbon Processing Facilities, Centre for Chemical Process Safety, American Institute of Chemical Engineers, 2003.
3. Guidelines for Hazard Evaluation Procedures Centre for Chemical Safety, Wiley-AIChE, 3rd Edition, 2008.
4. Guideline for Process Safety Fundamentals in General Plant Operations, Centre for Chemical Process Safety, AIChE, 1995.
5. Chemical Process Industry Safety, K S N Raju, McGraw Hill, 2014.