INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
(Approved by AICTE | NAAC Accreditation with 'A' Grade | Accredited by NBA | Affiliated to JNTUH)
Dundigal, Hyderabad - 500 043, Telangana

OUTCOME BASED EDUCATION
WITH
CHOICE BASED CREDIT SYSTEM

MASTER OF TECHNOLOGY
CAD / CAM

ACADEMIC REGULATIONS, COURSE STRUCTURE AND SYLLABI UNDER AUTONOMOUS STATUS

M. Tech Regular Two Year Degree Program
(for the batches admitted from the academic year 2016 - 17)

FAILURE TO READ AND UNDERSTAND THE REGULATIONS IS NOT AN EXCUSE

CONTENTS

"Take up one idea.
Make that one idea you're life-think of it, dream of it, and live on that idea.
Let the brain muscles, nerves, every part of your body be full of that idea and just leave every other idea alone.
This is the way to success" **Swami Vivekananda**

PRELIMINARY DEFINITIONS AND NOMENCLATURES

Academic Council: The Academic Council is the highest academic body of the institute and is responsible for the maintenance of standards of instruction, education and examination within the institute. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Autonomy: Means freedom to an institute in all aspects of conducting its academic programs, granted by UGC for Promoting Excellence.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises two consecutive semesters i.e., Even and Odd semester.

AICTE: Means All India Council for Technical Education, New Delhi.

Autonomous Institute: Means an institute designated as autonomous by University Grants Commission (UGC), New Delhi in concurrence with affiliating University (Jawaharlal Nehru Technological University, Hyderabad) and State Government.

Backlog Course: A course is considered to be a backlog course if the student has obtained a failure grade (F) in that course.

Basic Sciences: The courses offered in the areas of Mathematics, Physics, Chemistry, Biology etc., are considered to be foundational in nature.

Betterment: Betterment is a way that contributes towards improvement of the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Board of Studies (BOS): BOS is an authority as defined in UGC regulations, constituted by Head of the Organization for each of the departments separately. They are responsible for curriculum design and updation in respect of all the programs offered by a department.

Certificate course: It is a course that makes a student gain hands-on experience and skill required for holistic development in a specific area/field.

Choice Based Credit System: The credit based semester system is one which provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching along with provision of choice for the student in the course selection.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Commission: Means University Grants Commission (UGC), New Delhi.

Continuous Internal Examination: It is an examination conducted towards internal assessment.

Course: A course is a subject offered by the University for learning in a particular semester.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture hour per week.

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

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed upto two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources and processes for evaluating the attainment of Program Educational Objectives.

Degree with Specialization: A student who fulfills all the program requirements of her/his discipline and successfully completes a specified set of professional elective courses in a specialized area is eligible to receive a degree with specialization like Structural Engineering, Embedded Systems, CSE, etc.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff and other resources in the process of study for a degree.

Detention in a course: Student who does not obtain minimum prescribed attendance in a course shall be detained in that particular course.

Dropping from the Semester: A student who doesn't want to register for any semester can apply in writing in prescribed format before commencement of that semester.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective and/or Open Elective.

Evaluation: Evaluation is the process of judging the academic performance of the student in her/his courses. It is done through a combination of continuous internal assessment and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are indicated by alphabets.

Grade Point: It is a numerical weight allotted to each letter grade on a 10 point scale.

Institute: Means Institute of Aeronautical Engineering, Hyderabad unless indicated otherwise by the context.

Massive Open Online Course (MOOC): MOOC courses inculcate the habit of self learning. MOOC courses would be additional choices in all the elective group courses.

Pre-requisite: A course, the knowledge of which is required for registration into higher level course.

Core: The courses that are essential constituents of each engineering discipline are categorized as professional core courses for that discipline.

Professional Elective: A course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: Means, Master of Technology (M.Tech) degree program / UG degree program: B.Tech.

Program Educational Objectives: The broad career, professional and personal goals that every student will achieve through a strategic and sequential action plan.

Project work: It is a design or research based work to be taken up by a student during his/her second year to achieve a particular aim. It is a credit based course and is to be planned carefully by the student.

Re-Appearing: A student can reappear only in the semester end examination for the theory component of a course, subject to the regulations contained herein.

Registration: Process of enrolling into a set of courses in a semester of a Program.

Regulations: The regulations, common to all M.Tech programs offered by Institute are designated as "IARE-R16" and are binding on all the stakeholders.

Semester: It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days. The odd semester starts usually in July and even semester in December.

Semester End Examinations: It is an examination conducted for all courses offered in a semester at the end of the semester.

S/he: Means "she" and "he" both.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.

University: Means the Jawaharlal Nehru Technological University Hyderabad, Hyderabad.

Withdraw from a Course: Withdrawing from a course means that a student can drop from a course within the first two weeks of the odd or even semester (deadlines are different for summer sessions). However s/he can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.

Words 'he', 'him', 'his', occur, they imply 'she', 'her', 'hers' also.

FOREWORD

The autonomy is conferred to Institute of Aeronautical Engineering (IARE), Hyderabad by University Grants Commission (UGC), New Delhi based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies like J N T University Hyderabad (JNTUH), Hyderabad and AICTE. It reflects the confidence of the affiliating University in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf and thus awards degrees on behalf of the college. Thus, an autonomous institution is given the freedom to have its own **curriculum, examination system** and **monitoring mechanism**, independent of the affiliating University but under its observance.

IARE is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, if not improving upon the standards and ethics for which it has been striving for more than a decade in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies like Academic Council and Boards of Studies are constituted with the guidance of the Governing Body of the institute and recommendations of the JNTUH to frame the regulations, course structure and syllabi under autonomous status.

The autonomous regulations, course structure and syllabi have been prepared after prolonged and detailed interaction with several expertise solicited from academics, industry and research, in accordance with the vision and mission of the institute to order to produce a quality engineering graduate to the society.

All the faculty, parents and students are requested to go through all the rules and regulations carefully. Any clarifications needed are to be sought at appropriate time and with principal of the college, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The Cooperation of all the stake holders is sought for the successful implementation of the autonomous system in the larger interests of the college and brighter prospects of engineering graduates.

PRINCIPAL

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

ACADEMIC REGULATIONS

M.Tech. Regular Two Year Degree Program
(for the batches admitted from the academic year 2016 - 17)

For pursuing two year postgraduate Master Degree program of study in Engineering (M.Tech) offered by Institute of Aeronautical Engineering under Autonomous status and herein after referred to as IARE.

1.0 CHOICE BASED CREDIT SYSTEM

The Indian Higher Education Institutions (HEI's) are changing from the conventional course structure to Choice Based Credit System (CBCS) along with introduction to semester system at first year itself. The semester system helps in accelerating the teaching learning process and enables vertical and horizontal mobility in learning.

The credit based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching. The choice based credit system provides a 'cafeteria' type approach in which the students can take courses of their choice, learn at their own pace, undergo additional courses and acquire more than the required credits and adopt an interdisciplinary approach to learning.

Choice Based Credit System (CBCS) is a flexible system of learning and provides choice for students to select from the prescribed elective courses. A course defines learning objectives and learning outcomes and comprises of lectures / tutorials / laboratory work / field work / project work / comprehensive examination / viva / seminars / assignments / presentations / self-study etc. or a combination of some of these.

Under the CBCS, the requirement for awarding a degree is prescribed in terms of number of credits to be completed by the students.

The CBCS permits students to:

1. Choose electives from a wide range of elective courses offered by the departments of the Institute.
2. Undergo additional courses of interest.
3. Adopt an inter-disciplinary approach in learning.
4. Make the best use of expertise of the available faculty.

2.0 MEDIUM OF INSTRUCTION

The medium of instruction shall be English for all courses, examinations, seminar presentations and project work. The curriculum will comprise courses of study as given in course curriculum in accordance with the prescribed syllabi.

3.0 ELIGIBILITY FOR ADMISSION

The admissions for category A and B seats shall be as per the guidelines of Telangana State Council for Higher Education (TSCHE) in consonance with government reservation policy.

a) Under Category A: 70% of the seats are filled based on GATE/PGECET ranks.

b) Under Category B: 30% seats are filled on merit basis as per guidelines of TSCHE.

4.0 UNIQUE COURSE IDENTIFICATION CODE

Every specialization of the M.Tech programme will be placed in one of the seven groups as listed in the Table 1.

Table 1: Group of Courses

S. No	Specialization	Offering Department	Code
1	Structural Engineering	Civil Engineering	ST
2	Power Electronics and Electrical Drives	Electrical and Electronics Engineering	PE
3	CAD / CAM	Mechanical Engineering	CC
4	Embedded Systems	Electronics and Communication Engineering	ES
5	Computer Science and Engineering	Computer Science and Engineering	CS
6	Software Engineering	Information Technology	SE
7	Aerospace Engineering	Aeronautical Engineering	AE

5.0 TYPES OF COURSES

Courses in a programme may be of two kinds: **Core and Elective.**

5.1 Core Course:

There may be a core course in every semester. This is the course which is to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in said discipline of study.

5.2 Elective Course:

Electives provide breadth of experience in respective branch and applications areas. Elective course is a course which can be chosen from a pool of courses. It may be:

- Supportive to the discipline of study
- Providing an expanded scope
- Enabling an exposure to some other discipline/domain
- Nurturing student's proficiency/skill.

An elective may be discipline centric (Professional Elective) focusing on those courses which add generic proficiency to the students or may be chosen from supportive/general discipline called as "Open Elective".

There shall be four professional elective groups out of which students can choose not more than two courses from each group. Overall, students can opt for four professional elective courses which suit their project work in consultation with the faculty advisor/mentor. In addition, one course from each of the two open electives has to be selected. A student may also opt for more elective courses in his/her area of interest.

6.0 SEMESTER STRUCTURE

The institute shall follow semester pattern. An academic year shall consist of a first semester and a second semester and the summer term. Each semester shall be of 23 weeks (Table 2) duration and this period includes time for course work, examination preparation and conduct of examinations. Each main semester shall have a minimum of 90 working days; out of which number of contact days for teaching / practical shall be 75 and 15 days shall be for examination preparation. The duration for each semester shall be a minimum of 17 weeks of instruction. The Academic Calendar is declared at the beginning of the academic year as given in Table 2.

Table 2: Academic Calendar

<table>
<tr><td rowspan="6">FIRST SEMESTER
(23 weeks)</td><td>I Spell Instruction Period</td><td>9 weeks</td><td rowspan="5">21 weeks</td></tr>
<tr><td>I Mid Examinations</td><td>1 week</td></tr>
<tr><td>II Spell Instruction Period</td><td>8 weeks</td></tr>
<tr><td>II Mid Examinations</td><td>1 week</td></tr>
<tr><td>Preparation and Practical Examinations</td><td>2 weeks</td></tr>
<tr><td colspan="2">Semester End Examinations</td><td>2 weeks</td></tr>
<tr><td colspan="3">Semester Break and Supplementary Exams</td><td>2 weeks</td></tr>
<tr><td rowspan="6">SECOND SEMESTER
(23 weeks)</td><td>I Spell Instruction Period</td><td>9 weeks</td><td rowspan="5">21 weeks</td></tr>
<tr><td>I Mid Examinations</td><td>1 week</td></tr>
<tr><td>II Spell Instruction Period</td><td>8 weeks</td></tr>
<tr><td>II Mid Examinations</td><td>1 Week</td></tr>
<tr><td>Preparation & Practical Examinations</td><td>2 weeks</td></tr>
<tr><td colspan="2">Semester End Examinations</td><td>2 weeks</td></tr>
<tr><td colspan="3">Summer Vacation</td><td>4 weeks</td></tr>
<tr><td>THIRD SEMESTER</td><td colspan="2">Project Work Phase - I</td><td>18 weeks</td></tr>
<tr><td>FOURTH SEMESTER</td><td colspan="2">Project Work Phase - II</td><td>18 weeks</td></tr>
</table>

7.0 PROGRAM DURATION

A student shall be declared eligible for the award of M.Tech degree, if s/he pursues a course of study and completes it successfully in not less than two academic years and not more than four academic years. A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his/her admission, shall forfeit his/her seat in M.Tech course.

a) A student will be eligible for the award of M.Tech degree on securing a minimum of 5.0/10.0 CGPA.

b) In the event of non-completion of project work and/or non-submission of the project report by the end of the fourth semester, the candidate shall re-register by paying the semester fee for the project. In such a case, the candidate will not be permitted to submit the report earlier than three months and not later than six months from the date of registration.

8.0 CURRICULUM AND COURSE STRUCTURE

The curriculum shall comprise Core Courses, Elective Courses, Laboratory Course, Comprehensive Examination, Internship and Project Work. The list of elective courses may include subjects from allied disciplines also.

Each Theory and Laboratory course carries credits based on the number of hours/week as follows:

- **Lecture Hours (Theory):** 1 credit per lecture hour per week.
- **Laboratory Hours (Practical):** 1 credit for 2 practical hours, 2 credits for 3 or 4 practical hours per week.
- **Project Work:** 1 credit for 4 hours of project work per week.

8.1 Credit distribution for courses offered is shown in Table 3.

Table 3: Credit distribution

S. No	Course	Hours	Credits
1	Core Courses	3	3
2	Elective Courses	3	3
3	MOOC Courses	-	2
4	Laboratory Courses	3	2
5	Seminar and Technical Writing	3	2
6	Comprehensive Examination	-	2
7	Project Work	128	30

8.2 Course wise break-up for the total credits:

Total Theory Courses (12) Core Courses (06) + Professional Electives (04) + Open Electives (02)	06 @ 3 credits + 06 @ 3 credits	36
Total Laboratory Courses (03)	03 @ 2 credits	06
MOOC Courses (02)	02 @ 2 credits	04
Seminar and Technical Writing (01)	1 @ 2 credits	02
Comprehensive Examination (01)	1 @ 2 credits	02
Project Work	1 @ 30 credits	30
TOTAL CREDITS		**80**

9.0 EVALUATION METHODOLOGY

9.1 Theory Course:

Each theory course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIE during the semester, marks are awarded by taking average of two sessional examinations.

9.1.1 Semester End Examination (SEE):

The SEE shall be conducted for 70 marks of 3 hours duration. The syllabus for the theory courses shall be divided into FIVE units and each unit carries equal weightage in terms of marks distribution. The question paper pattern shall be as defined below. Two full questions with 'either' 'or' choice will be drawn from each unit. Each question carries 14 marks. There could be a maximum of three sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept
30 %	To test the analytical skill of the concept
20 %	To test the application skill of the concept

9.1.2 Continuous Internal Assessment (CIA):

For each theory course the CIA shall be conducted by the faculty/teacher handling the course as given in Table 4. CIA is conducted for a total of 30 marks, with 25 marks for Continuous Internal Examination (CIE) and 05 marks for Technical Seminar and Term Paper.

Table 4: Assessment pattern for Theory Courses

COMPONENT	THEORY		TOTAL MARKS
Type of Assessment	CIE Exam (Sessional)	Technical Seminar and Term Paper	
Max. CIA	25	5	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 9th and 17th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration, consisting of 5 one mark compulsory questions in part-A and 4 questions in part-B. The student has to answer any 4 questions out of five questions, each carrying 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Technical Seminar and Term Paper:

Two seminar presentations are conducted during I year I semester and II semester. For seminar, a student under the supervision of a concerned faculty member, shall identify a topic in each course and prepare the term paper with overview of topic. The evaluation of Technical seminar and term paper is for maximum of 5 marks. Marks are awarded by taking average of marks scored in two Seminar Evaluations.

9.2 Laboratory Course:

9.2.1 Each lab will be evaluated for a total of 100 marks consisting of 30 marks for internal assessment and 70 marks for semester end lab examination. Out of 30 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance and 10 marks for the final internal lab assessment. The semester end lab examination for 70 marks shall be conducted by two examiners, one of them being a internal examiner and another is external examiner, both nominated by the Principal from the panel of experts recommended by Chairman, BOS.

9.2.2 All the drawing related courses are evaluated in line with lab courses. The distribution shall be 30 marks for internal evaluation (20 marks for day–to–day work, and 10 marks for internal tests) and 70 marks for semester end lab examination. There shall be ONE internal test for 10 marks each in a semester.

9.3 MOOC Courses:

Meeting with the global requirements, to inculcate the habit of self learning and in compliance with UGC guidelines, MOOC (Massive Open Online Course) courses have been introduced as electives.

9.3.1 The proposed MOOC Courses would be additional choices in all the elective groups subject to the availability during the respective semesters and respective departments will declare the list of the courses at the beginning of the semester. Course content for the selected MOOC Courses shall be drawn from respective MOOCs links or shall be supplied by the department. Course will be mentored by faculty members and Assessment and evaluation of the courses shall be done by the department.

9.3.2 There shall be one Mid Sessional Examination (Quiz exam for 30 marks) after 8 weeks of the commencement of the course and semester end evaluation (Descriptive exam for 70 marks) shall be done along with other regular courses.

9.3.3 Two credits will be awarded upon successful completion of each MOOC Course.

9.3.4 Students interested in doing MOOC Courses shall register the course title at their department office at the start of the semester against the courses that are announced by the department.

9.4 Project work

Normally, the project work should be carried out at Host Institute (Institute of Aeronautical Engineering). However, it can also be carried out in any of the recognized Educational Institutions, National Laboratories, Research Institutions, Industrial Organizations, Service Organizations or Government Organizations with the prior permission from the guide and concerned Head of the Department. A student shall submit the outcome of the project work in the form of a dissertation.

9.4.1 The student shall submit the project work synopsis at the end of III semester for Phase-I of project evaluation. The Phase-I of project work shall be evaluated by Project Review Committee (PRC) at the end of the third semester for a maximum of 100 marks. Head of the Department (HOD) shall constitute a PRC comprising of senior faculty of the specialization, Guide and Head of the Department.

9.4.2 The first phase of project work is to be carried out in IV semester for Phase –II of Project work. The student will be allowed to appear for final viva voce examination at the end of IV semester only if s/he has submitted s/he project work in the form of paper for presentation / publication in a conference/journal and produce the proof of acceptance of the paper from the organizers/publishers.

9.4.3 The student shall submit the project work in the form of dissertation at least four weeks ahead of the completion of the program. Head of the Department shall constitute an Internal Evaluation Committee (IEC) comprising of the Chairman BOS (PG), HOD and Guide. As per convenes of all meeting for open pre-submission seminar evaluation of the student. If the open pre-submission seminar by a student is not satisfactory, another seminar shall be scheduled within two weeks.

The evaluation of the project work and the marks allotted are as under:

S.No	Project Phases	Mode	Evaluation Committee	Marks
1	Phase - I	Continuous evaluation at the end of III Semester	Guide	30
2		Evaluation at the end of III Semester	Project Review Committee (PRC) comprising of senior faculty of the specialization, guide and HOD.	70
Total(Phase – I)				**100**
3	Phase - II	An open pre-submission seminar by the student	The Internal Evaluation Committee (IEC) comprising of the Chairman, BOS (PG), HOD and guide wherein the HOD convenes its meeting.	30
4		End Semester Examination (An open seminar followed by viva-voce)	The External Evaluation Committee (EEC) comprising of External Examiner, HOD and guide wherein the HOD shall be the chairman of the committee.	70
Total(Phase-II)				**100**

9.4.4 As soon as a student submits his project work, Principal shall appoint the External Examiner among the panel of examiners recommended by the Chairman, BOS (PG).

9.4.5 The Principal shall schedule the End Semester Examination in project work soon after the completion of the study of program and a student can appear for the same provided s/he has earned successfully all the requisite credits. The student shall produce the dissertation duly certified by the guide and HOD during the Examination.

9.4.6 The project reports of M.Tech students who have not completed their course work successfully will be evaluated in that semester itself and the result sent confidentially to the Controller of Examinations. The results of the project work evaluation will be declared by the Controller of Examinations only after the successful completion of the courses by those students.

