SANJAY GHODAWAT UNIVERSITY KOLHAPUR

Sanjay Ghodawat University (SGU) is established in the Academic Year 2017-18, as a State Private University under Govt. of Maharashtra Act No. XL of 2017 dated 3rd May 2017, with the approval of the UGC and the state Government. "For the true measure of giving is giving without measure." Spread across 150 Acres, Sou. Sushila Danchand Ghodawat Charitable Trust's Sanjay Ghodawat University (SGU) is situated in serene atmosphere amidst idyllic hills and lush green meadows to study in harmony with Nature. The Institution aspires to run along the lines of best-in- the-world education and become a world-class institution where teaching-learning process gets a far deeper meaning. SGU always stands as the guiding star of brilliance, quality and deliverance beyond expectations. Innovativeness and Creativity are the hallmarks of a genius enterprise and SGU stands to be a stage where these qualities would be nurtured, encouraged and blossomed. The genius is incomplete without the sense of social responsibility and SGU's ultimate goal remains the development of an attitude of gratitude that freely gives back without expectations.

The Sanjay Ghodawat University stands as a beacon of light to guide the younger generation of the day on the right path to fulfilment in career and life. The USP of the University is its research based curriculum and academically oriented teaching staff. The world class ambience and infrastructure helps the students to easily accommodate themselves in an environment that is conducive to the teaching- learning process. Hands on experience, challenge based case studies, maximum participation of students in the classroom, use of modern digital technology, smart classrooms, solution oriented thinking promotion, stress on research and innovation, international tie ups, choice based credit system for flexibility in choosing areas of interest etc. are some of the features of the University.

The university will help students develop as a unique individual-to be educated as a whole person, intellectually, emotionally, socially, ethically, and spiritually. The educational program designs are worked out meticulously in line with best in class universities with special focus on:

- Flexible Choice Based Credit System
- OBE - Outcome Based Education System
- Experiential Learning
- Project Based Learning

- Case Based Learning
- Training need analysis based on Performance Appraisal System
- Active Learning tools for effective delivery
- Mentoring / Proctorship
- On line learning /Self learning platforms
- Flipped Classroom concept
- Effective Student Feedback Mechanism

VISION

Internationally recognized university of excellence in creating and disseminating knowledge through value-based quality education leading to betterment of mankind.

MISSION

- To prepare students for life-long learning and leadership in a global academic culture
- To create intellectual manpower relevant to the industry and society at large
- To collaborate with institutions of international repute for academic excellence
- To promote research and development through conducive environment
- To encourage entrepreneurship and skill development programs

CORE VALUES

- Integrity
- Transparency
- Accountability
- Equality
- Empathy
- Stewardship

QUALITY POLICY

Sanjay Ghodawat University is committed to establish high standards in value-based quality education to enhance and nurture young minds to excel in their chosen profession and develop into socially responsible citizens through resourceful collaboration, innovation and research

CHOICE BASED CREDIT SYSTEM (CBCS)

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.

University Grants Commission has come up with the Choice Based Credit System (CBCS) programme in which the students have a choice to choose from the prescribed courses, which are referred as core, elective or minor or soft skill courses and they can learn at their own pace and the entire assessment is graded-based on a credit system. The basic idea is to look into the needs of the students so as to keep up-to-date with development of higher education in India and abroad. CBCS aims to redefine the curriculum keeping pace with the liberalization and globalization in education. CBCS allows students an easy mode of mobility to various educational institutions spread across the world along with the facility of transfer of credits earned by students.

Where the students can choose the prescribed courses, as the core, and elective or soft skill courses, from a range of options, rather than to simply consume what the curriculum offers. They can learn at their own pace and the assessments are graded based on a credit system. It provides an opportunity for students to have a choice of courses or subjects within a programmed resembling a buffet, against the mostly fixed set of subjects now being offered (except for the limited choice of electives in professional degrees and postgraduate programmers) with the flexibility to complete the programmed by earning the required number of credits at a pace decided by the students.

The UGC has always initiated measures to bring efficiency and excellence in the Higher Education System of India. The basic motive is to expand academic quality in all aspects, right from the curriculum to the learning-teaching process to examination and evaluation systems. However, so far multiple methods are followed by different universities across the country towards examination, evaluation and grading system. Considering this diversity, the implementation of the choice based credit system seems to be a good system in assessing the overall performance of a student in a universal way of a single grading system.