9.5 Comprehensive Examination

The comprehensive examination is aimed at assessing the student's understanding of various Foundation, Skill and Core courses studied by the end of II semester and is intended to test the student's grasp of the chosen field of study. The comprehensive examination is an online test evaluated for 100 marks.

10.0 ATTENDANCE REQUIREMENTS AND DETENTION POLICY

10.1 It is desirable for a candidate to put on 100% attendance in each course. In every course (theory/laboratory), student has to maintain a minimum of 80% attendance including the days of attendance in sports, games, NCC and NSS activities to be eligible for appearing in Semester End Examination of the course.

10.2 For cases of medical issues, deficiency of attendance in each course to the extent of 15% may be condoned by the College Academic Committee (CAC) on the recommendation of Head of the Department if his/her attendance is between 80% to 65% in every course, subjected to submission of medical certificate and other needful documents to the concerned department.

10.3 The basis for the calculation of the attendance shall be the period prescribed by the institute by its calendar of events. For late admission, attendance is reckoned from the date of admission to the program.

10.3 However, in case of a student having less than 65% attendance in any course, s/he shall be detained in the course and in no case such process will be relaxed.

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

10.5 A prescribed fee shall be payable towards Condonation of shortage of attendance.

10.6 A candidate shall put in a minimum required attendance at least in three (3) theory courses for getting promoted to next higher class / semester. Otherwise, s/he shall be declared detained and has to repeat semester.

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

11.0 CONDUCT OF SEMESTER END EXAMINATIONS AND EVALUATION

11.1 Semester end examination shall be conducted by the Controller of Examinations (COE) by inviting Question Papers from the External Examiners.

11.2 Question papers may be moderated for the coverage of syllabus, pattern of questions by Semester End Examination Committee chaired by Head of the Department one day before the commencement of semester end examinations.

11.3 Internal Examiner shall prepare a detailed scheme of valuation.

11.4 The answer papers of semester end examination should be evaluated by the internal examiner immediately after the completion of exam and the award sheet should be submitted to COE in a sealed cover before the same papers are kept for second evaluation by external examiner.

11.5 In case of difference is more than 15% of marks, the answer paper shall be re-evaluated by a third examiner appointed by the Examination Committee and marks awarded by him shall be taken as final.

11.6 HOD shall invite 3-9 external examiners to evaluate all the end semester answer scripts on a prescribed date(s). Practical laboratory exams are conducted involving external examiners.

11.7 Examination Control Committee shall consolidate the marks awarded by internal and external examiners to award grades.

12.0 SCHEME FOR THE AWARD OF GRADE

12.1 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each theory course, if s/he secures:

i. Not less than 40% marks for each theory course in the semester end examination, and

ii. A minimum of 50% marks for each theory course considering both CIA and SEE

12.2 A student shall be deemed to have satisfied the minimum academic requirements and earn the credits for each Laboratory / Seminar and Technical Writing / Project, if s/he secures

i. Not less than 40% marks for each Laboratory / Seminar and Technical Writing / Project course in the semester end examination,

ii. A minimum of 50% marks for each Laboratory / Seminar and Technical Writing / Project course considering both internal and semester end examination.

12.3 If a candidate fails to secure a pass in a particular course, it is mandatory that s/he shall register and reappear for the examination in that course during the next semester when examination is conducted in that course. It is mandatory that s/he should continue to register and reappear for the examination till s/he secures a pass.

13.0 LETTER GRADES AND GRADE POINTS

13.1 Performances of students in each course are expressed in terms of marks as well as in Letter Grades based on absolute grading system. The UGC recommends a 10 point grading system with the following letter grades as given below:

Range of Marks	Grade Point	Letter Grade
100 - 80	10	S (Superior)
70 – 79	9	A+ (Excellent)
60 – 69	8	A (Very Good)
55 – 59	7	B+ (Good)
50 – 54	6	B (Average)
Below 50	0	F (Fail)
Absent	0	Ab (Absent)
Authorized Break of Study	0	ABS

13.2 A student is deemed to have passed and acquired to correspondent credits in particular course if s/he obtains any one of the following grades: “S”, “A+”, “A”, “B+”, “B”.

13.3 A student obtaining Grade “F” shall be considered Failed and will be required to reappear in the examination.

13.4 "SA" denotes shortage of attendance (as per item 10) and hence prevention from writing Semester End Examination.

13.5 At the end of each semester, the institute issues grade sheet indicating the SGPA and CGPA of the student. However, grade sheet will not be issued to the student if s/he has any outstanding dues.

14.0 COMPUTATION OF SGPA AND CGPA

The UGC recommends to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA). The credit points earned by a student are used for calculating the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA), both of which are important performance indices of the student. SGPA is equal to the sum of all the total points earned by the student in a given semester divided by the number of credits registered by the student in that semester. CGPA gives the sum of all the total points earned in all the previous semesters and the current semester divided by the number of credits registered in all these semesters. Thus,

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course and n represent the number of courses in which a students is registered in the concerned semester.

$$CGPA = \sum_{j=1}^{m} (C_j S_j) / \sum_{j=1}^{m} C_j$$

Where, S_j is the SGPA of the j^{th} semester and C_j is the total number of credits upto the semester and m represent the number of semesters completed in which a student registered upto the semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

15.0 ILLUSTRATION OF COMPUTATION OF SGPA AND CGPA

15.1 Illustration for SGPA

Course Name	Course Credits	Grade letter	Grade point	Credit Point (Credit x Grade)
Course 1	3	A	8	3 x 8 = 24
Course 2	4	B+	7	4 x 7 = 28
Course 3	3	B	6	3 x 6 = 18
Course 4	3	O	10	3 x 10 = 30
Course 5	3	C	5	3 x 5 = 15
Course 6	4	B	6	4 x 6 = 24
	20			**139**

$Thus, SGPA = 139 / 20 = 6.95$

15.2 Illustration for CGPA

Semester 1	Semester 2	Semester 3	Semester 4
Credit: 20 SGPA: 6.9	Credit: 22 SGPA: 7.8	Credit: 25 SGPA: 5.6	Credit: 26 SGPA: 6.0

$$Thus,\ CGPA = \frac{20x6.9 + 22x7.8 + 25x5.6 + 26x6.0}{93} = 6.51$$

16.0 PHOTOCOPY / REVALUATION

A student, who seeks the revaluation of the answer script, is directed to apply for the photocopy of his/her semester examination answer paper(s) in the theory course(s) within 2 working days from the declaration of results in the prescribed format to the Controller of Examinations through the Head of the Department. On receiving the photocopy, the student can consult with a competent member of faculty and seek the opinion for revaluation. Based on the recommendations, the student can register for the revaluation with prescribed fee. The Controller of Examinations shall arrange for the revaluation and declare the results. Revaluation is not permitted to the courses other than theory courses.

17.0 GRADUATION REQUIREMENTS

The following academic requirements shall be met for the award of M .Tech degree.

17.1 Student shall register and acquire minimum attendance in all courses and secure 80 credits.

17.2 A student who fails to earn 80 credits within four consecutive academic years from the year of his/her admission with a minimum CGPA of 5.0, shall forfeit his/her degree and his/her admission stands cancelled.

18.0 AWARD OF DEGREE

Classification of degree will be as follows:

CGPA ≥ 7.5	CGPA ≥ 6.5 and < 7.5	CGPA ≥ 5.5 and < 6.5	CGPA ≥ 5.0 and < 5.5	CGPA < 5.0
First Class with Distinction	**First Class**	**Second Class**	**Pass Class**	**Fail**

a) In case a student takes more than one attempt in clearing a course, the final marks secured shall be indicated by * mark in the grade sheet.

b) All the candidates who register for the semester end examination will be issued grade sheet by the Institute. Apart from the semester wise grade sheet, the institute will issue the provisional certificate subject to the fulfillment of all the academic requirements.

19.0 IMPROVEMENT OF GRADE:

A candidate, after becoming eligible for the award of the degree, may reappear for the final examination in any of the theory courses as and when conducted for the purpose of improving the aggregate and the grade. But this reappearance shall be within a period of two academic years after becoming eligible for the award of the degree.

However, this facility shall not be availed of by a candidate who has taken the Original Degree Certificate. Candidates shall not be permitted to reappear either for CIE in any course or for Semester End Examination (SEE) in laboratory courses (including Project Viva-voce) for the purpose of improvement.

20.0 TERMINATION FROM THE PROGRAM

The admission of a student to the program may be terminated and the student may be asked to leave the institute in the following circumstances:

a) The student fails to satisfy the requirements of the program within the maximum period stipulated for that program.

b) The student fails to satisfy the norms of discipline specified by the institute from time to time.

21.0 WITH-HOLDING OF RESULTS

If the candidate has not paid any dues to the college / if any case of indiscipline / malpractice is pending against him/her, the results of the candidate will be withheld. The issue of the degree is liable to be withheld in such cases.

22.0 GRADUATION DAY

The institute shall have its own annual Graduation Day for the award of Degrees to students completing the prescribed academic requirements in each case, in consultation with the University and by following the provisions in the Statute.

The college shall institute prizes and medals to meritorious students annually on Graduation Day. This will greatly encourage the students to strive for excellence in their academic work.

23.0 DISCIPLINE

Every student is required to observe discipline and decorum both inside and outside the institute and not to indulge in any activity which will tend to bring down the honor of the institute. If a student indulges in malpractice in any of the theory / practical examination, continuous assessment examinations he/she shall be liable for punitive action as prescribed by the Institute from time to time.

24.0 GRIEVANCE REDRESSAL COMMITTEE

The institute shall form a Grievance Redressal Committee for each course in each department with the Course Teacher and the HOD as the members. This Committee shall solve all grievances related to the course under consideration.

25.0 TRANSITORY REGULATIONS

25.1 A student who has been detained in any semester of previous regulations for not satisfying the attendance requirements shall be permitted to join in the corresponding semester of this regulation.

25.2 Semester End Examination in each course under the regulations that precede immediately these regulations shall be conducted three times after the conduct of last regular examination under those regulations. Thereafter, the failed students, if any, shall take examination in the equivalent papers of these regulations as suggested by the Chairman, BOS concerned.

26.0 REVISION OF REGULATIONS AND CURRICULUM

The Institute from time to time may revise, amend or change the regulations, scheme of examinations and syllabi if found necessary and on approval by the Academic Council and the Governing Body shall come into force and shall be binding on the students, faculty, staff, all authorities of the Institute and others concerned.

FAILURE TO READ AND UNDERSTAND THE REGULATIONS IS NOT AN EXCUSE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

CAD / CAM

COURSE STRUCTURE

I SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BCC001	Advanced CAD	PC	Core	3	-	-	3	30	70	100
BCC002	Numerical Method for Partial Differential Equations	PC	Core	3	-	-	3	30	70	100
BCC003	Rapid Prototype Technologies	PC	Core	3	-	-	3	30	70	100
	Professional Elective – I	PE	Elective	3	-	-	3	30	70	100
	Professional Elective – II	PE	Elective	3	-	-	3	30	70	100
	Open Elective – I	OE	Elective	3	-	-	3	30	70	100
BCC301	MOOC - I (Massive Open Online Course)	PE	Elective	-	-	3	2	30	70	100
PRACTICAL										
BCC101	Computer Aided Design Laboratory	PC	Core	-	-	3	2	30	70	100
TOTAL				**18**	**00**	**06**	**22**	**240**	**560**	**800**

II SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BCC004	Design of Hydraulic and Pneumatic System	PC	Core	3	-	-	3	30	70	100
BCC005	Computer Aided Manufacturing	PC	Core	3	-	-	3	30	70	100
BCC006	Flexible Manufacturing System	PC	Core	3	-	-	3	30	70	100
	Professional Elective –III	PE	Elective	3	-	-	3	30	70	100
	Professional Elective –IV	PE	Elective	3	-	-	3	30	70	100
	Open Elective –II	OE	Elective	3	-	-	3	30	70	100
PRACTICAL										
BCC102	Computer Aided Machining and Robotics Laboratory	PC	Core	-	-	3	2	30	70	100
BCC103	Application Development Mini Project Laboratory	-	Core	-	-	3	2	30	70	100
TOTAL				**18**	**00**	**06**	**22**	**240**	**560**	**800**

III SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
THEORY										
BCC401	Seminar and Technical Writing	PC	Core	-	-	3	2	30	70	100
BCC302	MOOC-II (Massive Open Online Course)	PE	Elective	-	-	3	2	30	70	100
PRACTICAL										
BCC501	Comprehensive Examination	-	Core	-	-	-	2	30	70	100
BCC601	Project Work (Phase -I)	-	Core	-	-	-	10	100	-	100
TOTAL				**00**	**00**	**06**	**16**	**190**	**210**	**400**

IV SEMESTER

Course Code	Course Name	Subject Area	Category	Periods per week			Credits	Scheme of Examination Max. Marks		
				L	T	P		CIA	SEE	Total
BCC602	Project Work (Phase -II)	-	Core	-	-	-	20	30	70	100
TOTAL				**00**	**00**	**00**	**20**	**30**	**70**	**100**

PROFESSIONAL ELECTIVES

GROUP 1: GEOMETRICAL DIMENSIONING AND TOLERANCING

Course Code	Course Title
BCC201	Precision Engineering
BCC202	Design for Manufacturing and Assembly
BCC203	Automation in Manufacturing
BCC204	Industrial Robotics

GROUP 2: SELECTION OF ENGINEERING MATERIALS

Course Code	Course Title
BCC205	Special Manufacturing Process
BCC206	Advanced Mechanics of Solids
BCC207	Design Optimization
BCC208	Computer Aided Process Planning

GROUP 3: PRODUCTION PLANNING AND CONTROL

Course Code	Course Title
BCC209	Advanced Automatic Control
BCC210	Design for Manufacturing MEMS and Micro Systems
BCC211	Intelligent Manufacturing Systems
BCC212	Expert System Design

GROUP 4: STRESS ANALYSIS

Course Code	Course Title
BCC213	Stress Analysis and Vibration
BCC214	Computer Aided Analysis of Mechanical Systems
BCC215	Simulation Modeling of Manufacturing
BCC216	Data Communication in CAD/CAM

OPEN ELECTIVES-I

Course Code	Course Title
BST701	Disaster Management
BPE701	Renewable Energy Systems
BCC701	Automotive Design*
BES001	Embedded C
BCS701	Advanced JAVA Programming and Web Services
BAE701	Introduction to Aerospace Engineering
Note: * indicates that subject not offered to the students of Mechanical Engineering Department.	

OPEN ELECTIVES-II

Course Code	Course Title
BST702	Geo Spatial Techniques
BPE702	Solar Photo Voltaic Energy Conversion
BCC702	Computer Graphics*
BES702	Microcontrollers for Embedded System Design
BCS702	Linux Programming
BCS703	Research Methodology
BAE702	Industrial Aerodynamics and Wind Energy
Note: * indicates that subject not offered to the students of Mechanical Engineering Department.	

SYLLABI

ADVANCED CAD

I Semester: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC001	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand of basic trends in design and modeling applicable to CAD/CAM.
II. Applying the CAD tools for designing.
III. Create surface and geometric models.

UNIT-I	PRINCIPLES OF COMPUTER GRAPHICS	Classes: 09

Principles of computer graphics : Introduction, graphic primitives, point plotting, lines, Bresenham's circle algorithm, ellipse, transformation in graphics, coordinate systems, view port, 2D and 3D transformation, hidden surface removal, reflection, shading and generation of character.

UNIT-II	CAD TOOLS	Classes: 09

Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software; Geometric modeling: Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves hermite cubic splines Bezier curves Bezier splines rational curves.

UNIT-III	SURFACE MODELING	Classes: 09

Mathematical representation surfaces, surface model, surface entities surface representation.

Parametric representation of surfaces, plane surface, rule surface, surface of revolution, tabulated cylinder.

UNIT-IV	PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES	Classes: 09

Parametric representation of synthetic surfaces: : Hermite Bicubic surface, Bezier surface, Bezier Spline surface, COONs surface, Blending surface Sculptured surface, Surface manipulation; Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

UNIT-V	GEOMETRICMODELLING-3D	Classes: 09

Geometricmodelling-3D: Solid modeling, solid representation, boundary representation (13-rep), Constructive solid geometry (CSG). CAD/CAM exchange: Evaluation of data, exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS and DXF; Design applications: Mechanical tolerances, mass property calculations, finite element modeling and analysis and mechanical assembly; Collaborative engineering: Collaborative design, principles, approaches, tools, design systems.

Text Books:
1. Ibrhim Zeid, "Mastering CAD/CAM", Tata McGraw Hill, 2nd Edition, 2013. 2. P. N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill, 3rd Edition, 2010. 3. M. P. Groover, E. Zimmers, "CAD/ CAM Computer- Aided Design and Manufacturing", Pearson, 1st Edition, 2003. 4. R. Alavala Chennakesava, "CAD/ CAM Concepts and Applications", PHI, 1st Edition, 2013.
Reference Books:
1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, Pearson, 2nd Edition, 2004. 2. P. Radha Krishnan, "CAD/ CAM/ CIM", New Age International, 4th Edition, 2016. 3. Warren. S. Seames, "Computer Numerical Control Concepts and Programming", Delmar Cengage Learning, 4th Edition, 2013.
Web References:
1. http://nptel.ac.in/courses/112102101/ 2. http://www.journals.elsevier.com/computer-aided-design 3. https://www.elsevier.com/books/surface-modeling-for-cad-cam/choi/978-0-444-88482-4
E-Text Books:
1. http://sbmpme.blogspot.in/2011/01/cad-cam-cim-p-radhakrishnan.html 2. https://www.scribd.com/doc/228624725/cad-cam-text-book-by-P-N-RAO

NUMERICAL METHODS FOR PARTIAL DIFFERENTIAL EQUATIONS

I Semester: **CAD/CAM**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC002	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Analyze finite difference approximation.
II. Determine partial differential equations.
III. Apply partial differential equations with approximation.

UNIT-I	PARABOLIC EQUATIONS	Classes: 08

Introduction to finite difference formula**;** Parabolic equations: Introduction, explicit finite difference approximation to one dimensional equation, Crank-Nicholson implicit method, derivation for boundary conditions.

UNIT-II	CONVERGENCE STABILITY AND CONSISTENCY	Classes: 10

ADI: Alternate direction implicit (ADI) method, finite difference in cylindrical and spherical polar coordinates; Convergence stability and consistency: Definitions of local truncation error and consistency convergence analysis, stability analysis by matrix method, eigen value, Von Newmann stability methods, global rounding error, local truncation error Lax`s equation theorem.

UNIT-III	HYPERBOLIC EQUATIONS	Classes: 08

Analytical solution of first order quasi linear equation, numerical integration along a characteristic lax wenderoff explicit method.

CFI condition Wenderoff`s implicit approximation, propagation of discontinues, numerical solution by the method of characteristics.

UNIT-IV	ELLIPTIC EQUATIONS	Classes: 10

Introduction, finite differences in polar co-ordinates, formulas for derivative near a curved boundary analysis of the discretization error of the five point approximation to polman`s equation over a rectangle.

UNIT-V	SYSTEMATIC ITERATIVE METHODS	Classes: 09

Systematic iterative methods for large linear systems, necessary and sufficient condition for convergence of iterative methods, stones implicit methods, finite element method: Weighted residual method, variations methods, division of the region into elements linear element, Galerkin formulation.

Text Books:

1. G. D. Smith, "Numerical Solution of partial differential equations, finite Differences methods", Brunel University, Clarandon Press Oxford, 3rd Edition, 1985.
2. Joe D. Hoffman, "Numerical Methods for Engineers and scientists", Tata McGraw Hill, 2nd Edition, 2001.

Reference Books:

1. A. R. Mitchel and D. F. Griffiths, "The Finite Difference Methods in Partial Differential equation", John Wiley, 1st Edition, 1980.
2. Larry J. Segerlind, "Applied Finite Element Analysis", John Wiley, 2nd Edition, 1984.