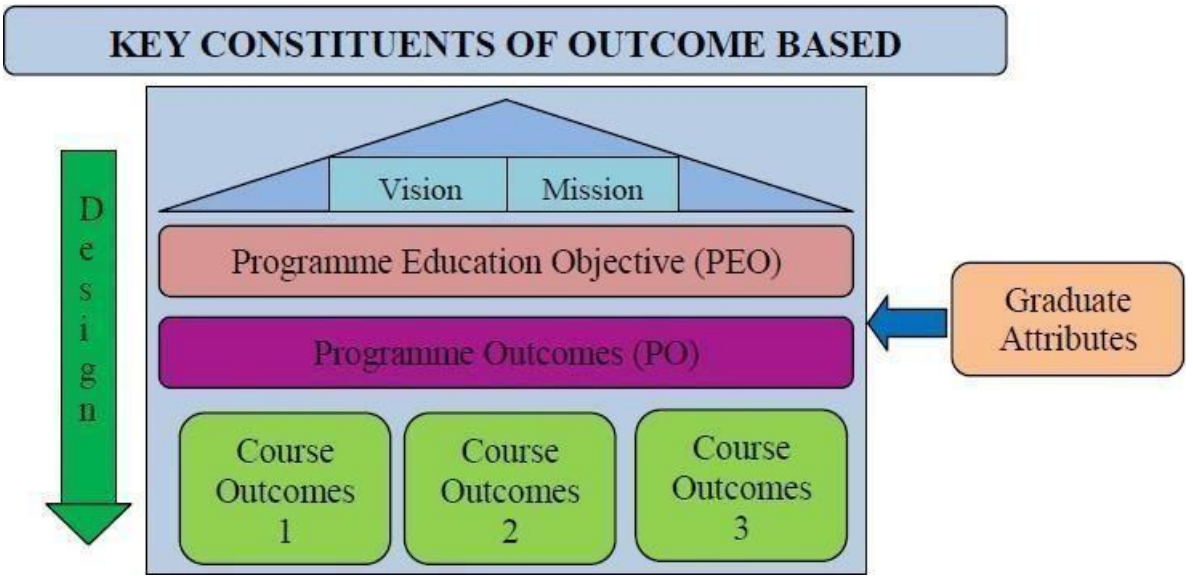
OUTCOME BASED EDUCATION (OBE) MODEL

Sanjay Ghodawat University (SGU) has implemented OBE model of education, which is a learner centered approach. SGU has witnessed a sea change in the entire academic systems with implementation of all three components of OBE – Design, Delivery and Assessment. The SGU model of autonomy focuses on experiential learning which believes in learning by doing. This is achieved through hands on experience, industrial assignments, mini projects and live problem solving and collaboration with industries.

SGU is set in to dynamics of transformation and witnessing a shift in focus from teaching to learning and entire academic system of SGU is designed to provide multiple learning opportunities for students to acquire and demonstrate the Knowledge, Skills and Attitudes (KSA) for rewarding career.

The Vision and Mission of the Management, contribution from eminent BOG members and knowledgeable members of Academic Council and Board of Studies, the motivation and drive of the Director, the relentless efforts of the fellow Deans and Head of Departments and all teaching and non teaching staff along with commitment to learning of students made it possible to successfully transform the institute and stand out to carve a niche for itself as an Institute of repute.

OBE is an approach of curriculum design and teaching that focuses on what students should be able to do (attained) at the end of course/ program. Outcome based education (OBE) is student-centered instruction model that focuses on measuring student performance through outcomes. Outcomes include knowledge, skills and attitudes (KSA). Its focus remains on evaluation of outcomes of the program by stating the knowledge, skill and behavior a graduate is expected to attain upon completion of a program and after 4 – 5 years of graduation. In the OBE model, the required knowledge and skill sets for a particular degree is predetermined and the students are evaluated for all the required parameters (Outcomes) during the course of the program.



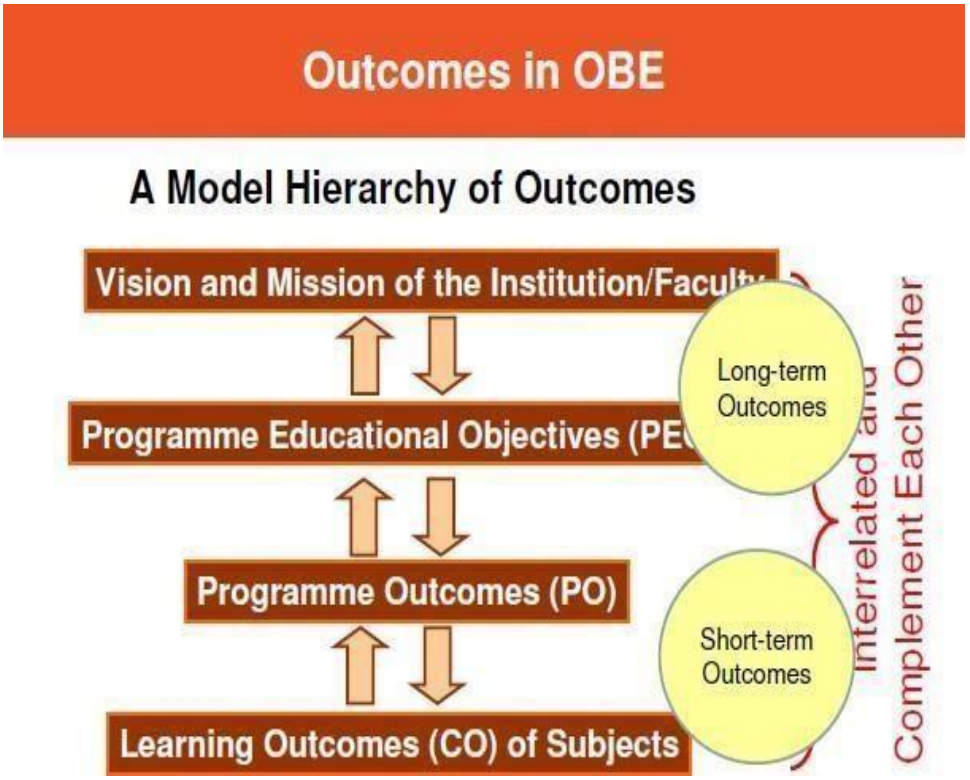
The OBE model measures the progress of the graduate in three parameters, which are

- Program Educational Objectives (PEO)
- Program Outcomes (PO)
- Course Outcomes (CO)

Program Educational Objectives (PEO) are broad statements that describe the career and professional accomplishments that the program is preparing the graduates to achieve. PEO‘s

are measured 4-5 years after graduation. Program outcomes are narrower statements that describe what students are expected to know and be able to do by the time of graduation. They must reflect the Graduate attributes. Course outcomes are the measurable parameters which evaluates each students performance for each course that the student undertakes in every semester.

The various assessment tools for measuring Course Outcomes include Tests and End Semester Examinations, Tutorials, Assignments, Project work, Labs, Presentations, Employer/Alumni Feedback etc,. These course outcomes are mapped to Graduate attributes and Program outcomes based on relevance. This evaluation pattern helps Institutions to measure the Program Outcome. The Program Educational Objective is measure through Employer satisfaction survey (Yearly), Alumni survey (Yearly), Placement records and higher education records.



Special Features of OBE

- OBE is an educational process that focuses on what students **can do** or the **qualities** they should develop after they are taught.
- OBE involves the restructuring of curriculum, assessment and reporting practices in education to reflect the achievement of high order learning and mastery rather than accumulation of course credits.
- Both structures and curricula are designed to achieve those **capabilities** or **qualities**.
- Discourages traditional education approaches based on direct instruction of facts and standard methods.
- It requires that the students demonstrate that they have learnt the required skills and content.

Sanjay Ghodawat University Kolhapur

(Established as a State University under Government of Maharashtra Act No XL dated 3rd May 2017)

Academic and Examination Rules and Regulations

Approved in the second Academic Council Meeting held on 9th May, 2018 and to be implemented from academic year 2018-19. [Version R0]

Sanjay Ghodawat University Kolhapur

Kolhapur - Sangli Highway, A/p Atigre - 416 118,
Tal. - Hatkanangale, Dist. Kolhapur,
Maharashtra, India

(Implemented from Academic year 2018-19)

Academic and Examination Rules and Regulations

Preamble

The Sanjay Ghodawat University (SGU) stands for quality and excellence. It aims at nurturing the young talent and grooming them into responsible citizen and a value added human resource. Outcome Based Education (OBE) model is adopted to enhance the effectiveness of teaching learning process and Credit Based semester system is implemented.

The focus of the University is its research based curriculum and academically oriented teaching staff. The world class ambience and infrastructure helps the students to easily accommodate themselves in an environment that is conducive to the teaching- learning process. Hands on experience, challenge based case studies, maximum participation of students in the classroom, use of modern digital technology, smart classrooms, solution oriented thinking promotion, stress on research and innovation, international tie ups, choice based credit system for flexibility in choosing areas of interest etc. are some of the features of the University.

Vision of SGU is internationally recognized university of excellence in creating and disseminating knowledge through value-based quality education leading to betterment of mankind. To achieve the vision SGU has developed state-of-the-art infrastructure that promotes conducive ambience promoting innovation and research. Create intellectual manpower relevant to the industry and society at large. Foster mutually beneficial partnership with alumni, industry and academia. Inculcate ethics and values to develop socially responsible citizens and promote entrepreneurship.

SGU is offering various programs through schools such as School of Technology, School of Commerce and Management, School of Sciences and School of Arts.

SGU has implemented the outcome-based Education (OBE) system and Credit based Evaluation System in all the schools.

The rules and regulations mentioned in this document are applicable to all the Under Graduate (UG) and Post Graduate programs offered by the Sanjay Ghodawat University from the academic year 2018-19. The rules and regulations stated under here are subject to revisions / refinements, updates and modifications and amendments by Academic Council (AC) from time to time and applicable to all batches including those already undergoing programs in different year and are binding on all stakeholders including students, faculty, parents and University authorities.

The academic programs of the University shall be governed by rules and regulations approved by the Academic Council from time to time. Academic council is the supreme and statutory academic body that governs all academic matters of the university and the decisions of the academic council are final and binding in the matters related to academics.

Definition of Terms

1. University: University means Sanjay Ghodawat University, Kolhapur
2. Academic Year: The period of the year during which students attend university for all academic activities, usually it starts from first of July and ends on 30th of June next year.
3. **Semester:** Academic Year is divided in to 2 parts called Semester, Odd Semester which starts from July and Even Semester which starts from January.
4. **Duration of Semester**: Total duration of semester is usually 20weeks per semester including instructions, examination and evaluation. Total instructional days are 90 per semester.
5. **Course:** It is a Subject that is in a semester. The course may consist of Theory/Practical/Project/Seminar during semester. Usually taught by instructor in a class. e.g. Physics, Chemistry, Engineering Mechanics, Workshop etc.
6. **Program:** Collection of Courses is called Program. B Tech in Mechanical Engineering,
7. M Tech in Civil Engineering, Bachelor of Business Administration. Bachelor of Science etc.
8. **Department:** Department is a unit of the school which offers one or more programs.
9. **Contact Hours:** Time of students in class/laboratory with instructor. Usually in the range of 26-30 Hrs./Week. For the purpose of uniformity one contact hour is measured as 60 minutes
10. **Academic Council (AC):** Means apex academic body governing the academic programs responsible for framing policy, rules and regulations.
11. **Board of Examination (BOE):** Central body responsible for framing policy ,rules and regulations for Examination.
12. **Board of Studies (BOS):** Departmental academic body to govern the academics of programs(BOS)offered by department.

3.0 Curriculum:

Curriculum:

Every program has a prescribed structure which, in general, is known as Curriculum. It prescribes courses to be studied in each semester. The booklet containing courses structure along with detail syllabus for each course of each program is updated periodically and made available on the website.

Semesters:

SGU implements a credit based semester system. The academic year is divided into two regular semesters. The semesters that begin in July are known as Odd semester and the semester that begin in January are known as Even semesters. Total duration of each semester is generally of 20 weeks including the period of examination, evaluation and grade declaration.

Course Credit System/Structure:

In general, a certain quantum of work measured in terms of credits is laid down as the requirement for a particular program. Calculation of number of credits for a course in any semester is as per Table 3.1

Table 3.1: Calculation of number of credits for a course

Sr. No.	Course	Credits
1	Lecture of 1 hour/week	**1**
2	Tutorial of 1 hour/week	**1**
3	Practical / Laboratory / Drawing/mini-project of two hours/ week	**1**
4	Seminar (1 hour per week)	**1**

There are mainly two types of courses- viz. Theory courses and Laboratory courses. Generally a theory course consists of Lecture hours (L) and Tutorial hours (T). Tutorial hours may not be assigned to a particular theory course if it has a separate laboratory course. Laboratory course consists of practical hours (P) for which a student works in a Laboratory/Drawing Hall/Workshop. The other courses required to be taken by a student include seminar, mini project, and project at various levels of the program.

A student shall earn credits for a particular course by fulfilling the minimum academic requirements for attendance and evaluation. No credits shall be awarded if a student satisfies the minimum attendance requirements but fails to meet minimum evaluation requirements.

The total number of credits required for completing a program shall be mentioned in the course structure. The total number of credits in a semester which a student registers shall generally be 20--25. The maximum number of credits per semester shall not exceed 30

Audit Course:

A student may have to register for an audit course in a semester which could be institute requirement or department requirement.

An audit course may include either a) a regular course required to be done as per structure or required as pre-requisite of any higher level course or b) the programmes like practical training, industry visits, societal activities etc.

Audit course shall not carry any credits but shall be reflected in Grade Card as "PP‖/"NP" depending upon the satisfactory performance in the semester evaluation as per the course curriculum structure.