Web References:

1. http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-920j-numerical-methods-for-partial-differential-equations-sma-5212-spring-2003/lecture-notes/
2. https://espace.library.uq.edu.au/view/UQ:239427/Lectures_Book.pdf
3. http://cms.unipune.ac.in/programmes/2006-07/modules/0613-2/resources/NSPDE.pdf

E-Text Books:

1. http://www.e-booksdirectory.com/details.php?ebook=10166
2. http://www.e-booksdirectory.com/details.php?ebook=7400re

RAPID PROTOTYPE TECHNOLOGIES

I Semester: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC003	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Applying of measurement and scaling technique for prototype manufacturing.
II. Organize the data collection.
III. Identify the application for rapid prototyping.
IV. Application for powder based rapid prototyping systems.

UNIT-I	INTRODUCTION TO RAPID PROTOTYPING	Classes: 09

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.

UNIT-II	TYPES OF PROTOTYPING SYSTEMS	Classes: 09

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. solid ground curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies; solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT-III	POWDER BASED RAPID PROTOTYPING SYSTEMS AND TOOLING	Classes: 09

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs. RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using3DP.

UNIT-IV	RAPID PROTOTYPING DATA FORMAT	Classes: 09

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magic's, Mimics, Solid View, View Expert, 3 D View, Velocity 2 , Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT-V	RAPID PROTOTYPING APPLICATIONS	Classes: 09

RP Applications: Application, Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

Text Book:

1. Chua C.K., Leong K.F, LIM C.S, "Rapid prototyping: Principles and Applications",World Scientific publications, 3rd Edition, 2010.

Reference Books:

1. D.T Pham, S. S. Dony, "Rapid Manufacturing", Springer, 1st Edition, 2001.
2.Paul F Jacobs, "Rapid Prototyping & Manufacturing", Wohlers Associates, 2000 ASME Press, 1st Edition, 1996.

Web References:

1. http://nptel.ac.in/courses/112107077/38
2. http://web.iitd.ac.in/~pmpandey/MEL120_html/RP_document.pdf

E-Text Books:

1.https://books.google.co.in/books?id=4OYcyiDUpsQC&redir_esc=y
2.http://store.elsevier.com/Direct-Write-Technologies-for-Rapid-Prototyping-Applications/isbn-9780121742317/

COMPUTER AIDED DESIGN LABORATORY

I Semester: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC101	Core	-	-	3	2	30	70	100
Contact Classes: Nil	Tutorial Classes: Nil	Practical Classes: 36			Total Classes: 36			

OBJECTIVES:

The course should enable the students to:

I. Basic understanding of modern trends in design and manufacturing using CAD/CAM.
II. Advanced aspects of enabling computer aided technologies used in design.
III. Application of thermal analysis software.

LIST OF EXPERIMENTS

Week-1	**Introduction to CAD and Tools**

Creation of working drawing, creating geometry, constraining the profile, extracting a part using tools, creating pattern of holes, translating rotating, mirroring, managing the specification tree. Creating sheets and views, creating text and dimensions.

Week-2	**Assembly of Part Drawing**

creating an assembly, moving components, assembling existing components, creating bill of materials, creating wire frame and surface geometry using generative shape design and sweep tools.

Week-3	**Generation of Surfaces**

Generation of Ferguson's cubic surface patches, Bezier surface patches. Coons patch, import and export of drawing from other software.

Week-4	**Analysis of Model**

Linear static analysis, automatic calculation of rigid body modes, uses specified eigen value shift, lumped and consistent mass matrices. Buckling analysis, jacobi inverse iteration techniques, steady state harmonic response, mode superposition method, overall structural and damping, linear dynamic analysis, non linear static analysis, non-linear dynamic analysis. Steady state heat transfer analysis problems.

Week-5	**Thermal Analysis**

Transient heat transfer analysis. Familiarity with element library. Defining Boundary conditions, multipoint constraint familiarity with different types of loads. Solution techniques, direct and iterative solver. Results and analysis. Design optimization.

Reference Books:

1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, Pearson, 2nd Edition, 2004.
2. P. Radha Krishnan, "CAD/ CAM/ CIM", New Age International, 4th Edition, 2016.
3. Warren. S. Seames, "Computer Numerical Control Concepts and Programming", Delmar Cengage Learning, 4th Edition, 2013.

E-Text Books:
1.http://sbmpme.blogspot.in/2011/01/cad-cam-cim-p-radhakrishnan.html 2.https://www.scribd.com/doc/228624725/cad-cam-text-book-by-P-N-RAO
SOFTWARE AND HARDWARE REQUIRED FOR A BATCH OF 18 STUDETNS **SOFTWARE:** AutoCAD 2016, CATIA R2016, ANSYS. **HARDWARE:** 500 GB HDD, 8GB RAM.

DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS

II Semester: **CAD/CAM**

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC004	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand of basic hydraulic circuits and maintenance.
II. Design of hydraulic, pneumatic pumps and circuits.
III. Apply of pneumatic and hydraulic systems, automation in industrial equipment.

UNIT-I	OIL AND HYDRAULIC SYSTEMS	Classes: 09

Introduction, history of fluid power, Pascal's law, Bramah's Press, Bernoulli's principle, Toricelli principle, fluid principle, fluid properties, viscosity, effect of temperature, dust and decay of oils, basic systems of hydraulic, physical units of fluid power, units of measurement, types of hydraulic fluid and selection criteria, properties of hydraulic fluid, physical characteristic, maintenance of hydraulic oils, oil hydraulic element and their representation in the circuits, comparison of mechanical, electrical, hydraulic and pneumatic systems for force and motion, analysis in automation.

UNIT-II	HYDRAULIC PUMPS	Classes: 09

Classification of pumps, gear pump, types of gear pumps, screw pump, vane pump, types of vane pumps, piston pump, bent axis in line piston pump, internal and external gear pumps, selection and sizing specification of pumps, specification of pumps, pump and pressure pulsation, flow rate and power of hydraulic pump, power and pump efficiencies, pressure, flow efficiencies, oil compatibility, size, noise, pump ripple, checklist; Actuators, design of linear actuator, cushioning, seals, mounting details, piston rod diameter and its effect on the pressure, servo controlled valves, hydraulic balanced circuits, sequencing and synchronizing circuits, rotary actuators.

UNIT-III	HYDRAULIC POWER PACK	Classes: 09

Element of power pack, design of hydraulic power pack, line pressure, discharge and motor.

Selection, power pack size and capacity, importance of pressure relief valve and safety systems, heating and cooling systems for hydraulic power pack.

UNIT-IV	HYDRAULIC CIRCUITS AND ACCUMULATOR	Classes: 09

Hydaulic circuits, manual or automatic hydraulic system, regenerative circuit, use of check valves in hydraulic circuit, selection of pump, standard in circuit circuit diagram representation, sequencing and synchronizing circuits; accumulator, low cost automation; meter-in circuit, meter-out circuit, bleed-off circuit, direction control valves, solenoid valves, flow control and pressure control valves, pressure compensation, accumulator.

UNIT-V	AUTOMATION	Classes: 09

Hydraulic and pneumatic equipment in automation, low cost automation, relay circuit, programmable logic circuit, automation, micro controller; maintenance and troubleshooting of hydraulic and pneumatic circuit.

Text Books:

1. S. R. Majumdar, "Oil Hydraulic Systems", Tata McGraw Hill, 1st Edition, 2013.
2. S. R. Majumdar, "Pneumatic Systems, Principles & maintaianance", Tata McGraw Hill, 1st Edition, 2013.

Reference Books:

1. Andrew Parr, "Hydraulic & Pneumatic", Butterworth-Heinemann Ltd, 2nd Edition, 2013.
2. Antony Esponssito, "Fluid Power with applications", Prentice Hall, 5th Edition, 2015.

Web References:

1. http://nptel.ac.in/courses/112105046
2. http://www.nptel.ac.in/courses/112106175/Module%201/Lecture%201.pdf
3. http://hydraulicspneumatics.com/fluid-power-basics

E-Text Books:

1.https://www.google.co.in/?gfe_rd=cr&ei=weV5V8HrNKLR8AeNgr7gBw&gws_rd=ssl#q=hydraulic+and+pneumatics+andrew+parr+pdf
2.https://books.google.co.in/books/about/Oil_Hydraulic_Systems.html?id=NBMtphgTmxgC&redir_esc=y
3. http://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/amt_airframe_handbook/media/ama_ch12.pdf

COMPUTER AIDED MANUFACTURING

II Semester: **CAD/CAM**

Course Code	Category	Hours / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC005	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Applying CNC programming for manufacturing.
II. Development of automatic programming techniques.
III. Applying the computer aided concepts in computer aided process planning.

UNIT-I	COMPUTER AIDED PROGRAMMING	Classes: 09

General information, APT programming, examples Apt programming problems (2D machining only), NC programming on CAD/CAM systems, the design and implementation of post processors; Introduction to CAD/CAM software, automatic tool path generation.

UNIT-II	TOOLING FOR CNC MACHINES	Classes: 09

Interchangeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers; DNC systems and adaptive control: Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, adaptive control with constrains, adaptive control of machining processes like turning, grinding.

UNIT-III	POST PROCESSORS FOR CNC	Classes: 09

Introduction to post processors: The necessity of a post processor, the general structure of a post processor, the functions of a post processor, DAPP based post processor.

Communication channels and major variables in the DAPP based post processor, the creation of a DAPP based post processor.

UNIT-IV	MICRO CONTROLLERS	Classes: 09

Introduction to microcontrollers: Hardware components, I/O pins, ports, external memory: counters, timers and serial data I/O interrupts, selection of micro controllers embedded controllers, applications and programming of micro controllers; Programming logic controllers: Introduction, hardware components of PLC, System, basic structure, principle of operations, programming mnemonics timers, internal relays and counters, applications of PLC's in CNC Machines.

UNIT-V	COMPUTER AIDED PROCESS PLANNING	Classes: 09

Hybrid CAAP system, computer aided inspection and quality control, coordinate measuring machine, limitations of CMM, computer aided testing, optical inspection methods, artificial intelligence and expert system: Artificial neural networks, artificial intelligence in CAD, experts systems and its structures.

Text Books:

1. Yoram Koren,"Computer Control of Manufacturing System", Tata Mcgraw Hill, 1st Edition, 1983.
2. K. Lalit Narayan, K. Mallikarjuna Rao, "Computer Aided Manufacturing", 1st Edition, 2008.

Reference Books:

1. Mikell. P. Grover, Emory W. Zimmer, "CAD/CAM", PHI, 1st Edition, 2010.

Web References:

1.http://nptel.ac.in/courses/112105046
2.http://nptel.ac.in/courses/Webcoursecontents/IITDelhi/Computer%20Aided%20Design%20&%20ManufacturingI/index.htm
3.http://www.nptel.ac.in/courses/112106175/Module%201/Lecture%201.pdf

E-Text Books:

1.https://www.google.co.in/?gfe_rd=cr&ei=weV5V8HrNKLR8AeNgr7gBw&gws_rd=ssl#q=hydraulic+and+pneumatics+andrew+parr+pdf
2.https://books.google.co.in/books/about/Oil_Hydraulic_Systems.html?id=NBMtphgTmxgC&redir_esc=y
3.http://www.faa.gov/regulations_policies/handbooks_manuals/aircraft/amt_airframe_handbook/media/ama_ch12.pdf

FLEXIBLE MANUFACTURING SYSTEMS

II Semester: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC006	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understanding of modern trends in design and manufacturing using CAD/CAM.
II. Apply performance analysis techniques.
III. Understand preventive maintenance procedures in manufacturing.

UNIT-I	FLEXIBLE MANUFACTURING SYSTEMS:	Classes: 09

Introduction: Definitions of manufacturing with input-output model, definition of system, basic problems concerning systems and system design procedure, modes of manufacturing – job/batch/flow and multi-product, small batch manufacturing

UNIT-II	SYSTEM MODELING ISSUES	Classes: 09

System modeling issues: Centralized versus distributed control; Real-time vs discrete event control; Forward vs. backward scheduling approaches with finite/infinite capacity loading; Modeling of absorbing states and deadlocks; Conflicts; Concurrency, and synchronization.

UNIT-III	SYSTEM MODELING TOOLS AND TECHNIQUES	Classes: 09

System Modeling Tools and Techniques: Introduction to mathematical modeling, optimization, and simulation; issues related with deterministic and stochastic models.

Continuous and discrete mathematical modeling methods -discrete event, monte carlo method; Basic concepts of Markov chains and processes; The M/M/1 and M/M/m queue; Models of manufacturing systems including transfer lines and flexible manufacturing systems, introduction to Petri nets.

UNIT-IV	PERFORMANCE ANALYSIS	Classes: 09

Performance Analysis: Transient analysis of manufacturing systems, analysis.

UNIT-V	PREVENTIVE MAINTAINANCE	Classes: 09

Preventive maintenance, Karban system, implementation issues.

Text Books:

1. N. K. Jha, "Hand Book of Flexible Manufacturing Systems", Academic Press, 1st Edition, 2013.
2. Talichi Ohno, "Production System beyond Large Scale Production", Toyota Productivity Press India Pvt. Ltd, 1st Edition, 2010.
3. H K Shivanand, "Flexible Manufacturing Systems", New Age International, 1st Edition, 2006.

Reference Books:
1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, 2nd Edition, 2004. 2. P. Radha Krishnan, "CAD/ CAM/ CIM", New Age International, 4th Edition, 2016.
Web References:
1. http://www.ignou.ac.in/upload/UNIT6-55.pdf 2. http://www.journals.elsevier.com/computer-aided-design 3. https://www.elsevier.com/books/surface-modeling-for-cad-cam/choi/978-0-444-88482-4
E-Text Books:
1. http://engineeringstudymaterial.net/ebook/flexible-manufacturing-system/ 2. http://www.sciencedirect.com/science/book/9780123853103

COMPUTER AIDED MANUFACTURING LABORATORY

II Semester: CAD/CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BCC102	**Core**	-	-	3	2	30	70	100
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 36**				**Total Classes: 36**		

OBJECTIVES:

The course should enable the students to:

I. Create the part model using CAM software.
II. Generate computer numerically part program for computer numerically control turning and milling operation.
III. Demonstrate the tool path for turning operation using CAM software.

LIST OF EXPERIMENTS

Week-1	**INTRODUCTION TO COMPUTER AIDED MACHINING**
Tool planning and selection of sequences of operation, tool setting on machine-practice.	
Week-2	**PART PROGRAM**
Practice in part programming and operation of CNC turning machines, sub routines and use of cycles.\	
Week-3	**PART PROGRAM**
Practice in part program and operation of a machine center, joining and selection of sequence of operation, tool setting on machine.	
Week-4	**NUMERICAL CONTROL PROGRAMMING**
Generate APT based NC programming and tool simulation for drilling operation.	
Week-5	**NUMERICAL CONTROL PROGRAMMING**
Practice in APT based NC programming and tool simulation for facing operation.	
Week-6	**NUMERICAL CONTROL PROGRAMMING**
Generate of NC code generation and tool path simulation for profile milling operation using CAM software.	
Week-7	**NUMERICAL CONTROL PROGRAMMING**
Develop NC code and tool path simulation for thread operation using CAM software.	
Week-8	**ROBOTICS SIMULATION**
Practice of robotic languages, 3-D Robot Simulation for operation of pick-place robot.	

Reference Books:

1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, Pearson, 2nd Edition, 2004.
2. P. Radha Krishnan, "CAD/ CAM/ CIM", New Age International, 4th Edition, 2016.
3. Warren. S. Seames, "Computer Numerical Control Concepts and Programming", Delmar Cengage Learning, 4th Edition, 2013.

E-Text Books:

1. http://sbmpme.blogspot.in/2011/01/cad-cam-cim-p-radhakrishnan.html
2. https://www.scribd.com/doc/228624725/cad-cam-text-book-by-P-N-RAO

PRECISION ENGINEERING

Group I: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC201	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorials Classes: Nil		Practical Classes: Nil			Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understanding the basics of tolerances.
II. Applying the tolerance analysis and tolerance charting technique for a process.
III. Understanding the basics fundamentals of nanotechnology.

UNIT-I	CONCEPT OF ACCURACYAND TOLERANCE ZONE CONVERSION	Classes: 09

Concepts of accuracy: Introduction, concept of accuracy of machine tools,spindle and displacement accuracies, accuracy of numerical control systems, errors due to numerical interpolation displacement measurement system and velocity lags; geometric dimensioning and tolerancing: Tolerance zone conversions, surfaces, features, features of size, datum features, datum Oddly configured and curved surfaces as datum features, equalizing datums datum feature of representation; form controls, orientation controls logical approach to tolerancing.

UNIT-II	DATUMS	Classes: 09

Datum systems: Design of freedom, grouped datum systems, different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped datum system with spigot and recess pair and tongue, slot pair, computation of transnational and rotational accuracy, geometric analysis and application.

UNIT-III	TOLERANCE ANALYSIS	Classes: 09

Tolerance analysis: Process capability, mean, variance, skewness, Kurtosis, process capability metrics, Cp, Cpk, Cost aspects, feature tolerances.

Geometric tolerances; surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances sure fit law, normal law and truncated normal law.

UNIT-IV	TOLERANCE CHARTING TECHNIQUES	Classes: 09

Tolerance charting techniques: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrally analysis, examples, design features to facilitate machining; datum features, functional and manufacturing components design, machining considerations, redesign for manufactured.

UNIT-V	MEASURING SYSTEM PROCESSING	Classes: 09

In Processing or In-Situ measurement of position of processing, point-post process and on machine measurement of dimensional features and surface-mechanical and optical measuring systems; working systems of CMM; Laser alignment and testing.

Text Books:
1. R. L. Murthy, "Precision Engineering in Manufacturing", New Age International limited, 1st Edition, 1996. 2. James D. Meadows, "Geometric Dimensioning and Tolerancing", Marcel Dekker, 1st Edition, 1995. 3. Norio Taniguchi, "Nano Technology", Oxford University Press, 1st Edition, 1996. 4. Matousek, "Engineering Design–A systematic Approach",Blackie & Son Ltd., London. 5. V. C. Venkatesh, S.Izman, "Precision Engineering", Tata McGraw Hill,
Reference Books:
1. Preumont, A., "Vibration Control of Active Structures", Kluwer Academic Publishers, 2002. 2. F. Y. Cheng, H. Jiang, K. Lou, "Smart Structures: Innovative Systems for Seismic Response Control", CRC Press, 2008
Web References:
1.http://nptel.ac.in/courses/112104173/ 2.http://ttp.net/978-3-908451-70-9.html 3.http://iopscience.iop.org/journal/0964726
E-Text Books:
1. http://www.me.umn.edu/~wkdurfee/projects/ccefp/fp-chapter/fluid-pwr.pdf 2. http://hydraulicspneumatics.com/ebooks/fluid-power-ebook-fluid-power-basics

DESIGN FOR MANUFACTURING AND ASSEMBLY

Group I: CAD/CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BCC202	**Elective**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**			**Total Classes: 45**			

OBJECTIVES:

The course should enable the students to:

I. Understanding of basic design rules for manufacturing and material selection.
II. Applying the production processes for ease of manufacturing..
III. Apply the concepts of design for manufacturing and assembly for product manufacturing.

UNIT-I	**INTRODUCTION TO DESIGN**	**Classes: 09**

Introduction: Design philosophy steps in design process, general design rules for manufacturability, basic principles of design Ling for economical production, creativity in design; Materials selection of materials for design developments in material technology, criteria for material selection, material selection interrelationship with process selection process selection charts.

UNIT-II	**MACHINING PROCESS**	**Classes: 09**

Machining process: Overview of various machining processes, general design rules for machining, dimensional tolerance and surface roughness, design for machining, ease of redesigning of components for machining ease with suitable examples. General design recommendations for machined parts; Metal casting: Appraisal of various casting processes, selection of casting process, general design considerations for casting, casting tolerances, use of solidification simulation in casting design, product design rules for sand casting.

UNIT-III	**METAL JOINING**	**Classes: 09**

Metal joining: Appraisal of various welding processes, factors in design of weldments, general design guidelines, pre and post treatment of welds, effects of thermal stresses in weld joints, design of brazed joints; Forging, design factors for forging, closed dies forging design, parting lines of die drop forging die design general design recommendations.

Extrusion and sheet metal work: Design guidelines for extruded sections, design principles for punching, blanking, bending, deep drawing, Keeler Goodman forming line diagram, component design for blanking.

UNIT-IV	**ASSEMBLY ADVANTAGES**	**Classes: 09**

Assembly advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation, automatic assembly transfer systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator, paced free, transfer machine

UNIT-V	**DESIGN OF MANUAL ASSEMBLY**	**Classes: 09**

Design of manual assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

Text Books:
1. GeoffreyBoothroyd, "Assembly Automation and Product Design", CRC Press, 2nd Edition, 2013. 2. George E. Deiter, "Engineering Design - Material & Processing Approach", Tata McGraw Hill, 2nd Edition, 2000. 3. Geoffrey Boothroyd, "Hand Book of Product Design", Marcel and Dekken, 1st Edition, 1990.
Reference Books:
1. A Delbainbre, **"**Computer Aided Assembly"1992. 2. Geoffrey Boothroyd, Peter Dewhurst, Winston. A. Knight, "Product Design for Manufacturing and Assembly",CRC Press, 3rd Edition, 2013.
Web References:
1. http://nptel.ac.in/courses/107103012/ 2. http://me.gatech.edu/files/capstone/L071ME4182DFA
E-Text Books:
1.https://books.google.co.in/books/about/Assembly_Automation_and_Product_Design.html?id=XFtgaNFzMHQC 2.https://books.google.co.in/books/about/Product_Design_for_Manufacture_and_Assem.html?id=qYGgjwEACAAJ

AUTOMATION IN MANUFACTURING

Group I: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC203	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand of modern trends in automation and manufacturing
II. Application of material handling systems and storage systems.
III. Design of automated assembly lines with quality control.

UNIT-I	OVER VIEW OF MANUFACTURING AND AUTOMATION	Classes: 09

Over view of manufacturing and automation: production systems, automation in production systems, automation principles and strategies, manufacturing operations, production facilities, basic elements of an automated system, levels of automation; hardware components for automation and process control, programmable logic controllers and personal computers.

UNIT-II	MATERIAL HANDLING AND IDENTIFICATION TECHNOLOGIES	Classes: 09

Material handling and identification technologies: Material handling, equipment, analysis storage systems, performance and location strategies, automated storage systems, AS/RS, types, automatic identification methods, barcode technology, RFID.

UNIT-III	MANUFACTURING SYSTEMS AND AUTOMATED PRODUCTION LINES	Classes: 09

Manufacturing systems and automated production lines: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells.

Manual Assembly lines, line balancing Algorithms, mixed model assembly lines, lternative assembly systems. Automated production lines, Applications, Analysis of transfer lines.

UNIT-IV	AUTOMATED ASSEMBLY SYSTEMS	Classes: 09

Automated assembly systems: Fundamentals, Analysis of Assembly systems. Cellular manufacturing, part families, cooling, production flow analysis. Group Technology and flexible Manufacturing systems, Quantitative Analysis.

UNIT-V	QUALITY CONTROL AND SUPPORT SYSTEMS	Classes: 09

Quality control and support systems: Quality in Design and manufacturing, inspection principles and strategies, Automated inspection, contact Vs non contact, CMM. Manufacturing support systems. Quality function deployment, computer aided process planning, concurrent engineering, shop floor control, just in time and lean production.

Text Books:

1. Mikell. P Groover, "Automation, Production system and computer integrated manufacturing", PHI, 3rd Edition, 2012.
2. MikeJ P. Groover, "Automation, Production Systems and CIM", PHI, 1st Edition, 2001.

3. P. Radha Krishnan, S. Subrahamanyan, “CAD/CAM/CIM”, New Age International, 1st Edition, 2005.
Reference Books:
1. Sadhu Singh, “Svstem Approach to Computer Integrated Design and Manufacturing”, John wiley, 1st Edition, 1996. 2. Tien-Chien Chang, Richard A. Wysk ,Hsu-Pin Wang, “Computer Aided Manufacturing”, Pearson, 1st Edition, 2009. 3. R Thomas Wright and Michael Berkeihiser, Good Heart, “Manufacturing and Automation Technology, Willcox Publishers, 1st Edition, 2012.
Web References:
1. https://www3.nd.edu/~manufact/MPEM_pdf_files/Ch14.pdf 2. http://www.journals.elsevier.com/journal-of-manufacturing-systems
E-Text Books:
1.http://www.automationmag.com/education/news/4721 2 http://www.e-booksdirectory.com/details.php?ebook=1120

INDUSTRIAL ROBOTICS

Group I: CAD/CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BCC204	**Elective**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**			**Total Classes: 45**			

OBJECTIVES:

The course should enable the students to:

I. Understand of basic automation and robotic in transfer lines.
II. Design of robot with kinematic, dynamic and path control.
III. Applying of robot programming using robot languages.
IV. Design of robot cell and control in computer aided transfer lines.

UNIT-I	**INTRODUCTION TO AUTOMATIC AND ROBOTICS**	**Classes: 09**

Introduction: Automation and robotics, robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement; Control system and components: basic concept and modais, controllers control system analysis, robot activation and feedback components, Positions sensors, velocity sensors, actuators sensors, power transmission system.

UNIT-II	**MOTION ANALYSIS AND CONTROL**	**Classes: 09**

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

UNIT-III	**END EFFECTORS AND MACHINE VISION**	**Classes: 09**

End effectors: Grippers, types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. Sensors: Desirable features, tactile, proximity and range sensors, uses sensors in robotics.

Machine vision: functions, sensing and digitizing-imaging, devices, lighting techniques, analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction, object recognition, training the vision system, robotics application.

UNIT-IV	**ROBOT PROGRAMMING AND ROBOT LANGUAGES**	**Classes: 09**

Robot programming: Lead through programming, robot programming as a path in space, motion interpolation, wait, signal and delay commands, branching capabilities and limitations; Robot languages: Textual robot languages, generation, robot language structures, elements in function.

UNIT-V	**ROBOT CELL DESIGN AND CONTROL**	**Classes: 09**

Robot cell design and control: Robot cell layouts, robot centered cell, In-line robot cell, Considerations in work design, work and control, inter locks, error detect ion, work wheel controller; Robot application: material transfer, machine loading/unloading, Processing operation, assembly and inspection, feature application.

Text Books:
1. Mikell P. Groover, “Industrial Robotics”, Tata McGraw Hill, 2nd Edition, 2012. 2. John. J Craig, “Introduction to Robotic Mechanics and Control”, Prentice Hall, 3rd Edition, 2004. 3. H.Asada, J. J. E. Slotine, “Robot Analysis and Intelligence”, Wiley, 1st Edition, 2013.
Reference Books:
1. King-Sun Fu, C. S. George Lee, “Robotics”, Tata McGraw Hill, 1st Edition, 2013. 2. R. K. Mittal, I. J. Nagrath, “Robotics and Control”, Tata McGraw Hill, 1st Edition, 2013.
Web References:
1. http://nptel.ac.in/courses/112101099/ 2. http://www.journals.elsevier.com/robotics-and-computer-integrated-manufacturing
E-Text Books:
1. https://books.google.co.in/books/about/Industrial_Robotics.html?id=dr9IAI7wucUC 2. https://books.google.co.in/books/about/Robotics_Control_Sensing_Vis.html?id=_oYYRzSohJgC 3.https://books.google.co.in/books/about/Robot_Analysis_and_Control.html?id=Zz9SAAAAMAAJ&redir_esc=y

SPECIAL MANUFACTURING PROCESSES

Group II: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC205	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understanding the basic surface treatment coating in manufacturing.
II. Applying the advanced aspects in processing of ceramics.
III. Understanding of modern trends in manufacturing fields.

UNIT-I	SURFACE TREATMENT	Classes: 09

Surface treatment: Scope, cleaners, methods of cleaning, surface coating types, and ceramic and organic methods of coating, economics of coating, electro forming, chemical vapor deposition, thermal spraying, ion implantation, diffusion coating, diamond coating and cladding.

UNIT-II	PROCESSING OF CERAMICS	Classes: 09

Processing of ceramics: Applications, characteristics, classification, processing of particulate ceramics, powder preparations, consolidation, drying, sintering, hot compaction, area of application, finishing of ceramics; Processing of composites: Composite layers, particulate and fiber reinforced composites, elastomers, reinforced plastics, metal matrix composites, ceramic matrix composites, polymer matrix composites.

UNIT-III	FABRICATION OF MICROELECTRONIC DEVICES	Classes: 09

Fabrication of microelectronic devices: Crystal growth and wafer preparation, film deposition oxidation, lithography, bonding and packaging, reliability and yield.

Printed Circuit boards, computer aided design in micro electronics, surface mount technology, integrated circuit economics.

UNIT-IV	E-MANUFACTURING	Classes: 09

E-manufacturing: Nano manufacturing techniques and micromachining, high Speed machining and hot machining.

UNIT-V	RAPID PROTOTYPING	Classes: 09

Rapid prototyping: Working principles, methods, stereo lithography, laser Sintering, fused deposition method, applications and limitations, rapid tooling, techniques of rapid manufacturing

Text Books:

1. I Kalpakijian, "Manufacturing Engineering and Technology", Adisson Wesley, 1995.
2. R. A. Lindburg, "Process and Materials of Manufacturing",PHI, 1st Edition, 1990.
3. Rao. R. Thummala, Eugene, J. Rymaszewski, Van Nostrand Renihold, "Microelectronic packaging handbook", 1st Edition, 2013.
4. Tai-Run Hsu, "MEMS & Micro Systems Design and manufacture", Tata McGraw Hill, 1st Edition, 2002.

Reference Books:
1. Rao. R. Thummala, Eugene, J. Rymaszewski, Van Nostrand Renihold, "Microelectronic packaging handbook", 1st Edition, 2013. 2. Tai-Run Hsu, "MEMS & Micro Systems Design and manufacture", Tata McGraw Hill, 1st Edition, 2002
Web References:
1.https://www.google.co.in/#q=design+of+mems+and+microsystems+nptel 2. http://www.thelibraryofmanufacturing.com
E-Text Book:
1.http://royalmechanicalbuzz.blogspot.in/2015/04/manufacturing

ADVANCED MECHANICS OF SOLIDS

Group II: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC206	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the theory of elasticity including stress, strain, displacement and Hooke's law and strain energy relationships.
II. Understand the shear force and bending moment diagrams of symmetrical beams.
III. Distinguish bending and shear stresses developed in beams of various sections.
IV. Compare stresses in a shaft under torsion and in thin cylindrical members.

UNIT-I	SHEAR CENTRE	Classes: 09

Bending axis and shear center, shear center for axi-symmetric and unsymmetrical sections; Unsymmetrical bending: Bending stresses in beams subjected to nonsymmetrical bending, deflection of straight beams due to nonsymmetrical bending.

UNIT-II	CURVED BEAM THEORY	Classes: 09

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

UNIT-III	TORSION	Classes: 09

Torsion of a cylindrical bar of circular cross section; Saint venant's semi inverse methods, linear elastic solution, prandtl elastic membrane (soap film) analogy.

Narrow rectangular cross section, hollow thin wall torsion members, multiply connected cross section, thin wall torsion members with restrained ends axi-symmetric problems: Rotating discs, flat discs, discs of uniform thickness, discs of uniform strength, rotating cylinders.

UNIT-IV	THEORY OF PLATES	Classes: 09

Introduction: Stress resultants in a flat plate, kinematics: Strain displacement relations for plates, equilibrium equations for small displacement theory of flat plates, stress strain temperature relation for isotropic plates, strain energy of a plate, boundary conditions for plate, solution of rectangular plate problem, solution of circular plate problem; Beams on elastic foundation: general theory, infinite beam subjected to concentrated load, boundary conditions, infinite beam subjected to a distributed load segment, semi infinite beam with concentrated load near its end, short beams.

UNIT-V	CONTACT STRESSES	Classes: 09

Introduction, problem of determining contact stresses, assumptions on which a solution for contact stresses is based, expressions for principal stresses, methods of computing contact stresses, deflection of bodies in point contact, stresses for two bodies in contact over narrow rectangular area (line contact), loads normal to area, stresses for two bodies in line contact, normal and tangent to contact area.

Text Books:

1. Arthur P. Boresi , Richard, J. Schmidt, "Advanced Mechanics of materials" wiley international, 6th Edition, 2003.
2. J. P. Den Hortog, "Advanced strength of materials", Dover Publications, 1st Edition, 2012.
3. Timoshenko, "Theory of Plates", Tata McGraw Hill, 1st Edition, 2013.

Reference Books:

1. Stephen P. Timoshenko, S. Woinowsky Kriger, "Theory of Plates and Shells", Tata McGraw Hill, 2nd Edition, 2013.
2. James. O. Seely, Smith, B. Fred, "Advanced Mechanics of materials, John Willey, 1st Edition 1967.

Web References:

1.http://nptel.ac.in/courses/105106049/pdf-assignments/main.pdf
2.http://www.nptel.ac.in/syllabus/105101003/
3.http://numgeom.ams.sunysb.edu/shells/ThinPlatesAndShellsTheory

E-Text Books:

1.https://books.google.co.in/books/about/Advanced_mechanics_of_materials.html
2.http://155.207.34.6/files/Timoshenko.pdf
3.https://books.google.co.in/books/about/Strength_of_Materials.html?id=S5A-sZgcYM0C

DESIGN OPTIMIZATION

Group II: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC207	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understanding the basic concepts techniques and applications of design optimization.
II. Understanding practical use of optimization.
III. Applying problem formulation techniques..

UNIT-I	INTRODUCTION TO DESIGN OPTIMIZATION	Classes: 09

General characteristics of mechanical elements, adequate and optimum design, principles of optimization, formulation of objective function, design constraints, classification of optimization problems, single and multivariable optimization techniques.

UNIT-II	OPTIMUM DESIGN PROBLEM FORMULATION	Classes: 09

Technique of unconstrained minimization, golden section, random, pattern and gradient search methods, interpolation methods, equality and inequality constraints.

UNIT-III	OPTIMUM DESIGN CONCEPTS	Classes: 09

Direct methods and indirect methods using penalty function.

Lagrange multipliers, geometric programming, stochastic programming, genetic algorithms.

UNIT-IV	PRACTICAL APPLICATIONS OF OPTIMIZATION	Classes: 09

Engineering applications, structural-design application axial and transverse loaded members for minimum cost, maximum weight, design of shafts and torsion members, design optimization of springs.

UNIT-V	OPTIMUM DESIGN PROBLEM FORMULATION	Classes: 09

Dynamics applications for two degree freedom system, vibration absorbers, application in mechanisms.

Text Books:

1 C.Johnson Ray, "Optimum Design of Mechanical elements", Wiley, John & Sons, 1st Edition, 2013.
2. Goldberg D. E. Addison, "Genetic Algorithms in search Optimization and Machine", Wesley, 13th Edition, 2013.

Reference Books:

1. Kalyanamoy Deb, "Optimization for Engineering Design Algorithms and Examples, Prentice Hal, 2nd Edition, 2013.
2. Jasbir S. Arora, "Introduction to Optimum Design", Academic Press, 3rd Edition, 2016.

Web References:
1. http://nptel.ac.in/courses/106104025/31 2.http://nptel.ac.in/courses/Webcoursecontents/IIScBANG/OPTIMIZATION%20METHODS/pdf/Module_1/M1L2_LN.pdf
E-Text Books:
1.https://books.google.co.in/books?id=_edSAAAAMAAJ&source=gbs_navlinks_s&redir_esc=y 2.https://books.google.co.in/books/about/Optimization_for_Engineering_Design.html?id=JypoXt5hHrkC

COMPUTER AIDED PROCESS PLANNING

Group II: CAD/CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BCC208	**Elective**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**			**Total Classes: 45**			

OBJECTIVES:

The course should enable the students to:

I. Understanding the basic concepts of computer aided process planning.
II. Applying the computer aided processing planning in the automation.
III. Understanding the fundamental theories and technologies in computer aided Process planning.

UNIT-I	**INTRODUCTION TO CAPP**	**Classes: 09**

Information requirement for process planning system, role of process planning, advantages of conventional process planning over CAPP, structure of automated process planning system, feature recognition, methods; Generative CAPP system: Importance, principle of generative CAPP system, automation of logical decisions, knowledge based systems, inference engine, implementation, benefits.

UNIT-II	**RETRIEVAL CAPP SYSTEM AND SELECTION OF MANUFACTURING SEQUENCE**	**Classes: 09**

Significance, group technology, structure, relative advantages, implementation, and applications: Selection of manufacturing sequence: Significance, alternative manufacturing processes, reduction of total set up cost for a particular sequence, quantitative methods for optimal selection.

UNIT-III	**DETERMINATION OF MACHINING PARAMETERS**	**Classes: 09**

Reasons for optimal selection of machining parameters, effect of parameters on production i-ate, cost and surface quality.

Different approaches, advantages of mathematical approach over conventional approach, solving optimization models of machining processes.

UNIT-IV	**DETERMINATION OF MANUFACTURING TOLERANCES:**	**Classes: 09**

Design tolerances, manufacturing tolerances, methods of tolerance allocation, sequential approach, integration of design and manufacturing tolerances, advantages of integrated approach over sequential approach.

UNIT-V	**GENERATION OF TOOL PATH AND IMPLEMENTATION TECHNIQUE FOR CAPP**	**Classes: 09**

Simulation of machining processes, NC tool path generation, graphical implementation, determination of optimal index positions for executing fixed sequence, quantitative method; Implementation techniques for CAPP: MIPLAN system, computer programming languages tbr CAPP, criteria for selecting a CAPP system and benefits of CAPP, computer integrated planning systems, and capacity planning system.

Text Books:

1. Mikell P. Groover "Automation Production systems and Computer Integrated Manufacturing System", 3rd Edition, 2013.

2. Sadhu Singh, “Computer Design and Manufacturing”, S.K. Kataria & Sons, 1st Edition, 2013.

Reference Books:

1. Chang, T. C, Wysk, R. A, “An Introduction to Automated Process Planning”, Prentice, 1st Edition, 1985.
2. Gallagher, C. C, Knight, W. A., “Group Technology: Production Method in Manufacturing”, Ellis Horewood, 1st Edition, 1986.
3. Nilsson, N. J., “Principles of Artificial Intelligence”, Springer, 1st Edition, 1982.
4. Cornelius, L.T, “Computer Aided and Integrated Manufacturing Systems: Manufacturing Processes” World scientific, 1st Edition, 2003.

Web References:

1.http://nptel.ac.in/courses/Webcoursecontents/IITdelhi/ComputerAidedDesign20ManufacturingII/Module/p3.html
2. http://www.ignou.ac.in/upload/CRC.pdf

E-Text Books:

1.http:// elsevierComputer-Aided-Process-Planning/H_P_-Wang/isbn-9780444886316/
2.http://link.springer.com/chapter/10.1007%2F978-94-011-1250-5_15

ADVANCED AUTOMATIC CONTROL

Group III: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC209	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil		Practical Classes: Nil			Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understanding the advanced concepts of state space approach in control system.
II. Applying the stability, controllability and observability issues and synthesis of industrial control systems.

UNIT-I	MATHEMATICAL MODELS OF LINEAR SYSTEM	Classes: 09

Mathematical models of linear system: Linear systems and state equations, linearization of non linear equations, linearizing functions, linearizing differential equations.