Course Registration:

Every student must register for the courses that he/she wants to study for earning credits at the beginning of each semester on the prescribed dates announced from time to time and shall be mandatory for every student till he/she completes the program. Only after registration his/her name shall appear in the roll list of each of such courses.

Students shall be required to fill up a Course Registration Form which shall be made available to them by the Student section of Administration office after payment of required fees.

Registration, according to rules, should be carried out as per the schedule given in academic calendar. Late registration may be permitted only for valid reasons and on payment of late registration fees. In any case, registration must be completed before the prescribed last date for registration, failing which his/her studentship shall be liable to be cancelled. Students having dues outstanding towards the institute or hostel shall be permitted to register only after clearing such dues.

In-absentia registration may be allowed only in rare cases at the discretion of the Dean Academics and with prior permission.

For registration in an odd semester, the student must have earned all the credits of the pre-previous year and at least 2/3rd credits of the previous year. For example, for registration of the 5^{th} semester courses (i.e. 3^{rd} year of program), a student must have earned all the credits of the first year and 2/3rd credits of the second year. Similarly for registration of the 7^{th} semester courses (i.e. 4^{th} year of program), a student must have earned all the credits of the second year and 2/3rd credits of the third year. However, if 2/3rd calculation turns out to be a mixed number (integer + fraction) then only the integer part of that number shall be considered for taking decision related with this clause.

A student registered in odd semester shall be eligible to register for the courses offered in the even semester of that year irrespective of his/her SGPI or the number of credits earned by him/her in that odd semester.

5 .0 Lateral Entry For B Tech Programs

Post diploma students in engineering and B.Sc. Graduates can have lateral entry at third semester of the program. Such admissions are governed by the rules of regulatory bodies like AICTE New Delhi and Directorate of Technical Education Maharashtra state and Sanjay Ghodawat University for Admission criteria and shall undergo all academic requirements as specified by the Academic council.

For such students there shall not be First Year Performance Index (FYPI). Semester Performance Index (SGPI) and Cumulative Performance Index (CGPI) shall be calculated from the third semester onwards taking into consideration the courses undergone by them at Sanjay Ghodawat University Kolhapur.

Registration of the students not covered by the cases mentioned above shall be decided by the Academic Council. Such students shall undergo the academic program as specified by the Academic Council. Such odd entry students shall not be eligible for any medals or awards instituted by the institute.

Change of Program:

This is applicable to B Tech Program only. Students shall be eligible to apply for Change of Program after completing the first two semesters. The following rules/ guidelines shall be used for considering their applications for change:

The change of program shall be permitted strictly on merit basis subject to the rules of admissions prevailing at the time of such change.

Students without fail grades and/or backlogs shall be eligible to apply for change of program and can give their choices in the order of preference.

The request for change of program by a student from program A to program B shall be considered if number of students of program B does not exceed the sanctioned capacity of program B and also the minimum strength required to run the program as decided by Academic Council.

All such transfers can be effected only once at the beginning of the second academic year of the 4-year UG program. No application for change of program during subsequent academic years shall be entertained.

7. 0 Facilitation to Students:

Faculty Advisor:

On joining the institute, a student or a group of students shall be assigned to a faculty advisor who shall be mentor for a student throughout his/her tenure in the institute. A student shall be expected to consult the faculty advisor on any matter relating to his/her academic performance and the courses he/she may take in various semesters / summer term. A Faculty advisor shall be the person to whom the parents/guardians should contact for performance related issues of their ward. The role of a faculty advisor is as outlined below:

The role of the Faculty Adviser is outlined below:

a. Guide the students about the rules and regulations governing the courses of study for a particular degree.
b. Advise the students for registering courses as per curriculum given. For this purpose the Faculty Adviser has to discuss with the student his/her academic performance during the previous semester and then decide the number and nature of the courses for which s/he can register during the semester as per the curriculum.
c. Approve the registration of the students.
d. Advice students to overload/ drop one or more courses/activities based on her/his academic performance as per the prescribed rules.
e. At the end of the first semester/year, the Faculty Adviser may even advise a reduced load program for a poorly performing student.
f. Pay special attention to weak students and carefully monitor performance of students recommended for slow track option.
g. Advice students for Course Adjustment / Dropping of courses during the Semester within the stipulated time frame given in the Academic calendar.
h. Advice students seeking semester drop either during the ongoing semester or before the commencement of the semester. FA has to ensure strict compliance of rules and regulations laid down for this purpose. Recommend the cases to the appropriate authorities for consideration.
i. Make revised plan of study for weak/bright students based on their semester wise performance.
j. Suggest modalities for course/credit requirements for the students recommended for exchange program.
k. Guidance and liaison with parents of students for their performance.
l. To ensure that students are not permitted to re•register for courses, which they have already passed.
m. Inform students that any academic activity (course / Lab. / seminar / project / noncredit requirement etc.) undergone without proper registration will not be counted towards the requirements of his/her degree.
n. Strictly warn students that if she/he fails to register during any semester without prior approval, his/her studentship is liable to be cancelled.

- Keep the students updated about the Academic Administration of the University.

7 .2. Helping Weaker Students:

A student with backlog/s should continuously seek help from his/her faculty advisor, Head of the Department and the Dean of respective schools. Additionally, he/she must also be in constant touch with his/her parents/local guardians for keeping them informed about academic performance. The university also shall communicate to the parents/guardians of such student at least once during each semester regarding his/her performance in in-in various tests and examination and also about his/her attendance. It shall be expected that the parents/guardians too keep constant touch with the concerned faculty advisor or Head of the Department, and if necessary - the Dean of the respective school.

8. 0 Discipline And Conduct:

Every student shall be required to observe discipline and decorous behavior both inside and outside the campus and not to indulge in any activity, which shall tend to bring down the prestige of the university.

Any act of indiscipline of a student reported to the Dean, Student Development, shall be discussed in a Disciplinary Action Committee of the institute. The Committee shall enquire into the charges and recommend suitable punishment if the charges are substantiated.