UNIT-II	LINEAR ALGEBRA AND STATE VARIABLE ANALYSIS	Classes: 09

Linear algebra Vector spaces, linear dependence and independence, bases, change of basis, rank and degeneracy, norms, GramSchmidt orthonormalization, subspaces and projection theorem; State variable analysis: State variable representation, conversion of state variable model to transfer function, characteristic equation, eigen values, eigen vectors, conversion of transfer function to canonical state variable models, solution to state equations.

UNIT-III	STABILITY OF CONTROL SYSTEMS , CONTROLLABILITY AND OSERVABILITY	Classes: 09

Stability of control systems: Bounded input, bounded output stability, zero input and asymptotic stability of continuous data system, Lyapunov stability, Lyapunov's direct method, external stability, relationship between stability types.

Controllability and observability: Controllability tests for LTI systems, modal controllability and observability, control ability and observability of time varying systems, discrete time systems.

UNIT-IV	SYSTEM REALIZATIONS AND OPTIMAL ESTIMATION	Classes: 09

system realizations: Minimal realization, specific realization, Markov parameters, balanced realizations state feedback and observers: State feedback for SISO systems, multivariable canonical forms and feedback, observers, state estimator, multivariable case, optimal control and estimation the principle of optimality, optimal estimator.

UNIT-V	POLE PLACEMENT AND MODEL MATCHING	Classes: 09

Pole Placement and Model Matching: unity feedback configuration, implementable transfer function, multi variable unity feedback system.

Text Books:

1. Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall, 1st Edition, 2002.
2. F. H. Raven, "Automatic control Theory", Tata McGraw Hill, 1st Edition, 1995.
3. B. C. Kuo, "Automatic Control System", Prentice Hall, 5th Edition, 1995.
4. C. T. Chen, "Linear System Theory & Design", Oxford University Press, 3rd Edition, 1999.

Reference Books:

1. H. L. Harrison, J. G. Bollinger, "Automatic Controls", International Text Book Company, 1970.
2. J. S. Bay, "Fundamentals of Linear State Space Systems", Tata McGraw 1st Edition, 1999.
3. S. N. Norman, "Control Systems Engineering", Wiley 1st Edition, 2003.

Web References:

1.https://www.google.co.in/?gfe_rd=cr&ei=HeWGV4yuM6aM8QfPxYPIBQ&gws_rd=ssl#q=advanced+automatic+control
2. http://nptel.ac.in/syllabus/108103007/

E-Text Books:

1.https://books.google.co.in/books?id=A93AAAQBAJ&pg=PA430&lpg=PA430&dq=H.+L.+Harrison,+J.+G.+Bollinger,+"Automatic+Controls"
2. https://books.google.co.in/books/about/Modern_Control_Engineering.html?id=Wu5GpNAelzkC

DESIGN FOR MANUFACTURING OF MEMS AND MICRO SYSTEMS

Group III: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC210	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil				Practical Classes: Nil		Total Classes: 45	

OBJECTIVES:

The course should enable the students to:

I. Understanding of modern trends in design and manufacturing using CAD/CAM.
II. Applying advanced aspects of enabling computer aided technologies used in design.
III. Enumerate fundamental theories and technologies in computer aided manufacturing.

UNIT-I	OVERVIEW AND WORKING PRINCIPLES OF MEMS AND MICROSYSTEMS	Classes: 09

Overview and working principles of mems and microsystems: MEMS and microsystems, evolution of micro fabrication, microsystems and microelectronics, microsystems and miniaturization, applications of MEMS in industries, micro sensors, micro actuation, MEMS with micro actuators micro accelerometers, micro fluidies.

UNIT-II	ENGINEERING SCIENCE FOR MICROSYSTEMS DESIGN AND FABRICATION	Classes: 09

Engineering science for microsystems design and fabrication: Atomic structure of matter, ions and ionization, molecular theory of mater and intermolecular force, doping of semiconductors, diffusion Process, plasma physics, electrochemistry, quantum physics.

UNIT-III	ENGINEERING SCIENCE FOR MICROSYSTEMS DESIGN AND FABRICATION	Classes: 09

Engineering mechanics for microsystems design: Static Bending of thin Plates, mechanical vibration.

Thermo mechanics fracture mechanics, thin-film mechanics, overview of finite element stress analysis

UNIT-IV	THERMO FLUID ENGINEERING AND MICROSYSTEMS DESIGN	Classes: 09

Thermo fluid engineering and microsystems design: Overview of basics of fluid mechanics in macro and meso scales, basic equations in continuum fluid dynamics, laminar fluid flow in circular conduits, computational fluid dynamics, incompressible fluid flow in micro conduits, fluid flow in sub micrometer and nano scale, overview of heat conduction in solids, heat conduction in multilayered thin films and in solids in sub micrometer scale, design considerations, process design mechanical design, mechanical design using finite element method, design of a silicon die for a micro pressure sensor.

UNIT-V	MATERIALS FOR MEMS, MICROSYSTEMS AND THEIR FABRICATION	Classes: 09

Materials for mems and microsystems and their fabrication: Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon Compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, chemical and physical vapor deposition, Etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process

Text Books:
1. Tai-Ran Hsu, "MEMs & Microsystems: Design & Manufacture", Tata McGraw Hill, 1st Edition, 2002. 2. M. Maluf, " An Introduction to Microelectromechanical Systems Engineering", Artech House,1st Edition, 2000 3. Trimmer, W.S.N, "Micro robots and Micromechanical Systems Sensors & Actuators", 19th Edition, 1989.
Reference Books:
1. Madou, M, "Fundamentals of Microfabrication", CRC Press, 1st Edition, 1997. 2. Hsu, T.R, "The Finite Element Method in Thermomechanics", Alien & Unwin, London, 1st Edition, 1986.
Web References:
1. http://nptel.ac.in/courses/117105082/ 2. https://www.mems-exchange.org/MEMS/what-is.html
E-Text Books:
1.http://ebooks.cawok.pro/Artech.House.Publishers.An.Introduction.to.Microelectromechanical.Systems.Engineering.2nd.edition.eBook-LiB.pdf 2. http://www.springer.com/la/book/9783540850557?token=prtst0416p

INTELLEGENT MANUFACTURING SYSTEM

Group III: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC211	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the student to:

I. Understanding of basic computer integrated manufacturing.
II. Applying the knowledge based system in manufacturing.
III. Applying of machine learning and group technology in manufacturing system.

UNIT-I	INTRODUCTION TO COMPUTER INTEGRATED MANUFACTURING	Classes: 09

Computer integrated manufacturing systems structure and functional areas of CIM system, CAD, CAPP, CAM, CAQC, ASRS. Advantages of computer aided manufacturing, manufacturing communication systems, MAP/TOP, OSI model, data redundancy, top-down and bottom-up approach, volume of information, intelligent manufacturing system components, system architecture and data flow, system operation.

UNIT-II	KNOWLEDGE BASED SYSTEM	Classes: 09

Components of knowledge based systems, basic components of knowledge based systems, knowledge representation, comparison of knowledge representation schemes, interference engine, knowledge acquisition.

UNIT-III	MACHINE LEARNING	Classes: 09

Machine learning, concept of artificial intelligence, conceptual learning.

Artificial neural networks, biological neuron, artificial neuron, types of Neural Networks, applications in manufacturing.

UNIT-IV	AUTOMATED PROCESS PLANNING AND KNOWLEDGE BASED SYSTEM	Classes: 09

Automated process planning: Variant approach, generative approach, expert systems for process planning, feature recognition, phases of process planning.

Knowledge based system for equipment selection, manufacturing system design. equipment selection Problem, modeling the manufacturing equipment selection problem, problem solving approach in KBSES, structure of the KRSES.

UNIT-V	GROUP TECHNOLOGY	Classes: 09

Group technology: Models and algorithms visual method, coding Method, cluster analysis method, matrix formation, similarity coefficient method, sorting based algorithms, bond energy algorithm, cost based method, cluster identification method, extended CI Method; Knowledge based group technology, group technology in automated manufacturing system, structure of knowledge based system for group technology (KBSCIT), data Base, knowledge base, clustering algorithm.

Text Books:

1. Andrew Kusiak, "Intelligent Manufacturing Systems", Prentice Hall, 1st Edition, 1990.
2. Yagna Narayana, "Artificial Neural Networks", PHI, 1st Edition, 2006.
3. M. P. Groover, "Automation, Production Systems and CIM", PHI, 2nd Edition, 2007.
4. Simon Hhaykin, "Neural networks: A comprehensive foundation", PHI, 1st Edition, 1994

Reference Books:

1. B.yegnanarayana, "Artificial neural networks", PHI, 1st Edition, 2004.
2. Li Min Fu, "Neural networks in Computer intelligence", TMH, 1st Edition, 2003.
3. David M. Skapura, James A. Freeman, "Neural networks", Pearson education, 1st Edition, 2004.
4. Jacek M. Zurada, "Introduction to Artificial Neural Systems", JAICO Publishing House 1st Edition, 2013.

Web References:

1, http://nptel.ac.in/courses/117105084/
2. http://prolog.univie.ac.at/teaching/LVAs/Layout_und_Design/SS09/Skript%20insel.pdf
3. http://nptel.ac.in/courses/106106139/
4. http://nptel.ac.in/courses/106106126/

E-Text Books:

1.https://books.google.co.in/books/about/Intelligent_manufacturing_systems.html?id=5RVUAAAAMAAJ&hl=en
2.https://books.google.co.in/books/about/ARTIFICIAL_NEURAL_NETWORKS.html?id=RTtvUVU_xL4C
3.https://donvalebooks.com/pdf-automation-production-systems-and-cim-groover-second-edition.html

EXPERT SYSTEMS DESIGN

Group III: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC212	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understanding concepts, techniques and tools for developing expert systems for various engineering systems.
II. Applying the pattern matching techniques.
III. Designing of expert system design.

UNIT-I	INTRODUCTION TO EXPERT SYSTEM DESIGN	Classes: 09

Introduction: Overview: Evolution and characteristics of knowledge based system; Introduction to expert system languages: CLIPS (C language integrated production system) and JESS (java expert system shell).

UNIT-II	PATTERN MATCHING	Classes: 09

Pattern matching: Basic and advanced pattern matching techniques; Modular design and control: Salience, phases and control facts, modules and execution control.

UNIT-III	KNOWLEDGE REPRESENTATION	Classes: 09

Knowledge representation: Productions, semantic nets, schemata, frames, logic and sets.

Methods of Inferences: Inference rules, resolution system, forward and backward chaining.

UNIT-IV	REASONING UNDER UNCERTAINTY	Classes: 09

Reasoning under Uncertainty: Hubert Dreyfus from Socrates to expert systems: Limits and Dangers of computational rationality, CSUS Library video collection, hypothetical reasoning and backward induction, temporal reasoning and Markov chains, uncertainty in inference chains; Probability-based techniques: Objective probability, experimental probability, subjective probability, Bayes' theorem, inexact or heuristic reasoning; Inexact reasoning: uncertainty and rules, certainty factors, Dempster-Shafer theory.

UNIT-V	DESIGN OF EXPERT SYSTEMS	Classes: 09

Design of expert systems: Approximate reasoning, fuzzy expert system.

Text Books:

1. J. C. Giarratano, G. D. Riley, "Expert Systems: Principles and Programming", 4th Edition., Course Technology,2004.
2. A. Gonzalez, D. Dankel, "The Engineering of KnowledgeBased Systems", Prentice Hall, 1st Edition, 1994.

Reference Books:

1. P. Jackson, "Introduction to Expert Systems", Addison Wesley, 3rd Edition, 1998.
2. R. Akerkar, P. Sajja, "Knowledge-Based Systems", Jones & Bartlett Publishers, 1st Edition, 2009.

Web References:
1.http://nptel.ac.in/courses/Webcoursecontents/IIT%20Kharagpur/Artificial%20intelligence/pdf/Lesson%2018.pdf 2.http://nptel.ac.in/courses/106105077/25
E-Text Books:
1. http://www.worldcat.org/title/expert-systems-design-and-development/oclc/622154797 2. https://www.cs.ru.nl/~peterl/proe.pdf

STRESS ANALYSIS AND VIBRATION

Group IV: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC213	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understanding of modern trends in design and manufacturing using CAD/CAM.
II. Applying vibration theory for engineering.

UNIT-I	**INTRODUCTION OF THEORY OF ELASTICITY**	**Classes: 09**

Two dimensional elasticity theory in Cartesian coordinates, plane stress problem in polar coordinates, Thick cylinders, Rotating discs, stress concentration.

UNIT-II	**STRESS ANALYSIS OF SYMMETRIC BODIES AND CONTACT STRESSES**	**Classes: 09**

Torsion of non circular prismatic sections, rectangular and axi-symmetric, circular plates, introduction to shell theory, contact stresses.

UNIT-III	**FREE AND FORCED VIBRATIONS**	**Classes: 09**

Single degree freedom, two degree freedom system without and with damping.

Free and forced vibrations, transient vibrations.

UNIT-IV	**TRANSIENT VIBRATIONS**	**Classes: 09**

Transient vibrations of single and two degree freedom systems, multi-degree of freedom systems, applications of matrix methods, continuous systems.

UNIT-V	**CONTINUOUS SYSTEMS**	**Classes: 09**

Free and forced vibrations of strings bars and beams, principle of orthogonality, classical and energy methods.

Text Books:

1. S.P. Timoshenko, J. N. Goodier, "Theory of Elasticity", Mc Graw Hill, 3rd Edition, 1970.
2. 3. J. P. Den Hartog, "Mechanical Vibrations", Dover Publications, 1st Edition, 2013.

Reference Books:

1. W. T. Thomson, "Theory of Vibrations with Applications", CBS Publishing, 3rd Edition, 2013.
2. S. S. Rao, "Mechanical Vibrations", Addison Wesley Longman.

Web References:

1.http://nptel.ac.in/Courses/11210311/
2.http://nptel.ac.in/courses/112106068/

E-Text Book:

1.https://aerocastle.files.wordpress.com/2012/10/mechanical_vibrations_5th-edition_s-s-rao.pdf

COMPUTER AIDED ANALYSIS OF MECHANICAL SYSTEM

Group IV: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC214	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understanding the computer based design tools for analysis.
II. Analysis of kinematics and dynamics of mechanical system.
III. Understanding the concept of expert system and their application in CAD.

UNIT-I	INTRODUCTION TO COMPUTER AIDED ANALYSIS OF MECHANICAL SYSTEM	Classes: 09

Introduction: Introduction to mechanical systems analysis, kinematic modeling: Modeling the kinematics of mechanical systems; Vector loop methods, vector chain methods.

UNIT-II	SOLUTION OF KINEMATIC MODELS	Classes: 09

Solution of Kinematic Models: Solution of kinematic models for displacements, velocities, accelerations; Direct analytical solutions of position, velocity, acceleration problems; Numerical solution of position problem; Matrix method solutions of velocity and acceleration problems.

UNIT-III	DYNAMIC MODELING	Classes: 09

Dynamic modeling: Modeling the dynamics of mechanical systems.

Newton-Euler methods to define dynamic constraints between forces, moments, and accelerations, energy methods to define dynamic constraints between input and output links.

UNIT-IV	SOLUTIONS OF DYMNAMICS MODELS	Classes: 09

Solution of Dynamics Models: Solution of inverse dynamics models for joint-link forces and torques, solution of forward dynamics models using numeric integration, model formulation into standard format for solution, Euler's method of integration, Runge-Kutta methods of integration, modeling and analysis of the Trebuchet mechanism.

UNIT-V	ADVANCED DYNAMIC ANALYSIS AND SIMULATION	Classes: 09

Advanced dynamic analysis and simulation: Bond graph modeling of dynamic systems, generation of system equations, causality, and simulation.

Text Books:

1. Norton R., "Design of Machinery", McGraw Hill, 1992.
2. Palm W. J., "Introduction to MATLAB 6 for Engineers", Tata McGraw Hill, 1st Edition, 2000.
3. Nikravesh, P. E., "Computer-Aided Analysis of Mechanical Systems", Prentice Hall, 1988.

Reference Books:
1. Haug, E. J., "Computer Aided Analysis and Optimization of Mechanical System Dynamics", Springer-Verlag.1984. 2. Mukherjee, A., Karmaker, R. and Samantaray, A.K., "Bond Graph in Modeling, Simulation and Fault identification", I & K International 1st Edition, 2007.
Web References:
1.http://nptel.ac.in/courses/106105077/ 2.http://nptel.ac.in/courses/Webcourse-contents/IITKharagpur/Artificialintelligence/New_index1.html
E-Text Books:
1.http://www.ulb.ac.be/scmero/documents/Teaching/Mecah405/MecaH405_part1.pdf 2.http://link.springer.com/book/10.1007%2F978-3-642-52465-3

SIMULATION MODELING OF MANUFACTURING

Group IV: CAD/CAM								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
BCC215	**Elective**	3	-	-	3	30	70	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

OBJECTIVES:

The course should enable the students to:

I. Understand concepts, techniques and tools for modeling and simulation of thermal systems.
II. Apply the fluid mechanics and heat transfer with discrete continuous systems.

UNIT-I	**INTRODUCTION TO MODELING AND MATHEMATICAL PRELIMINARIES**	**Classes: 09**

Introduction to Modeling: Concept of system, continuous and discrete systems, types of models, steps in simulation study; Mathematical preliminaries: Review of vector calculus, Cartesian tensors, vector spaces and linear transformations; Interpolation and extrapolation; Numerical differentiation and integration.

UNIT-II	**DISCRETE AND CONTINUOUS SYSTEMS**	**Classes: 09**

Discrete and Continuous systems: Continuous and discrete systems from fluid mechanics and heat transfer; Characteristics of discrete systems, eigenvalue problems; Characteristics of continuous systems based on differential equations; Inverse problems;

UNIT-III	**MATHEMATICAL MODELING OF THERMAL PROCESSES**	**Classes: 09**

Mathematical modeling of thermal processes: Conservation laws, mass, momentum and energy balance; Classification of governing equations, boundary conditions.

Dimensional analysis, model development for various thermal processes and system; Dynamics of thermo-fluid systems.

UNIT-IV	**SIMULATION OF THERMAL SYSTEMS**	**Classes: 09**

Simulation of Thermal Systems: Numerical methods for solution of partial and ordinary differential equations; Numerical solution of linear and nonlinear algebraic equations; Numerical simulation of steady state and dynamic systems.

UNIT-V	**OPTIMIZATION OF THERMAL SYSTEMS**	**Classes: 09**

Optimization of Thermal Systems: Introduction to optimization, formulation of objective function, constrained single and multivariable optimization, dynamic integer and geometric programming.

Text Books:

1 Y. Jaluria, “Design and Optimization of Thermal Systems”, 2nd Edition, CRC Press. 2007.
2. Bejan, A., Tsatsaronic, G., and Moran, M., “Thermal Design and Optimization”, John Wiley & Sons. 1995.
3. Close, C. M., and Frederick, D. K., “Modeling and Analysis of DynamicSystems”, John Wiley & Sons. 2001.

Reference Books:
1. Jaluria, Y. “Computer Methods for Engineering with MATLAB Applications”, 2nd Edition, CRC Press. 2011. 2. W. H., Teukolsky, S. A., Vetterling, W. T., Flannery, B. P., “Numerical Recipes: The Art of Scientific Computing”, Third Edition, Cambridge UniversityPress, 2007.
Web References:
1.https://www.youtube.com/watch?v=-gYcZt5iKPA 2.https://www.google.co.in/#q=simulation+modelling+of+manufacturing
E-Text Book:
1. http://www.mescenter.ru/images/abook_file/ManufacturingSystems.pdf

DATA COMMUNICATION IN CAD/CAM

Group IV: CAD/CAM

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC216	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understanding the basic concepts of computer and microprocessors.
II. Identify the function of operating system.
III. Applying the data communication and networking in transmission of data.

UNIT-I	COMPUTERS AND MICRO PROCESSORS	Classes: 09

Block diagram, register transfer language, logic and shift micro operations, instruction code, training and control instruction cycle, input and output, interrupt design of basic computer, machine language, assembly language, assembler, registers arithmetic logic unit and bus Systems, timing and control signals, machine cycle and timing diagram, functional block diagrams of 8086 and modes of operation, features of pentium processors.