If a student while studying in the university is found indulging in anti-national activities contrary to the provisions of acts and laws enforced by Government he/she shall be liable to be expelled from the institute without any notice.

If a student is involved in any kind of ragging, the student shall be liable for strict action as per provisions in the Maharashtra anti-ragging act.

If any statement/information supplied by the student in connection with his/her admission is found to be false/ incorrect at any time, his/ her admission shall be cancelled and he/she shall be expelled from the university and fees paid shall be forfeited.

If a student is found guilty of malpractice in examinations then he/she shall be punished as per the recommendations of the Grievance Redressed Committee (CRC) constituted by Board of Examinations.

Every admitted student shall be issued photo identification (ID) card which must be retained by the student while he/she is registered at Sanjay Ghodawat University Kolhapur. The student must have valid ID card with him/her while in the University Campus.

Any student who alters or intentionally mutilates an ID card or who uses the ID card of another student or allows his/her ID card to be used by another, student shall be subjected to disciplinary action.

The valid ID card must be presented for identification purpose as and when demanded by authorities. Any student refusing to provide an ID card shall be subjected to disciplinary action.

Students should switch off the Mobiles during the Instructional hours and in the academic areas of university Building, Library, Reading room etc. Strict action will be taken if students do not adhere to this.

During the conduct of any Tests and Examination students must not bring their mobiles. A student in possession of the mobile whether in use or switched off condition will face disciplinary action and will be debarred from appearing for the Test / Examination.

9.0 Academic Calendar

The academic activities of the institute are regulated by Academic Calendar and is made available to the students/ faculty members and all other concerned in electronic form or hard copy. It shall be mandatory for students / faculty to strictly adhere to the academic calendar for completion of academic activities

Attendance:

Regular 100% attendance is expected from all students for every registered course in lectures, tutorial, laboratory, projects, mini-projects and other courses mentioned in program curriculum. Hence, attendance is compulsory and shall be monitored during the semester rigorously. Students shall be informed at the end of every month if they are failing short of attendance requirements.

A Maximum of 25% absence for the attendance may be permitted only on valid grounds such as illness, death in family of blood relations (Father, Mother, Sister, and Brother) and any other emergency reason which is beyond the control of the student and shall be approved by the authorities in respective departments.

If a student fails to put up 75% attendance individually in each course, the student will be put under X grade category and student will be debarred form attending the End Semester Examination (ESE) and Re-Exam for that semester in that course. However, student has an option to re-register for the course whenever it is offered next time or he can appear for 100% examination for which he will be awarded two grade penalties. Student‘s FET, CAT1 and CAT2 marks are treated as null and void.

The maximum number of days of absence for students participating in Co-curricular activities /Sports/ Cultural events during a semester shall not exceed 10. Any waiver in this context shall be on the approval of the Academic council only after the recommendation by Dean Academics of the university

The HOD and Dean of the respective school shall report and recommend to Academic council the cases of students not having 75% attendance as per the records of course instructor. After rigorously analyzing these cases AC may take a decision to debar such

student from End-Semester Examination (ESE) for that course. Such a student shall re-register for that course as and when it is offered next. ISE and MSE evaluations of such a student for this course during regular semester shall be treated as null & void.

A student remaining absent during ESE of a course either on medical ground (Accident and/or hospitalization of a student) or any other emergency circumstances (death of immediate close relative i.e. father, mother, brother and sister) or due to representing University at university/state level in sports/co-curricular activities shall be treated as per the rules of Sec 12.6.2 and 11.1.2

The critical cases of absenteeism which are not covered by any of the above clauses shall be reported by concerned Head of Department to Academic dean and all such cases the decision of Academic council is final.

Modes of Assessment:

Assessment of Theory Courses:

A student shall be evaluated for his/her academic performance in a theory course through Faculty Evaluation Theory (FET), Continuous Assessment Tests (CAT1 and CAT2) and End Semester Examination (ESE).

The relative weightage for the theory courses having ESE shall be generally as shown in the Table 11.1.2

Table 11.1.2: Weightage for the theory courses in %

FET	CAT1	CAT2	ESE
20	15	15	50

The details of the weightage of each course shall be listed in the structures of each program.

FET shall be based on student's performance in assignments, quizzes, seminars, Course projects and field assignments, term papers, etc. The mode of FET shall be decided and announced by the Course Instructor at the beginning of the course.

CAT1 shall generally be of one hour duration for each course and shall be held as per the schedule declared in the Academic calendar for that Semester. The test will be based on first two units of the course.

CAT2 shall generally be of one hour duration for each course and shall be held as per the schedule declared in the Academic calendar for that semester based on unit 3 and unit 4 of the syllabus.

ESE is of three hours comprehensive examination having the weightage of 60% for unit 5 and 6 and 20 to unit 1 to unit 4. It is of 100 marks

All examinations and evaluations shall be compulsory. Credits for a course shall be awarded only if a student satisfies evaluation criteria and acquires the necessary minimumgrade.

There shall be no re-examination for CAT1 and CAT2 of the courses having all the three components of evaluation viz. FET, CAT1 CAT2 and ESE. However, a student remaining absent for CAT1 and CAT2 for representing the institute in state level or university level sports/co-curricular activities (on prior recommendation and approval from) or on valid grounds such as illness, death in family or other emergency reasonwhich is beyond control of a student (on approval by the head of department and dean of respective school shall be considered for Make- up examinations.

A student remaining absent for ESE of a course either due to medical reason (Accident and/or hospitalization of a student) or other emergency circumstances (death of immediate close relative i.e. father, mother, brother and sister) or due to representing college at university/state level in sports/co-curricular activities shall be awarded with grade "I". Such a student shall be allowed to appear for make-up examination scheduled along with re-examinations of other courses. The student shall apply to COE with proper documentary evidence to appear for make-up examination. After make-up examination, a student shall be entitled to an appropriate grade as per Table I of Sec. 10.1.2 based on his/her performance during the regular semester and in make-up examination.