UNIT-II	OPERATING SYSTEM AND ENVIRONMENTS	Classes: 09

Types, functions, UNIX and WINDOWS NT, architecture, graphical user interfaces, compilers, analysis of the source program the phases of a compiler, cousins of the compiler, grouping of phases, compiler construction tools.

UNIT-III	DATA COMMUNICATION AND NETWORKING	Classes: 09

Data communication and networking, protocols and architecture, data transmission concepts and terminology guided transmission media.

Wireless transmission, data encoding, asynchronous and synchronous communication, base band interface standards RS232C, and RS449 interface.

UNIT-IV	NETWORKING STRUCTURE	Classes: 09

Network structure, network architecture, OSI reference model services, network standardization, managing remote systems in network, network file systems, networking in manufacturing.

UNIT-V	INTERNET	Classes: 09

Internet services, Protocols, intranet information services, mail based service, system and network requirements Internet tools, usenet, e-mail, IRC, www, FTP, Telnet.

Text Books:

1. Morris Mano. M., "Computer System Architecture", Prentice Hall of India, 1st Edition, 1996.
2. Gaonkar R.S., "Microprocessor Architecture, Programming and Applications of 8085", Penram International, 1997.
3. Peterson J.L., Galvin P. and Silberschaz, A., "Operating Systems Concepts", Addison Wesley, 1st Edition, 1997.

Reference Books:

1. Alfred V. Aho, Ravi Setjhi, Jeffrey D Ullman, "Compilers Principles Techniques and Tools", Addison Wesley,
1986.
2. William Stallings, "Data of Computer Communications" Prentice Hall of India, 1997.
3. Andrew S. Tanenbanum "Computer Networks", Prentice Hall of India, 3rd Edition, 1996.
4. Christian Crumlish, "The ABC's of the Internet", BPB Publication, 1996.

Web References:

1. http://nptel.ac.in/downloads/106108100/
2. http://nptel.ac.in/courses/106105082/
3. http://nptel.ac.in/courses/106105080/2
4. http://nptel.ac.in/courses/ microcontrollers/micro/ui/Course_home1_1.html

E-Text Books:

1. http://www.faadooengineers.com/threads/3371-Data-communication-and-networking-Ebook-PDF-DCN-Ebook
2. https://www.google.co.in/?gfe_rd=cr&ei=Dq6SV_G6KNLk8Ae624HgCw&gws_rd=ssl#q=data+communication+ebook
3. https://books.google.co.in/books?id=zrWQ4Bk-XHMC&redir_esc=y

DISASTER MANAGEMENT

Open Elective I : AE / (CAD/CAM) / CSE / ES / SE /PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	S	Total
BST701	Elective	3	-	-	3	30	7	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The student should enable the students to:

I. Exposure to disasters, their significance and types.
II. Understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
III. Explore on Disaster Risk Reduction (DRR) approaches.
IV. Enhance awareness of institutional processes in the country.
V. Develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live,with due sensitivity.

UNIT-I	INTRODUCTION TO NATURAL AND MANMADE DISASTERS	Classes: 09

Concepts and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks. Impact of drought, review of past disasters and drought in India, its classification and characteristics. Classification of drought, causes, Impacts (including social, economic. political, environmental, health, psychosocial, etc.).

UNIT-II	DISASTER, DIFFERENTIAL IMPACTS, CYCLONES AND FLOODS	Classes: 09

Classifications, Causes, Impacts including social, economic, political, environmental, health, psychosocial etc. Differential Impacts in terms of caste, class, gender, age, location, disability Global trends in disasters, urban disasters, pandemics, complex emergencies, climate change.Tropical cyclones & Local storms, Destruction by tropical cyclones and local storms, Cumulative atmospheric hazards/ disasters, Cold waves, Heat waves, Causes of floods, Rood hazards in India.

UNIT-III	APPROACHES TO DISASTER RISK REDUCTION	Classes: 09

Disaster cycle, its analysis, phases, culture of safety, prevention, mitigation and preparedness community based Disaster risk reduction.

Structural, nonstructural sources, roles and responsibilities of community, Panchayati raj Institutions, Urban local bodies, states, centre and other stake holders.

UNIT-IV	INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT	Classes: 09

Factors affecting vulnerabilities, differential impacts, impact of development projects such as darns, embankments, changes in Land-use etc. Climate Change Adaptation, Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT-V	DISASTER RISK MANAGEMENT IN INDIA	Classes: 09

Hazard and Vulnerability profile of India Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness,

OM Act and Policy, other related policies, plans, programmes and legislation).
Field work and case Studies to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the institute is located.

Text Books:

1. Nick, "Disaster Management: A Disaster Manager's Handbook", Asian Development Bank, Manila Philippines, 1991.
2. Kapur, et al., "Disasters in India: Studies of Grim Reality", Rawat Publishers, Jaipur, 2005.
3. Pelling Mark, "The Vulnerability of Cities: Natural Disaster and Social Resilience", Earthscan Publishers, London, 2003.

Reference Books:

1. Sharma, V. K. (1999), "Disaster Management", National Centre for Disaster Management, IIPE, Delhi, 1999.
2. Anil, K. Gupta and Sreeja, S. Nair (2011), "Environmental Knowledge for Disaster Risk Management", NIDM, New Delhi, 2011.

Web References:

1. http://humanityroad.org/
2. http://www.wcpt.org/disaster-management/what-is-disaster-management
3. http://www.ndmindia.nic.in/
4. http://nidm.gov.in/default.asp
5. http://www.unisdr.org/2005/mdgs-drr/national-reports/India-report.pdf

Web References:

1. http://www.ekalavvya.com/disaster-management-in-india-volume-i-free-ebook/
2. http://cbse.nic.in/natural%20hazards%20&%20disaster%20management.pdf
3. http://www.undp.org/content/dam/india/docs/disaster_management_in_india.pdf
4. http://www.digitalbookindex.org/_search/search010emergencydisastera.asp

RENEWABLE ENERGY SYSTEMS

Open Elective I : AE / (CAD / CAM) / CSE / ES / SE / ST

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE701	Open Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Illustrate the concept of photo voltaic power generation.
II. Discuss the Magneto hydrodynamic (MHD) and wind energy power conversion systems.
III. Explain tidal and wave energy.
IV. Design energy conversion systems with low impact on environment.
V. Understand the technology of fuel cells.

UNIT-I	PHOTOVOLTAIC POWER GENERATION SYSTEMS	Classes: 09

Photo voltaic power generation: spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, commercial photo voltaic systems, test specifications for PV systems, applications of super conducting materials in electrical equipment systems.

UNIT-II	MHD WIND ENERGY CONVERSION AND WIND POWER GENERATION	Classes:10

Principles of MHD power generation, ideal MHD generator performance, practical MHD generator, MHD technology; Wind Energy conversion: Power from wind, properties of air and wind, types of wind turbines, operating characteristics.

UNIT-III	TIDAL AND WAVE ENERGY CONVERSION	Classes:08

Tides and tidal power stations, modes of operation, tidal project examples, turbines and generators for tidal power generation.

Wave energy conversion: Properties of waves, power content, vertex motion of waves, device applications, types of ocean thermal energy conversion systems application of OTEC systems examples.

UNIT-IV	ENERGY CONVERSION SYSTEMS AND ENVIRONMENTAL EFFECTS	Classes:09

Miscellaneous energy conversion systems: coal gasification and liquefaction, biomass conversion, geothermal energy, thermo electric energy conversion, principles of EMF generation, co generation and energy storage, combined cycle co generation, energy storage; Global energy position and environmental effects: energy units, global energy position.

UNIT-V	FUEL CELLS	Classes:09

Fuel cells: Types of fuel cells, H_2O_2 Fuel cells, application of fuel cells, batteries, description of batteries, battery application for large power, environmental effects of energy conversion systems.

Text Books:

1. Ashok Desai V, Non-Conventional Energy, Wiley Eastern Ltd, 1990.
2. Rakosh das Begamudre, "Energy conversion systems", New age International publishers, New Delhi - 2000.
3. Freris L.L. Prentice Hall1, "Wind energy Conversion Systems", 1990.
4. Spera D.A., "Wind Turbine Technology: Fundamental concepts of wind turbine technology", ASME Press, NY, 1994.

Reference Books:

1. Mittal K.M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, 1997.
2. Ramesh R, Kurnar K.U, Renewable Energy Technologies, Narosa Publishing House, New Delhi, 1997.
3. John Twidell, Tony Weir "Renewable Energy Resources", 2nd edition.
4. Kreith, Kreider, "Solar Energy Handbook", McGrawHill

Web References:

1. http://www.nrel.gov/docs/fy13osti/54909.pdf
2. http://www.gisday.com/resources/ebooks/renewable-energy.pdf
3. http://www.geni.org/globalenergy/library/energytrends/currentusage/renewable/Renewable-Energy-Potential-for-India.pdf
4. http://www.cerien.upc.edu/jornades/jiie2005/ponencies/power%20converters%20and%20control%20of%20renewable%20energy%20systems%20paper.pdf
5. https://www.irena.org/DocumentDownloads/Publications/RE_Technologies_Cost_Analysis-SOLAR_PV.pdf

E-Text Books:

1. http://maxwell.sze.hu/~marcsa/MegujuloEnergiaforrasok/Books/renewable%20energy%20resources.pdf
2. http://lab.fs.uni-lj.si/kes/erasmus/Renewable%20Energy%20Conversion,%20Transmission,%20and%20Storage.pdf
3. http://www.landartgenerator.org/LAGI-FieldGuideRenewableEnergy-ed1.pdf

AUTOMOTIVE DESIGN

Open Elective I : AE / CSE / ES / SE / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC701	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand and Specify automotive styling and design principles of automotive exteriors.
II. Analyze automotive exterior design trends.
III. Design automotive exteriors using manual and digital renderings.
IV. Create clay models of automotive exterior design.

UNIT-I	AUTOMOTIVE DESIGN TERMINOLOGY , CLASSIFICATION OF CARS BASED ON BODY STYLE	Classes: 09

Overview, Automotive design terminology, automotive design process and factors influencing automotive design, development and history behind different body styles, micro cars, hatchback and it sub types, sedan and its sub-types, coupe and its variants, convertible and its variants, station wagon, sports utility vehicles, multi utility vehicles.

UNIT-II	PLATFORM TECHNOLOGY, TYPES OF CHASSIS, AND AUTOMOTIVE PACKAGING	Classes: 09

Platform technology, types of chassis, and automotive packaging**:** Definition, motivation, versions of platform, benefits of platform sharing and downside of platform technology; History of automotive chassis, composite construction, unibody construction, tubular space frame, glass-fibre monocoque chassis, aluminium monocoque construction, carbon fibre monocoque construction, ULSAB type, definition and different layout sectors in packaging, Interior dimensions, exterior dimensions, front end (engine compartment), rear end (luggage space), under-body, major factors influencing automotive packaging, regulatory requirements.

UNIT-III	AUTOMOTIVE FRONT- REAR END DESIGN	Classes: 09

Factors affecting the front end design, front end design for better air cooling, latest design trends, bumper design theme, regulation for bumper design.

Evolution of grille design, grille design as a new brand image, hood design and new trends in exterior design, tail lamp, spoiler, bumper design, overall rear design for aerodynamics.

UNIT-IV	AUTOMOTIVE LIGHTING SYSTEM , AUTOMOTIVE GLASSES	Classes: 09

History and development in automotive lighting, different types of optical system, light sources used in lighting, headlamp design and styling, advanced lighting technology, pedestrian friendly lights, signal lamps, latest trends in automotive lighting, different types of automotive glasses, recent development in automotive glass design, importance of glass in car design, role of glazing for car safety, developments in automotive glass design.

UNIT-V	AUTOMOTIVE EXTERIOR DESIGN, PAINTING , SURFACE PROTECTION	Classes: 09

Design methodology, image boards: lifestyle board, mood board, theme board, design trends, design movements, application of design principles, product aesthetics, different types of corrosion on automotive bodies, corrosion protection methods, automotive body painting procedure, paint components and latest trends in automotive body colors.

Text Books:

1. J.Fenton, "Handbook of Automotive Body and System Design", Professional Engineering Publishing, 1st Edition, 2000.
2. Erik Eckermann, "World History of the Automobile", SAE International, 1st Edition, 2002.

Reference Books:

1. Stephen Newbury, "Car Design Year Book 1 to 5", Marrell, 1st Edition, London, 2007.
2. Tony Lewin, "How to Design Car Like A Pro", Motorbooks International, 1st Edition, 2003

Web References:

1. www.carbodydesign.com
2. www.style4cars.com
3..www.cardesignnews.com

E-Text Books:

1. http://www.sciencedirect.com/science/book/9780750656924
2. http://books.sae.org/r-312/

EMBEDDED C

Open Elective I: AE / (CAD / CAM) / CSE / SE / ST /PEED | I Semester: ES

Course code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BES001	Core/Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understand embedded C and use it for programming embedded system.
II. Apply techniques for data transfer between I/O ports and memory.
III. Apply object oriented programming for designing embedded system.
IV. Use timers to generate time delays.

UNIT-I	PROGRAMMING EMBEDDED SYSTEMS IN C	Classes: 09

Introduction, what is an embedded system, which processor should you use, which programming language should you use, which operating system should you use, how do you develop embedded software, conclusions; Introduction, what's in a name, the external interface of the standard 8051, reset requirements, clock frequency and performance, memory issues, I/O pins, timers, interrupts, serial interface, power consumption, conclusions.

UNIT-II	SWITCHES	Classes: 09

Introduction, basic techniques for reading from port pins; Example: Reading and writing bytes, example: Reading and writing bits (simple version), Example: Reading and writing bits (generic version), The need for pull-up resistors, Dealing with switch bounce, Example: Reading switch inputs (basic code), example: counting goats, conclusions.

UNIT-III	ADDING STRUCTURE TO THE CODE	Classes: 09

Introduction, object oriented programming with C, the project header (MAIN.H), the port header (PORT.H);

Example: Restructuring the 'Hello Embedded World' example, Example: Restructuring the goat-counting example, further examples and conclusions.

UNIT-IV	MEETING REAL-TIME CONSTRAINTS	Classes: 09

Introduction, creating hardware delays using Timer 0 and Timer 1, example: Generating a precise 50 ms delay, example: Creating a portable hardware delay, Why not use Timer 2? The need for timeout mechanisms, creating loop timeouts and example: Testing loop timeouts, example: A more reliable switch interface, Creating hardware timeouts, example: Testing a hardware timeout, conclusions.

UNIT-V	CASE STUDY: INTRUDER ALARM SYSTEM	Classes: 09

Introduction, The software architecture, key software components used in this example, running the program, the software, conclusions.

Text Books:

1. Michael J. Pont, "Embedded C", Pearson Education, 2nd Edition, 2008.

Reference Books:

1. Nigel Gardner, "The Microchip PIC in CCS C", Ccs Inc, 2nd Revision Edition, 2002.

Web References:

1. http://www.keil.com/forum/5973/
2. http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Embedded%20systems /New_index1.html
3. http://nptel.iitg.ernet.in/courses/Elec_Engg/IIT%20Delhi/Embedded%20Systems%20(Video).htm
4. http://freevideolectures.com/Course/2999/Embedded-Systems-I/5

E-Text Books:

1. http://teachers.teicm.gr/kalomiros/Mtptx/e-books/eBook%20-%20PIC%20Programming%20with %20C.pdf
2. http://www.ecpe.nu.ac.th/ponpisut/22323006-Embedded-c-Tutorial-8051.pdf
3. http://dsp-book.narod.ru/CPES.pdf
4. http://staff.ustc.edu.cn/~shizhu/WinCE/winCE6%20Fundamentals.pdf
5. http://read.pudn.com/downloads167/ebook/769402/Wrox.Professional.Microsoft.Windows.Embedd
6. ed.CE.6.0.Nov.2008.eBook-DDU.pdf
7. https://syhpullpdf.files.wordpress.com/2015/05/embedded-systems-textbook-pdf.pdf

ADVANCED JAVA PROGRAMMING AND WEB SERVICES

Open Elective I: AE / (CAD/CAM) / ES / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCS701	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to :

I. Understand OOPS Concepts Describe client side technologies.
II. Implement database connections.
III. Develop the skills to design user interfaces for web Applications.

UNIT-I	INTRODUCTION TO OOPs	Classes: 09

Basic concepts of OOPs: Java History, Java Features, Comparison in Java and C++ ,Java Virtual Machine, Java Environment, Program, Data types, operators, Control Structure, Classes and Objects, Constructors, Interfaces, Exception Handling.

UNIT-II	APPLETS AND SWINGS	Classes: 09

Applets: Introduction to applet, applet vs application, applet class, advantages of applet, applet lifecycle, applet tag, passing parameters to applet, types of applets, examples; swing: introduction to JFC, swing, Swing, Features, JComponent, JApplet, JFrame, JPannel, JButtons, Jcheckboxes and JRadiobuttons, JTextField, JMenu, JMenuBar

UNIT-III	HTML AND XML	Classes: 09

HTML common tags: list, tables, images, forms, frames; cascading style sheets; introduction to java scripts, objects in java script, dynamic HTML with java script.

XML: document type definition, XML schemas, document object model, presenting XML, using XML processors: DOM and SAX.

UNIT-IV	WEB SERVERS,SERVLETS AND JSP	Classes: 09

Web servers: Tomcat server installation and testing, introduction to servelets: lifecycle of a servelet, JSDK, servelet API, javax. servelet package, reading servelet parameters, reading initialization parameters; servlets: javax, servelet HTTP package, handling http request and responses, using cookies session tracking, security issues, JSP: problem with servelet, anatomy of a JSP Page, JSP processing, JSP application design with MVC architecture, AJAX.

UNIT-V	JDBC AND ODBC	Classes: 09

JDBC & ODBC :Java and JDBC , JDBC vs ODBC, JDBC driver model, JDBC driver types, two-tier architecture for data access ,three-tier architecture for data access , types of driver managers, connecting to an ODBC data source, JDBC programs

Text Books:

1. WILEY Dreamtech Chris Bates, "Web Programming, building internet applications", 2nd edition.
2. Patrick Naughton and Herbert Schildt, "The complete Reference Java 2" , TMH, 5th Edition.
3. Hans Bergsten , "Java Server Pages", SPD O'Reilly.

Reference Books:

1. Sebesta, "Programming world wide web", Pearson Core,8th Edition 2008.
2. Marty Hall, Larry Brown, "Servlets and Javaserver Pages", Volume 1: Core Technologies, Pearson 2nd Edition 1998.

Web References:

1. http://engineeringppt.blogspot.in/2010/01/advance-java-web-technology.html
2. http://www.scoopworld.in/2015/02/ajwt-ppt-lab-materials-cse.html
3. http://jntuh.ac.in/new/bulletin_board/WEB_TECHNOLOGIES.pdf

E-Text Books:

1. http://www.freetechbooks.com/advanced-programming-for-the-java-2-platform-t36.html
2. https://www.mkyong.com/featured/top-5-free-java-ebooks/
3. http://www.e-booksdirectory.com/listing.php?category=226

INTRODUCTION TO AEROSPACE ENGINEERING

Open Elective I: (CAD/CAM) / CSE / ES / SE / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BAE701	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil		Practical Classes: Nil			Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Outline different aspects of flight vehicles and their operational environment.
II. Description of flow behavior of one-dimensional incompressible and compressible flow, two-dimensional flow and finite wing.
III. Apprise about boundary layer effects, aerodynamic forces on airfoils, wings and high-lift systems.
IV. Analyze airplane performance, stability and control.

UNIT-I	INTRODUCTION TO AERONAUTICS AND ASTRONAUTICS	Classes: 08

Historical perspective of aeronautics and astronautics, anatomy of the airplane, anatomy of a space vehicle, aerodynamic forces; Parameters affecting aerodynamic forces: Dimensional analysis; Theory and experiment, wind tunnels; Atmosphere: Properties of U.S. standard atmosphere, definitions of altitude.