Assessment of Laboratory Courses:

The assessment of laboratory course shall be continuous and based on turn-by-turn supervision of the student's work and the quality of his/her work as prescribed through laboratory journals and his/her performance in viva-voce examinations uniformly distributed throughout the semester. Where ESE for the laboratory course is specified ESE shall be based on performing an experiment followed by an oral examination. The relative weightage for FEP and ESE for assessment of laboratory courses shall be 50% each for FEP and ESE and a minimum performance of 20 in both ISE and ESE separately shall be required to get the passing grade.

ESE for laboratory course shall normally be held before the ESE for theory courses and shall be conducted by a panel of examiners appointed by COE from the panel of experts approved by BOS. This activity shall be coordinated by Department Examination Coordinator (DEC) in consultation with HOD of the respective department.

Student failed in ESE of a laboratory course in a regular semester shall be eligible to appear for 100% examination conducted along with ESEs of laboratory courses of the subsequent semester. Such examination shall be fairly comprehensive (generally of 3 hours similar to POE i.e. Practical-Oral-Examinations) to properly judge his/her practical skill and theoretical knowledge for that laboratory course. He/She shall suffer one grade penalty.

12.0 The Grading System:

Absolute Grading System (AGS) is adopted based on absolute numerical marks obtained by the student during all stages of evaluation for a course.

Award of Grade (Regular Semester):

For every course registered by a student in a semester, he/she shall be assigned a grade based on his/her combined performance in all components of evaluation scheme of a course as per the structure. The grade indicates an assessment of the student's performance and shall be associated with equivalent number called a grade point.

The academic performance of a student shall be graded on a ten point scale. The Absolute Grading System is followed. Letter grades, the guidelines for conversion of marks to letter grades and their equivalent grade points are as given in Table

Table 12.1.2: Grade Table for Regular Semester

Marks Obtained	Grade Letter GL	Grade Point GP	Performance Description
90-100	**O**	**10**	Outstanding
80-89	**A+**	**09**	Excellent
70-79	**A**	**08**	Very Good
60-69	**B+**	**07**	Good
50-59	**B**	**06**	Above Average
45-49	**C**	**05**	Average
40-44	**P**	**04**	Pass
00-39	**F**	**00**	Fail
-	**Ab**	**00**	Absent
-	**X**	**00**	Detained (Failed)
-	**Satisfactory**	-	Pass in Non Credit Courses
-	**Un Satisfactory**	-	Failed in Non Credit Courses

A student shall pass the course if he/she gets any grade in the range "O" to "P".

–FF" grade shall be awarded to a student in a course if he/she gets less than 20 marks jointly in the FET, CAT1, and CAT2 & ESE for a theory course and in PET & ESE for a laboratory course. A course shall then be eligible to apply for re-examination. A student failed in laboratory course shall be eligible to apply only for 100% examination conducted with the laboratory examinations of the subsequent semester. In both cases, a student has to suffer one grade penalty.

13 Assignment of X Grade

Grade "X" in a regular course shall be given to a student if he/she falls in any of the following categories.

A student does not maintain the minimum 75% attendance in any of the theory or laboratory courses.

A student has not completed most of the Evaluations like FET, CAT1 and CAT2 dueto non-medical reasons (for example when a student has missed all or most of the components of internal evaluation conducted by the instructor in that semester).

The performance of a student is less than 20 in FET, CAT1 and CAT2 Combined.

A student is guilty of any academic malpractice during semester (Such cases shall be dealt by Grievance Redressed and Discipline Committee).

In above four cases grade "X" shall be declared one week before ESE and intimated to the Academic Office and COE immediately thereafter. Such a student shall not be permitted to take the ESE of that course.

Grade "X" may be given to a student if

13.1..5.1 A student eligible for ESE remains absent for ESE of a course with no written intimation to Exam Cell within four days after the respective ESE is over.

13.1.5.2 A student is guilty of any academic malpractice during examination. (Such cases shall be dealt by Grievance Redressal Committee).

In 13.1.5.2 grade "X" in that course shall be declared after Grievance Redressed Committee confirms the academic malpractice.

In above two cases when a student gets "X " grade in a course, then this shall be treated as "FF" for the purpose of calculation of Semester Performance Index (SGPI) and First Year Performance Index (FYPI) or Cumulative Performance Index (CGPI).
Following rules apply to the student who has obtained grade "X" in a regular semester:

A student obtaining grade "X" in a course in a regular semester or during examination shall be not be allowed to appear for End semester examination and also Re ESE conducted before the beginning of the next semester. His/her FET, CAT1 and CAT2 evaluations for all courses shall be treated as null and void. He/She needs to re-register for courses of that semester in the next academic year whenever they are offered and undergo all evaluations along with fresh regular students for which he will get one grade penalty.

Grade "I" shall be declared in a theory/laboratory course if a student has satisfactory performance FET, CAT1, CAT2 and has fulfilled the 75% attendance requirement, but has not appeared for ESE due to genuine reasons. Such students shall be eligible for the make-up examination of ESE only on medical grounds/valid reasons and on production of authentic medical certificate or other supporting document/s (as required by the University) to the COE within ten days after the respective examination is over. The application form with requisite amount of fees must be submitted to the Exam Cell before the last date of filling such application forms for make-up examinations. These examinations shall be based on 100% syllabus and shall be scheduled before the commencement of the subsequent semester for theory courses and along with ESEs of laboratory courses of the subsequent semester. A student with "I" grade when appears for the make-up examination shall be eligible to obtain a regular performance grade ("O" to "F") as per Table 11.1.2 depending on his/her overall performance in FET, CAT1 ,CAT2 and make-up examination. If a student fails to appear for make-up examination too, a grade "XX" shall be awarded to him/her. Thus "I" is only a temporary grade and shall be replaced by a valid grade only after make-up examination.

There shall be a few audit courses as per the policies of the institute or as decided by DPC of respective program. The grade "PP" (Passed)/ "NP" (Not Passed) shall be awarded for such courses depending upon the performance of a student evaluated by the faculty in-charge. No grade points shall be associated with these grades and performance in these courses shall be not taken into account in the calculation of the performance indices (SGPI, CGPI). However, the award of the degree shall be subject to obtaining a "PP" grade in all such courses.