UNIT-II	ONE DIMENSIONAL FLOW IN INCOMPRESSIBLE AND COMPRESSIBLE FLUIDS, TWO DIMENSIONAL FLOW AND FINITE WING	Classes: 10

Continuity equation, Bernoulli's equation; Application of Bernoulli's equation: Airspeed indicators and wind tunnels, one dimensional compressible flow concepts, speed of sound, compressible flow equations in a variable-area stream tube, application to airspeed measurement, applications to channels and wind tunnels; Two dimensional flow and finite wing: Limitations of one dimensional flow equations; Theory of lift: circulation, Airfoil pressure distribution, Helmholtz vortex theorems, Simulating the wing with a vortex Line, downwash, elliptic lift distribution; Lift and drag: Momentum and energy, Slope of finite wing lift curve, verification of Prandtl wing theory, additional effects of wing vortices, search for reduced induced drag.

UNIT-III	VISCOUS EFFECTS, DRAG DETERMINATION, AIRFOILS, WINGS AND HIGH-LIFT SYSTEMS	Classes: 10

Boundary layer, boundary layer on bluff bodies, creation of circulation, laminar and turbulent boundary layers: skin friction, nature of Reynolds number, effect of turbulent boundary layer on separation; Total Incompressible drag: Parasite drag, drag due to lift, importance of aspect ratio; Compressibility drag: Prediction of drag divergence Mach number, sweptback wings, total drag.

Supersonic flow: Shock waves and Mach waves, supersonic wing lift and drag, area rule, supersonic aircraft, airfoils; Wings: early airfoil development, modern airfoils, supersonic airfoils, airfoil pitching moments, effects of sweepback on lift, airfoil characteristics, airfoil selection and wing design; High-lift Devices: Airfoil maximum lift coefficient, leading and trailing edge devices, effect of sweepback, deep stall, effect of Reynolds number, propulsive lift.

UNIT-IV	AIRPLANE PERFORMANCE, STABILITY AND CONTROL, AEROSPACE PROPULSION	Classes: 09
Level flight performance, climb performance, range, endurance, energy-state approach to airplane performance, takeoff performance, landing performance; Static longitudinal stability; Dynamic longitudinal stability; Dynamic lateral stability; Control and maneuverability: Turning performance, control systems, active controls; Aerospace propulsion: Piston engines, gas turbines; Speed limitations of gas turbines: Ramjets, propellers, overall propulsion efficiency, rocket engines, rocket motor performance, propulsion-airframe integration.		
UNIT-V	**AIRCRAFT STRUCTURES, HYPERSONIC FLOWS, ROCKET TRAJECTORIES AND ORBITS**	**Classes: 08**
Aircraft structures: Importance of structural weight and integrity, development of aircraft structures, importance of fatigue, materials, loads, weight estimation; Hypersonic flows: temperature effects, Newtonian theory; rocket trajectories, multistage rockets, escape velocity, circular orbital or satellite velocity, elliptical orbits, orbital maneuvers.		

Text Books :

1. Richard S. Shevell, Fundamentals of Flight, Pearson Education Publication, 2nd Edition, 1988.
2. Anderson J. D, "Introduction to Flight", McGraw-Hill, 5th Edition, 1989.
3. Newman D, "Interactive Aerospace Engineering and Design", McGraw-Hill, 1st Edition, 2002.
4. Barnard R.H and Philpot. D.R, "Aircraft Flight", Pearson, 3rd Edition, 2004.

Reference Books:

1. Introduction to Flight, John D. Anderson, Jr., Tata McGraw-Hill Publishing Company, Fifth Edition, Fifth Edition, 2007.
2. Kermode, A. C, "Flight without Formulae", McGraw Hill, 4th Edition, 1997.
3. Swatton P. J, "Flight Planning", Blackwell Publisher, 6th Edition, 2002.

Web References:

1. https://fas.org/irp/doddir/army/fm3-04-203.pdf
2. http://www.aerospaceengineering.es/book/
3. http://www.ne.nasa.gov/education/
4. http://nptel.ac.in

E-Text Books:

1. http://www.e-booksdirectory.com/
2. http://www.adl.gatech.edu/extrovert/Ebooks/ebook_Intro.pdf
3. http://www.academia.edu/7950378/Introduction_to_Flight_-_Anderson_5th_Ed._

GEOSPATIAL TECHNIQUES

Open Elective-II: AE / (CAD/CAM) / CSE / ES / SE /PEED

Course Code	Category	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BST702	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Provide technical skills to use geo-referenced data for the purpose of economic, educational, and social development.
II. Learn the art of image interpretation and mapping.
III. Learn the applications of geospatial technologies.

UNIT-I	INTRODUCTION TO GEOSPATIAL DATA	Classes: 09

Geospatial data, why to study geospatial data, importance of geospatial technology, spatial data infrastructure, three important geospatial technologies, spatial elements., coordinates and coordinate systems, basic electromagnetic radiation.

UNIT-II	PHOTOGRAMMETRY AND REMOTE SENSING	Classes: 10

Definition and scope, history of photogrammetry and remote sensing, principle, remote sensing data acquisition, Remote sensing data analysis methods, advantages and limitations, hardware and software required. Map Vs mosaic, ground control points. Energy interactions with atmosphere and earth surface features.

UNIT-III	MAPPING AND CARTOGRAPHY	Classes: 10

What is map and its importance, map scale and types, elements of map and Indexing, map coordinate systems, visual interpretation of satellite images, and interpretation of terrain evaluation.

Introduction to digital data analysis, cartographic symbolization, classification of symbols, colours in cartography, scale and purpose of a map, cartographic design, thematic cartography, digital cartography.

UNIT-IV	GEOGRAPHIC INFORMATION SYSTEM	Classes:10

Introduction to GIS, definition and terminology, GIS categories, components of GIS, fundamental operations of GIS, theoretical framework for GIS, GIS data structures, data collection and input overview, processing of spatial data, data Input or output, vector data model, raster data model, geometric representation of spatial feature and data structure. Spatial data and modeling, TIN, DTM, overlay, spatial measurement .

UNIT-V	GEOSPATIAL TECHNOLOGIES APPLICATIONS	Classes:09

Visual image analysis for land use / land cover mapping, land use and land cover in water resources, surface water mapping and Inventory, geological and soil mapping, agriculture applications for forestry applications, water resources applications, urban and regional planning, environmental assessment, principles of land form identification and evaluation: sedimentary, igneous and metamorphic rock terrain.

Text Books :

1. John D. Bossler, “Manual of Geospatial Science and Technology” Taylor & Francis.
2. M. Anji Reddy, “Textbook of Remote Sensing and Geographical Information Systems”, BS Publications.

Reference Books:

1. C. P. Lo Albert, K.W. Yonng, “Concepts and Techniques of GIS”, Prentice Hall (India) Publications.
2. Peter A Burragh and Rachael A. Mc Donnell, “Principles of Geo- Physical Information Systems”, Oxford Publishers, 2004.
3. M. Anji Reddy, “Geo-informatics for Environmental Management” BS Publications.

Web References:

1. https://www.aaas.org/content/what-are-geospatial-technologies
2. http://www.istl.org/10-spring/internet2.htmls

E-Text Books:

1. http://www.springer.com/us/book/9781441900494
2. https://www.amazon.com/Introduction-Geospatial-Technologies-Bradley-Shellito/dp/146413345X
3. http://www.springer.com/us/book/9784431555186
4. http://gep.frec.vt.edu/VCCS/materials/2011/Day1/Handouts/1.2-Ch.1_GIS_Intro.pdf
5. http://www.slideshare.net/CuteGirl11/introduction-to-geospatial-technologies-pdf

SOLAR PHOTOVOLTAIC ENERGY CONVERSION

Open Elective II : AE / (CAD / CAM) / CSE / ES / SE / ST

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BPE702	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

This course should enable the students to:

I. Illustrate the operation of Photo voltaic power generation.
II. Analyze the characteristics of solar photovoltaic power generation.
III. Design energy conversion systems with low impact on environment.
IV. Understand the technology of fuel cells.

UNIT-I	INTRODUCTION	Classes: 09

Introduction: Highlights, an atomic description of silicon, the effect of light on silicon the potential barrier, the function of the barrier, the potential barrier in action the electric current.

UNIT-II	PHYSICAL ASPECTS OF SOLAR CELL EFFICIENCY	Classes: 09

Physical aspects of solar cell efficiency: Reflection light with too little or too much energy, recombination of electron hole pairs, direct recombination indirect recombination, resistance, self shading, performance degradation at non optimal temperatures, high temperature losses, low temperature losses.

UNIT-III	SINGLE CRYSTAL SILICON SOLAR CELLS AND ARRAYS	Classes: 09

Single Crystal Silicon Solar cells: New fabrication edge, defined film fed growth (dendritic web growth, Ribbon to ribbon (rtr) growth innovative cell designs back surface fields (BSF) and other minority carrier mirrors (MCM). Schottky barrier cells, inversion layer cells, cells for concentrated sun light advances in component technology highlights, PV building blocks, boosting voltage and amperage design requirements for connecting components, the physical connection. placing the cells;

Arrays: Array support, module covers, module cooling, hybrid designs, Brayton cycle, electricity production, the rmo electric generators, intercepting sunlight, arrays with relectors, arrays that follow the sun, controlling intensity, imaging optics, mirrors,
lenses tracking devices, steering mechanisms, tracking device controls, optimizing the use of the spectrum, splitting the spectrum, converting the spectrum to a single color.

UNIT-IV	SOLAR ARRAY CONSTRUCTIONS	Classes: 09

Solar array constructions: Intercepting sunlight, arrays with relectors, arrays that follow the sun, controlling intensity, imaging optics, mirrors, lenses; Tracking devices: steering mechanisms, tracking device controls, optimizing the use of the spectrum, splitting the spectrum, converting the spectrum to a single color.

UNIT-V	PV SUPPORT EQUIPMENT	Classes: 09

PV support equipment: PV vs conventional electricity, storing PV's electricity, batteries, fuel cells, power conditioning equipment the inverter regulators other devices; system analysis, design procedure, design constraints, other considerations.

Text Books:

1. CS Solanki, "Solar photovoltaic's fundamentals, Technologies and Applications", PHI Learning Pvt. Ltd., 2011.
2. Rai. G.D, "Solar energy utilization", Khanna publishes, 1993.
3. Rai,G.D., "Non- conventional resources of energy", Khanna publishers, Fourth edition, 2010.

Reference Books:

1. Rai. G.D, "Solar energy utilization", Khanna publishes, 1993.
2. Pai, B. R. and Ram Prasad, "Power Generation through Renewable Sources of Energy", Tata McGraw Hill, New Delhi, 1991.
3. Bansal, Kleeman and Meliss, "Renewable Energy Sources and Conversion Techniques", Tata Mc Graw Hill, 1990.
4. Godfrey Boyl, "Renewable Energy: Power sustainable future", Oxford University Press, Third edition, 2012.
5. B.H.Khan, "Non-Conventional Energy Resources", The McGraw Hills, Second edition, 2009.
6. John W Twidell and Anthony D Weir, "Renewable Energy Resources", Taylor and Francis, 2006.

Web References:

1. http://www.tue.nl/fileadmin/content/faculteiten/tn/PMP/White_papers/Delft2012_-_ALD4PV.pdf
2. http:// www.en.wikipedia.org/wiki/Photovoltaics
3. http://www.desware.net/Sample-Chapters/D06/D10-014.pdf
4. http://www.southampton.ac.uk/~solar/files/Strasbourg.pdf
5. http:// www.science.nasa.gov/science-news/science-at-nasa/2002/solarcells/

E-Text Books:

1. http://www.nrel.gov/docs/legosti/old/1448.pdf
2. http://www.irena.org/DocumentDownloads/Publications/IRENAETSAP%20Tech%20Brief%20E11%20Solar%20PV.pd
3. http://www.opalrt.com/sites/default/files/technical_papers/SOLAR%20PHOTOVOLTAIC%20ENERGY%20GENERATION%20AND%20CONVERSION.pdf

COMPUTER GRAPHICS

Open Elective II: AE / CSE / ES / SE / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCC702	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Understanding the basics of Computer Graphics needed for CAD/ CAM applications.
II. Applying the geometrical modeling for computer graphics.
III. Applying data structures in computer graphics.

UNIT-I	INTRODUCTION TO COMPUTER GRAPHICS	Classes: 09

Introduction: Role of computer graphics in CAD/CAM, configuration of graphic workstations, menu design and graphical user interfaces, customization and parametric programming.

UNIT-II	GEOMETRIC TRANSFORMATIONS, PROJECTIONS AND FUNDAMENTALS OF 2D AND 3D TRANSFORMATIONS	Classes: 09

Geometric transformations and projections: Vector representation of geometric entities, homogeneous coordinate systems; Fundamentals of 2D and 3D transformations: reflection, translation, rotation, scaling, and shearing, various types of projections.

UNIT-III	DEVELOPMENT OF GEOMENTRICAL MODELLING	Classes: 09

Curves: Modeling planar and space curves, analytical and synthetic approaches, non-parametric and parametric equations.

Surfaces: Modeling of bi-parametric freedom surfaces, Coons, Bezier, B-spline, and NURBS surfaces, surface manipulation techniques.

UNIT-IV	GEOMENTRICAL MODELING	Classes: 09

Geometric Modeling: Geometric modeling techniques, wireframe modeling, solid modeling: B Rep CSG, hybrid modelers, feature based, parametric and variation modeling.

UNIT-V	DATA STRUCTURES IN COMPUTER GRAPHICS	Classes: 09

Data Structure in Computer Graphics: Introduction to product data standards and data structures, data-base integration for CIM.

Text Books:

1. D. F. Rogers, J. A. Adams, “Mathematical Elements for Computer Graphics”, Tata McGraw Hill.1989.
2. I. D. Faux, M. J. Pratt, “Computational Geometry for Design and Manufacture”, Ellis Horwood, 1979.
3. Mortenson, M. E., “Geometric Modeling”, 3rd Ed., Industrial Press. 2006
4. Ibrahim Zeid, “CAD/CAM: Theory and Practice”, Tata McGraw Hill, 1998.

5. B. K. Choi, B. K., “Surface Modeling for CAD/CAM", John Wiley & Sons 1991.

Reference Books:

1. C. Pozrikidis, “Introduction to Theoretical and Computational Fluid Dynamics”, Oxford University Press, 2nd Edition, 2013.
2.V. Patankar, Hema shava Suhas , “ Numerical heat transfer and fluid flow”, Tata McGraw Hill

Web References:

1. http://nptel.ac.in/courses/106106090/
2. http://nptel.ac.in/courses/112102101/

E-Text Books:

1. http://www.freebookcentre.net/CompuScience/Free-Computer-Graphics-Books-Download.html
2.https://docs.google.com/file/d/0B_YZ665nBRhlYmNiOTU5ZDItMmU2OC00YTVmLThiNmMtMjg
3. Y2E3ZTgwZDYw/edit?hl=en_US&pref=2&pli=1

MICROCONTROLLERS FOR EMBEDDED SYSTEM DESIGN

Open Elective II: AE / (CAD / CAM) / CSE / SE / ST /PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BES702	Elective	3	-	-	3	30	70	100

Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil	Total Classes: 45

OBJECTIVES:

The course should enable the students to:

I. Understand hardware units and devices for design of embedded systems.
II. Use architectures of embedded RISC processors and system on chip processor design of embedded systems.
III. Analyze interrupt latency, context switching time, for development of device drives for timing devices.

UNIT-I	INTRODUCTION TO EMBEDDED SYSTEMS	Classes: 09

Overview of embedded systems, processor embedded into a system, embedded hardware units and devices in system, embedded software, complex system design, design process in embedded system, formalization of system design, classification of embedded systems.

UNIT-II	MICROCONTROLLERS	Classes: 09

8051 architecture, input/output ports and circuits, external memory, counters and timers, PIC controllers; Interfacing processor 8051, PIC, memory interfacing, I/O devices, memory controller and memory arbitration schemes.

UNIT-III	EMBEDDED RISC PROCESSORS	Classes: 09

programmable system on chip architectures, continuous timer blocks, switched capacitor blocks, I/O blocks, digital blocks, programming of PSOC;

Embedded RISC processor architecture, ARM processor architecture, registers set, modes of operation and overview of Instructions.

UNIT-IV	INTERRUPTS AND DEVICE DRIVERS	Classes: 09

Exceptions and Interrupt handling Schemes, Context and periods for context switching, deadline and interrupt latency; Device driver using interrupt service routine, serial port device driver and device drivers for internal programmable timing devices.

UNIT-V	NETWORK PROTOCOLS	Classes: 09

Serial communication protocols, Ethernet protocol, SDMA, Channel and IDMA, external bus interface.

Text Books:

1. Raj Kamal, "Embedded Systems, Architecture Programming and Design", Tata Mc Graw Hill, 2nd Edition, 2008.
2. Muhammad Ali Mazidi, Rolin D. Mckinaly, Danny Causy, "PIC Microcontroller and Embedded Systems", Pearson Education, 1st Edition, 2008.
3. Robert Ashpy, "Designers Guide to the Cypress PSOC", Elsevier, 1st Edition, 2005.

Reference Books:

1. Jonathan W. Valvano – Brookes / Cole, "Embedded Microcomputer Systems, Real Time Interfacing", Thomas Learning, 1st Edition, 1998.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM Systems Developers Guides, Design & Optimizing System Software", Elsevier, 1st Edition, 2004.
3. John B. Peatman, "Designing with PIC Microcontrollers", PH Inc, 1st Edition, 1998.

Web References:

1. http://nptel.ac.in/syllabus/108102045/
2. http://nptel.ac.in/courses/Webcourse-contents/IIT,KANPUR/microcontrollers/micro/ui/Course_home1_1.Htm

E-Text Books:

1. http://microcontrollershop.com/default.php?cPath=239
2. http://www.sciencedirect.com/science/book/9780750667555
3. https://books.google.co.in/books/about/Embedded_Systems_Design_with_8051_Microc.html?id=YiTa, HChn0UC&redir_esc=y
4. https://books.google.co.in/books/about/Microcontroller_And_Embedded_Systems.html?id=4GrXJeC6HFkC

LINUX PROGRAMMING

Open Elective II: AE / (CAD/CAM) / ES / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCS702	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Total Tutorials: Nil	Total Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students to :

I. Understand basic Linux utilities and Shell scripting language (bash) to solve Problems.
II. Explore on implementation of linux utilities using system calls.
III. Develop the skills necessary for systems programming
IV. Illustrate the basic skills required to write inter process communication programs.

UNIT-I	LINUX UTILITIES	Classes: 09

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, awk-Execution, Fields and Records, Scripts, Operation, Patterns, Actions, Associative Arrays, String and Mathematical functions, System commands in awk, Applications.

UNIT-II	SHELL PROGRAMMING	Classes: 09

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, debugging shell scripts.

UNIT-III	FILES AND DIRECTORIES	Classes: 09

Files: File types, File System Structure, file metadata: Inodes, kernel support for files, system calls for file I/O operations: open, create, read, write, close, lseek, dup2, file status information: stat family, file and record locking: fcntl function.

File permissions - chmod, fchmod, file ownership, links: soft and hard links: symlink, link, unlink. Directories: Creating, removing and changing Directories, obtaining current working directory: getcwd, Directory contents, Scanning Directories: opendir, readdir, closedir, rewinddir functions.

UNIT-IV	INTERPROCESS COMMUNICATION AND MESSAGE QUEUES	Classes: 09

Introduction to IPC, IPC between processes on a single computer system, IPC between processes on different systems, pies-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 AND SOCKETS	Classes: 09

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.

Text Books:

1. T. Chan , "Unix System Programming using C++", PHI, 2nd Edition,2005.
2. Sumitabha Das, "Unix Concepts and Applications", 4th Edition, TMH, 2011.
3. W. R. Stevens , "Unix Network Programming", PHI, 2nd Edition ,1999.

Reference Books:

1. Mathew, R. Stones, Wrox, "Beginning Linux Programming", Wiley India Edition,4th Edition,2008.
2. Graham Glass, King Ables, "Unix for programmers and users", 3rd Edition,Pearson, 2006.
3. Hoover, "SystemProgramming with C and Unix", Pearson, 2nd Edition ,2009.
4. K. A. Robbins, "Unix System Programming, Communication, Concurrency and Threads", Pearson Education, 6th Edition, 2007.

Web References:

1. http://www.fuky.org/abicko/beginning-linux-programming.pdf
2. https://www.pdc.kth.se/about/links/linux-programming-for-beginners
3. http://www.tutorialspoint.com/unix/unix_tutorial.pdf
4. http://www.rpi.edu/dept/arc/training/shell/slides.pdf

E-Text Books:

1. http://onlinevideolecture.com/ebooks/?subject=Linux
2. http://www.onlineprogrammingbooks.com/linux-succinctly/
3. http://ebook-dl.com/item/beginning_linux_programming_4th_edition_neil_matthew_richard_stones/

RESEARCH METHODOLOGY

Open Elective II: AE / (CAD / CAM) / CSE / ES / SE / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BCS703	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			

OBJECTIVES:

The course should enable the students to:

I. Identify an appropriate research problem in their interesting domain.
II. Organize and conduct research project.
III. Prepare a research project thesis report.
IV. Understand the law of patent and copyrights.
V. Adequate knowledge on process for filing Patent.

UNIT-I	INTRODUCTION	Classes: 09

Definition, types of research, research approaches, research process, validity and reliability in research, features of good design, types of research design, and basic principles of experimental design.

UNIT-II	MEASUREMENT AND SCALING TECHNIQUES	Classes: 09

Errors in measurement, tests of sound measurement, scaling and scale construction techniques, forecasting techniques, time series analysis, interpolation and extrapolation.

UNIT-III	METHODS OF DATA COLLECTION	Classes: 09

Primary data, questionnaire and interviews, collection of secondary data, cases and schedules.

Professional attitude and goals, concept of excellence, ethics in science and engineering, some famous frauds in science, case studies.

UNIT-IV	INTERPRETATION OF DATA AND REPORT WRITING	Classes: 09

Layout of a research paper, techniques of interpretation, making scientific presentation at conferences and popular lectures to semi technical audience, participating in public debates on scientific issues.

UNIT-V	INTRODUCTION TO INTELLECTUAL PROPERTY	Classes: 09

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights; 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.

Text Books:

1. C. R. Kothari, "Research Methodology: Methods and Techniques", New Age International Publishers, 2nd Edition, 2004.
2. P. Gupta, "Statistical Methods", Sultan Chand and Sons, New Delhi, 1st Edition, 2005.
3. Richard W. Stim, "Intellectual Property: Patents, Trademarks, and Copyrights", Cengage learning, 2nd Edition, 2001.

Reference Books:

1. P. Narayana Reddy, G. V. R. K. Acharyulu, "Research Methodology and Statistical Tools", Excel Books, New Delhi, 1st Edition, 2008.
2. Prabuddha Ganguli, "Intellectual Property Right, Unleashing the Knowledge Economy", Tata Mc Graw Hill Publishing Company Ltd, 1st Edition, 2001.

Web References:

1. http://nptel.ac.in/courses/109103024/40
2. http://study.com/academy/topic/introduction-to-research-methods.html
3. https://www.vutube.edu.pk/vu-lectures/viewcategory/240/research-methods-sta630

E-Text Books:

1. http://www.metastudio.org/Science%20and%20Ethics/file/readDoc/535a76367d9d331598f49e2d/34_Hb_on_IPR.pdf
2. http://www.bits-pilani.ac.in/uploads/Patent_ManualOct_25th_07.pdf
3. http://euacademic.org/BookUpload/9.pdf

INDUSTRIAL AERODYNAMICS AND WIND ENERGY

OPEN ELECTIVE II : (CAD/CAM) / CSE / ES / SE / ST / PEED

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
BAE702	Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil		Practical Classes: Nil			Total Classes: 45		

OBJECTIVES:

The course should enable the students to:

I. Understand the atmospheric boundary layer and conditions.
II. Describe the wind energy and its application in turbines.
III. Familiarize with non-aeronautical uses of aerodynamics such as road vehicle, building aerodynamics and problems of flow induced vibrations.

UNIT-I	ATMOSPHERIC WINDS AND ATMOSPHERIC BOUNDARY LAYER	Classes: 08

Causes of wind thermal drive, Coriolis effect, pressure gradient effect, Geotropic 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	Classes: 10

Ship propulsion, sails, lift and drag translators, modern yachts; Horizontal and vertical axis wind turbines: History, first example of automatic feedback control for yaw in 16^{th} century English windmills, classification. Horizontal axis wind turbine: Elementary actuator disc theory, Betz coefficient; Definition of power coefficient and torque coefficient for all wind turbines; Working principle, power coefficients, tip speed ratio explanation, by introductory blade element theory, conventional horizontal axis wind turbine, savonious vertical axis wind turbine, Darries vertical axis wind turbine, merits and demerits of horizontal axis wind turbines and vertical axis wind turbines.

UNIT-III	VEHICLE AERODYNAMICS	Classes: 10

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 and 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	Classes: 09

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 VIBATIONS	Classes: 08

Classification: Vortex induced vibration and flow induced instability such as galloping and 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. Siraj Ahmed, "Wind Energy theory and practice", PHI learning Pvt Ltd., 3rd Edition, 2015.
2. R. D. Blevins, "Flow Induced Vibrations", Van Nostard, 2nd Edition, 1990.
3. P. Sachs, "Wind Forces in Engineering", Pergamon press, 2nd Edition, 1988.
4. N. G. Calvert, "Wind Power Principles", Charles Griffin & co. London, 1st Edition, 1979.

Reference Books:

1. R. S. Scorer, "Environmental Aerodynamics", Ellis Harword Ltd, England, 1st Edition, 1978.
2. M. Sorvan, "Aerodynamics Drag Mechanisms of Bluff Bodies and Road vehicles", plenum press, 2nd Edition, 1978.

Web References:

1. http://www.mech.canterbury.ac.nz/research/fluid%20mechanics.shtml
2. http://www.journals.elsevier.com/journal-of-wind-engineering-and-industrial-aerodynamics

E-Text Books:

1. http://www.sciencedirect.com/science/journal/01676105
2. https://www.scribd.com/doc/42602999/Flow-Induced-Vibration-by-Robert-D-Blevins-2nd-Ed
3. http://store.elsevier.com/Wind-Forces-in-Engineering/Peter-Sachs/isbn-9781483148359/

VISION AND MISSION OF THE INSTITUTE

VISION

To bring forth professionally competent and socially sensitive engineers, capable of working across cultures meeting the global standards ethically.

MISSION

To provide students with an extensive and exceptional education that prepares them to excel in their profession, guided by dynamic intellectual community and be able to face the technically complex world with creative leadership qualities.

Further, be instrumental in emanating new knowledge through innovative research that emboldens entrepreneurship and economic development for the benefit of wide spread community.

M.TECH - PROGRAM OUTCOMES (PO's)

PO-1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems (**Engineering Knowledge**).

PO-2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences **(Problem Analysis).**

PO-3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations **(Design/Development of Solutions).**

PO-4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions **(Conduct Investigations of Complex Problems).**

PO-5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations **(Modern Tool Usage).**

PO-6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice **(The Engineer and Society).**

PO-7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development **(Environment and Sustainability).**

PO-8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice **(Ethics).**

PO-9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings **(Individual and Team Work).**

PO-10: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions **(Communication).**

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change **(Life-long learning).**

OBJECTIVES OF THE DEPARTMENT

DEPARTMENT OF MECHANICAL ENGINEERING

Programme Educational Objectives (PEO's)

A graduate of Institute of Aeronautical Engineering, Mechanical Engineering should enjoy a successful career in Mechanical Engineering or a related field after graduation. The program aims to:

PEO – I: To provide students with a sound foundation in the mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze engineering problems.

PEO – II: To prepare students for successful careers in industry that meet the needs of local, Indian and multinational companies.

PEO – III: To develop the ability among students to synthesize data and technical concepts for application to product design and prepares students to work as part of teams on multidisciplinary projects.

PEO – IV: To promote student awareness for life-long learning and to introduce them to codes of professional practice, ethics and prepare them for higher studies.

PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO – I: To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.

PSO – II: An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.

PSO – III: To build the nation, by imparting technological inputs and managerial skills to become Technocrats.

FREQUENTLY ASKED QUESTIONS AND ANSWERS ABOUT AUTONOMY

1. **Who grants Autonomy? UGC, Govt., AICTE or University**
   In case of Colleges affiliated to a university and where statutes for grant of autonomy are ready, it is the respective University that finally grants autonomy but only after concurrence from the respective state Government as well as UGC. The State Government has its own powers to grant autonomy directly to Govt. and Govt. aided Colleges.

2. **Shall IARE award its own Degrees?**
   No. Degree will be awarded by Jawaharlal Nehru Technological University, Hyderabad with a mention of the name IARE on the Degree Certificate.

3. **What is the difference between a Deemed University and an Autonomy College?**
   A Deemed University is fully autonomous to the extent of awarding its own Degree. A Deemed University is usually a Non-Affiliating version of a University and has similar responsibilities like any University. An Autonomous College enjoys Academic Autonomy alone. The University to which an autonomous college is affiliated will have checks on the performance of the autonomous college.

4. **How will the Foreign Universities or other stake – holders know that we are an Autonomous College?**
   Autonomous status, once declared, shall be accepted by all the stake holders. The Govt. of Telangana mentions autonomous status during the First Year admission procedure. Foreign Universities and Indian Industries will know our status through our website.

5. **What is the change of Status for Students and Teachers if we become Autonomous?**
   An autonomous college carries a prestigious image. Autonomy is actually earned out of our continued past efforts on academic performances, our capability of self- governance and the kind of quality education we offer.

6. **Who will check whether the academic standard is maintained / improved after Autonomy? How will it be checked?**
   There is a built in mechanism in the autonomous working for this purpose. An Internal Committee called Academic Programme Evaluation Committee, which will keep a watch on the academics and keep its reports and recommendations every year. In addition the highest academic council also supervises the academic matters. The standards of our question papers, the regularity of academic calendar, attendance of students, speed and transparency of result declaration and such other parameters are involved in this process.

7. **Will the students of IARE as an Autonomous College qualify for University Medals and Prizes for academic excellence?**
   No. IARE has instituted its own awards, medals, etc. for the academic performance of the students. However for all other events like sports, cultural on co-curricular organized by the University the students shall qualify.

8. **Can IARE have its own Convocation?**
   No. Since the University awards the Degree the Convocation will be that of the University, but there will be Graduation Day at IARE.

9. **Can IARE give a provisional degree certificate?**
   Since the examinations are conducted by IARE and the results are also declared by IARE, the college

sends a list of successful candidates with their final Grades and Grade Point Averages including CGPA to the University. Therefore with the prior permission of the University the college will be entitled to give the provisional certificate.

10. **Will Academic Autonomy make a positive impact on the Placements or Employability?**
Certainly. The number of students qualifying for placement interviews is expected to improve, due to rigorous and repetitive classroom teaching and continuous assessment. Also the autonomous status is more responsive to the needs of the industry. As a result therefore, there will be a lot of scope for industry oriented skill development built-in into the system. The graduates from an autonomous college will therefore represent better employability.

11. **What is the proportion of Internal and External Assessment as an Autonomous College?**
Presently, it is 70 % external and 30% internal. As the autonomy matures the internal assessment component shall be increased at the cost of external assessment.

12. **Is it possible to have complete Internal Assessment for Theory or Practicals?**
Yes indeed. We define our own system. We have the freedom to keep the proportion of external and internal assessment component to choose.

13. **Why Credit based Grade System?**
The credit based grade system is an accepted standard of academic performance the world over in all Universities. The acceptability of our graduates in the world market shall improve.

14. **What exactly is a Credit based Grade System?**
The credit based grade system defines a much better statistical way of judging the academic performance. One Lecture Hour per week of Teaching Learning process is assigned One Credit. One hour of laboratory work is assigned half credit. Letter Grades like A, B,C,D, etc. are assigned for a Range of Marks. (e.g. 91% and above is A+, 80 to 90 % could be A etc.) in Absolute Grading System while grades are awarded by statistical analysis in relative grading system. We thus dispense with sharp numerical boundaries. Secondly, the grades are associated with defined Grade Points in the scale of 1 to 10. Weighted Average of Grade Points is also defined Grade Points are weighted by Credits and averaged over total credits in a Semester. This process is repeated for all Semesters and a CGPA defines the Final Academic Performance

15. **What are the norms for the number of Credits per Semester and total number of Credits for UG/PG programme?**
These norms are usually defined by UGC or AICTE. Usually around 25 Credits per semester is the accepted norm.

16. **What is a Semester Grade Point Average (SGPA)?**
The performance of a student in a semester is indicated by a number called SGPA. The SGPA is the weighted average of the grade points obtained in all the courses registered by the student during the semester.

$$SGPA = \sum_{i=1}^{n} (C_i G_i) / \sum_{i=1}^{n} C_i$$

Where, C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course and i represent the number of courses in which a student registered in the concerned semester. SGPA is rounded to two decimal places.

17. **What is a Cumulative Grade Point Average (CGPA)?**
An up-to-date assessment of overall performance of a student from the time of his first registration is obtained by calculating a number called CGPA, which is weighted average of the grade points obtained in all the courses registered by the students since he entered the Institute.

$$CGPA = \sum_{j=1}^{n} (C_i S_i) / \sum_{j=1}^{n} C_i$$

Where, S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester and j represent the number of courses in which a student's is registered upto the semester. CGPA is rounded to two decimal places.

18. **Is there any Software available for calculating Grade point averages and converting the same into Grades?**
Yes, The institute has its own MIS software for calculation of SGPA, CGPA, etc.

19. **Will the teacher be required to do the job of calculating SGPAs etc. and convert the same into Grades?**
No. The teacher has to give marks obtained out of whatever maximum marks as it is. Rest is all done by the computer.

20. **Will there be any Revaluation or Re-Examination System?**
No. There will double valuation of answer scripts. There will be a makeup Examination after a reasonable preparation time after the End Semester Examination for specific cases mentioned in the Rules and Regulations. In addition to this, there shall be a 'summer term' (compressed term) followed by the End Semester Exam, to save the precious time of students.

21. **How fast Syllabi can be and should be changed?**
Autonomy allows us the freedom to change the syllabi as often as we need.

22. **Will the Degree be awarded on the basis of only final year performance?**
No. The CGPA will reflect the average performance of all the semester taken together.

23. **What are Statutory Academic Bodies?**
Governing Body, Academic Council, Examination Committee and Board of Studies are the different statutory bodies. The participation of external members in everybody is compulsory. The institute has nominated professors from IIT, NIT, University (the officers of the rank of Pro-vice Chancellor, Deans and Controller of Examinations) and also the reputed industrialist and industry experts on these bodies.

24. **Who takes Decisions on Academic matters?**
The Governing Body of institute is the top academic body and is responsible for all the academic decisions. Many decisions are also taken at the lower level like Boards of Studies. Decisions taken at the Board of Studies level are to be ratified at the Academic Council and Governing Body.

25. **What is the role of Examination committee?**
The Examinations Committee is responsible for the smooth conduct of internal, End Semester and make up Examinations. All matters involving the conduct of examinations, spot valuations, tabulations and preparation of Grade Cards etc fall within the duties of the Examination Committee.

26. **Is there any mechanism for Grievance Redressal?**
The institute has grievance redressal committee, headed by Dean - Student affairs and Dean - IQAC.

27. **How many attempts are permitted for obtaining a Degree?**
All such matters are defined in Rules & Regulation

28. **Who declares the result?**
The result declaration process is also defined. After tabulation work wherein the SGPA, CGPA and final Grades are ready, the entire result is reviewed by the Moderation Committee. Any unusual deviations or gross level discrepancies are deliberated and removed. The entire result is discussed in the Examinations and Result Committee for its approval. The result is then declared on the institute notice boards as well put on the web site and Students Corner. It is eventually sent to the University.

29. **Who will keep the Student Academic Records, University or IARE?**
It is the responsibility of the Dean, Academics of the Autonomous College to keep and preserve all the records.

30. **What is our relationship with the JNT University?**
We remain an affiliated college of the JNT University. The University has the right to nominate its members on the academic bodies of the college.

31. **Shall we require University approval if we want to start any New Courses?**
Yes, It is expected that approvals or such other matters from an autonomous college will receive priority.

32. **Shall we get autonomy for PG and Doctoral Programmes also?**
Yes, presently our PG programs also enjoying autonomous status.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

S.No	**Nature of Malpractices/Improper conduct**	**Punishment**
	If the candidate:	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the Controller of Examinations.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Controller of Examinations /Additional Controller of Examinations/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 others to walk out, or threatens the COE 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 COE 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 Institute premises 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.	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 candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all semester end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the

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

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

UNDERTAKING BY STUDENT / PARENT

"To make the students attend the classes regularly from the first day of starting of classes and be aware of the College regulations, the following Undertaking Form is introduced which should be signed by both student and parent. The same should be submitted to the Dean, Academic".

I, Mr./Ms. ---------- joining I Semester for the academic year 2016-2017 in Institute of Aeronautical Engineering, Hyderabad, do hereby undertake and abide by the following terms, and I will bring the ACKNOWLEDGEMENT duly signed by me and my parent and submit it to the Dean, Academic.

1. I will attend all the classes as per the timetable from the starting day of the semester specified in the institute Academic Calendar. In case, I do not turn up even after two weeks of starting of classes, I shall be ineligible to continue for the current academic year.
2. I will be regular and punctual to all the classes (theory/practical/drawing) and secure attendance of not less than 80% in every course as stipulated by Institute. I am fully aware that an attendance of less than 70% in more than three courses will make me lose one year.
3. I will compulsorily follow the dress code prescribed by the college.
4. I will conduct myself in a highly disciplined and decent manner both inside the classroom and on campus, failing which suitable action may be taken against me as per the rules and regulations of the institute.
5. I will concentrate on my studies without wasting time in the Campus/Hostel/Residence and attend all the tests to secure more than the minimum prescribed Class/Sessional Marks in each course. I will submit the assignments given in time to improve my performance.
6. I will not use Mobile Phone in the institute premises and also, I will not involve in any form of ragging inside or outside the campus. I am fully aware that using mobile phone to the institute premises is not permissible and involving in Ragging is an offence and punishable as per JNTUH/UGC rules and the law.
7. I declare that I shall not indulge in ragging, eve-teasing, smoking, consuming alcohol drug abuse or any other anti-social activity in the college premises, hostel, on educational tours, industrial visits or elsewhere.
8. I will pay tuition fees, examination fees and any other dues within the stipulated time as required by the Institution / authorities, failing which I will not be permitted to attend the classes.
9. I will not cause or involve in any sort of violence or disturbance both within and outside the college campus.
10. If I absent myself continuously for 3 days, my parents will have to meet the HOD concerned/ Principal.
11. I hereby acknowledge that I have received a copy of IARE - R16 Academic Rules and Regulations, Syllabus copy and hence, I shall abide by all the rules specified in it.

ACKNOWLEDGEMENT

I have carefully gone through the terms of the undertaking mentioned above and I understand that following these are for my/his/her own benefit and improvement. I also understand that if I/he/she fail to comply with these terms, shall be liable for suitable action as per Institute/JNTUH/AICTE/UGC rules and the law. I undertake that I/he/she will strictly follow the above terms.

Signature of Student with Date

Signature of Parent with Date
Name & Address with Phone Number