Award of Grades for Re-Examination:

A student who has obtained grade "F" in regular semester shall be eligible to appear for re-examination conducted before the commencement of the next regular semester. In such cases FET, CAT1 and CAT2 marks are carried forward and a studenthas to suffer one grade penalty

A student shall apply for re-examination before the last date of such applicationand shall appear for re-examination.

50% weightage similar to ESE shall be given to re-examination and there is one grade penalty.

A student who has obtained "F" grade in ESE of a regular semester and has not availed re-examination option or a student who has obtained "F" grade in both ESE and re- examination shall be eligible to choose one of the two options below to clear his/her backlog:

- Re-registration for the next regular semester course whenever that course is offered.
- Appearing for ESE of the course when conducted...
  A student detained in a regular semester due to either a) by obtaining "X" grade or b) by involvement in academic malpractice or c) by breaking the institute code of conduct and discipline can re-register for the course when offered next

Following rules apply for these cases:

In first case i.e. Re- registration the earlier performance of a student in all the evaluations of that course shall be treated as null and void. The student has to undergo all the evaluations after re-registration.

Grades for Third and Subsequent attempts:

If A student opts for ESE or Re ESE who previously had obtained grade "F" in a course in two attempts, his/her FET, CAT1 and CAT2 performance of the regular semester shall be considered for evaluation and He/She has to suffer two grade penalty for the third attempt and for 4th and subsequent attempts shall be awarded a grade "P" or "F" or "X" based on his/her performance.. However, if a student takes more than three chances

(regular examination being the first chance, re-examination being the second chance, to clear a course, then the maximum passing grade that he/she can get shall be only "P". Thus a student has to suffer a grade penalty by accepting a lower grade than that obtained in the regular examination, re-examination, or examination for a re-registered course.

14. CALCULATION OF PERFORMANCE INDICES:

14.1. Semester Grade Point Average (SGPA)

The performance of a student in a one specific semester is indicated by SGPA. SGPA is a weighted average of the grade points obtained in all courses registered by the students during the semester. SGPA can be calculated by following equation.

$$SGPA = S_i = \frac{\sum_{i=1}^{n} C_i P_i}{\sum_{i=1}^{n} C_i}$$

Where, i = 1,2,3…….n are number of courses during semesters. C = No of credits associated with that course and P = Grade point earned in that course. SGPA will be rounded off to two decimal places.

Cumulative Grade Point Average (CGPA)

The total cumulative performance of a student at the end of specific semester is indicated by CGPA. An up-to-date assessment of the overall performance of a student for the courses from the first semester onwards till completion of the program shall be obtained by calculating Cumulative Grade Point Average (CGPA).

CGPA is a weighted average of the SGPA obtained in all semesters by the students during the semesters. CGPA can be calculated by following equation.

$$CGPA = \frac{\sum_{j=1}^{n} C_j S_j}{\sum_{j=1}^{n} C_j}$$

Where, j = 1,2,3…….n are number of semester during program. C = Total No of credits in the semester for which CGPA is to be calculated.

CGPA will be rounded off to two decimal places.

Conversion of CGPA to percentage marks for CGPA ≥ 4.5 can be obtained using equations. Percentage marks = (CGPA x 10) – 7.5.

For the students acquiring "I" grade (which is only a temporary grade) in any of the courses, SGPA, CGPA shall be calculated only after make-up examination.

14.4. First Year Performance Index (FYPI): (Applicable For B. Tech Programs Only)

For a student registered in Sanjay Ghodawat University Kolhapur right from the First semester, First-Year-Performance-Index (FYPI) shall be calculated as weighted average of the grade points obtained in all the courses registered by him/her in semesters I and II only.

$$FYPI = \frac{\sum_{i} C_i g_i}{\sum_{i} C_i}$$

Where summation is for all the courses registered by a student in first two semesters. FYPI shall be calculated when SPI for the second semester is calculated. FYPI shall be rounded off to two decimal places.

FYPI shall reflect all the courses undergone by a student in the first year including the courses in which he/she has failed. FYPI may get modified in the subsequent semesters whenever a student clears his/her first year backlog courses.

If a student has been awarded "I" grade in the regular semester course of the first year then, FYPI shall be calculated after the make-up examination on the basis of the grade obtained by that student in a make-up examination.

If a student has obtained grade "F" or "X" at any time in any of the courses registered by him, then zero grade points corresponding to these grades shall be taken into consideration for calculation of FYPI.

15 Maximum Duration for Completing the Program

Maximum duration for completing any program UG/PG offered by Sanjay Ghodawat University is respective program duration plus two additional years.

Maximum duration for getting the B. Tech degree for students admitted in the first semester of UG program is, program duration plus two additional years (i.e. 12 Semesters and 6 academic years) For lateral entry student academic admitted in the third semester shall be (10 Semester and 5 Years).

The maximum duration of the program includes the period of withdrawal, absence and different kind of leaves permission to student but excludes the period of rustication of the student from the university however genuine case an confidential of valid reason may be referred to academic council for extending this limit by additional criteria

16 NFTE (Not Fit For Technical Education) (Applicable to B Tech program only)

It is mandatory for the student to earn all credits of first year specified for semester I & II or eligible for ATKT as per the rules to seek admission to semester III of second year in three years from the date of admission to avoid NFTE. If a student fails to become eligible for admission to Semester III in three year form the date of his admission, he shall be declared as ―Not Fit for Technical Education‖ leading to discontinuation of his/her registration with the university. Such cases should be put up in the academic council.

17. Academic Progress Rules (ATKT Rules):

17.1 A student shall be allowed to register for the courses of the next year's odd semester only if he/she has earned all the credits of the previous year and has earned at least 75% credits of the current year. If 75% calculation turns out to be a mixed number (integer + fraction) then only the integer part of that number shall be considered for deciding the eligibility for ATKT.

At the end of 1st year a student shall be allowed to keep terms (ATKT) to 2nd year of study provided he/she attends course work prescribed for 1st year with prescribed attendance and successfully earned at least 75% of the total credits specified for 1st year program.

For Example: Total credits for B. Tech first year 2017-18, are 45 (Total of Semester I and II). A Student should earn mininum75% of the 45 Credits i.e. 33.15 (Rounded to 33 Credits). A student can go to next higher class with a maximum backlog of 12 credits of semester I & II of the first year.

Student, who fails to earn those credits, cannot register for next semester, either it can re-registrar for the course and credits or can use the next opportunity to earn the credits when exams are conducted. .

(b) At the end of 2nd year a candidate shall be allowed to keep terms to 3rd year of study provided he/she attends course work prescribed for 2nd year with prescribed attendance, and successfully cleared 1st year program and at least 75% of total credits prescribed for 2nd year program.

(c) At the end of 3rd year a candidate shall be allowed to keep terms to final year of study provided he/she attendants course work prescribed for 3rd year with prescribed attendance, and should have completed 2nd year program and 75% of total credits prescribed for 3rd year program.

All such candidates fulfilling the above criteria shall be declared as FAILED, ATKT.

A student shall be allowed to take admission for odd semester of next academic year only if he/ she have earned all the credits of the previous year and 75% happens to be a decimal, it is rounded to only integer part.

18 Semester Grade Report:

Semester grade report reflects the performance of a student in that semester (SGPI) and also his/her cumulative performance for the first year (FYPI) and also the cumulative performance since the third semester of his/her study (CGPA).

The semester grade card issued at the end of each semester/ summer term to each student shall contain the following.

- The credits for each course registered for that semester.
- Any audit course/s undertaken by a student in a Semester.
- The letter grade obtained in each course.
- The total number of credits earned by a student for the first year separately.
- The total number of credits earned by a student since the 3rd semester onwards.
- SGPI, FYPI, CGPI.
- A list of backlog courses, if any.
- Remarks regarding eligibility of registration for the next semester.

Semester grade card shall not indicate class or division or rank however a conversion from grade point index to percentage based on CGPI shall be indicated on the final grade card of the program.

19 Award of Degree:

Following rules prevail for the award of degree.

- A student has registered and passed all the prescribed courses under the general institutional and departmental requirements.
- A student has obtained CGPI $\geq$ 4.75.
- A student has paid all the institute dues and satisfied all the requirements prescribed.

- A student has no case of indiscipline pending against him/her.
- Academic Council shall recommend the award of degree to a student who is declared to be eligible and qualified for above norms.

20.0 Grace Marks

- Maximum total grace marks will be 1 % of the total theory credit courses x 100 subjected
- To maximum 6 marks in that semester.
- Grace marks will be given candidate for change in grades for theory credit courses, i.e. from
- Fail to pass grade only and will be reflected in final ESE marks.
- The grace marks are applicable only for maximum 1/3rd courses (rounded to higher Integer part i.e. if there are 4 theory courses then 4/3 = 1.33 = 2 courses).
- Maximum grace marks will be distributed in maximum courses
- Benefit of grace marks is not applicable for any medal/award.
- Applicable to theory and (Theory + Practical Courses). If is not applicable for Practical courses.
- Scheme for grace marks only can be used when the student will pass in all courses of That semester.

21.0 CGPA Improvement Policy for Award of Degree:

An opportunity shall be given to a student who has earned all the credits required by the respective program with CGPA greater than or equal to 4.00 but less than 4.75 to improve his/her grade by allowing him/her to appear for ESE examinations of maximum two theory courses of seventh semester. Such examinations shall be scheduled along with re-examinations/make-up examinations. However, CGPA shall be limited to 4.75 even though the performance of a student as calculated through modified CGPA becomes greater than 4.75.

Conclusions:

The academic policies regarding conduct of programs in Sanjay Ghodawat University Kolhapur are published in this document. The Academic Council shall reserve the right to modify these policies as and when required from the point of view of achieving academic excellence. In special and abnormal cases (i.e. the cases not covered through above rules) the decision of the (Chairman, Academic Council shall be final and shall be binding on all concerned.

Chairman

Academic Council

Sem.VII									
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme**			
						Component	**Exam**	**WT(%)**	**Min.Pass %**
AER4701	Aircraft Systems	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
AER4702	Computational Fluid Dynamics	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
AER4703	Space Flight Dynamics	2	-	-	2	Theory	FET	20	40
							CAT I	30	
							ESE	50	40
AER4704	Program Elective III	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
AER4705	Program Elective IV	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
AER4706	Aircraft Systems Lab		-	2	1	Practical	FEP	50	40
							POE	50	40
AER4707	Software Programming lab		-	2	1	Practical	FEP	50	40
							POE	50	40
AER4708	Program Elective Lab III		-	2	1	Practical	FEP	50	40
							POE	50	40
AER4709	Software Proficiency Program-III			4	2	Practical	FEP	100	40
	Phase – I Tracks *								
II2701	Industry Internship Program (IIP-II) with project	-	-	2	1	Project	FEP	100	40
ED2701	Entrepreneurship Venture Scheme (EVS)	-	-	2	1	Project	FEP	100	40
RE2701	Undergraduate Research Opportunity Program (UROP)	-	-	2	1	Project	FEP	100	40
CP2701	Capstone Project with Vertical and University Open Electives	-	-	2	1	Project	FEP	100	40
Total		**14**	**00**	**12**	**20**	**Total Hrs: 26, Total Credits: 20**			

Course Codes : AER – Aeronautical Engineering & Technology; II – Industrial Internship Program; ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program; P –Project; UE – University Open Elective

Elective		Aircraft Design and Analysis (Vertical 1)	Aircraft Operations and Maintenance (Vertical 2)	
III	AER4704A	Hypersonic aerodynamics	AER4704C	Aircraft Condition Monitoring
	AER4704B	Wind Tunnel Techniques	AER4704D	Helicopter Maintenance
IV	AER4705A	Rocket Propulsion	AER4705C	Air traffic Control
	AER4705B	Fatigue & Fracture Mechanics	AER4705D	Aircraft Technical Publications

Course Code	**AER4701**				Title	**Aircraft Systems**			
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**CAT I**	**CAT II**	**FET**	ESE
	3	-	-	3		15	15	20	50
						Minimum pass marks- 20			Minimum pass marks – 20

Course Outcomes: The students will be able to

CO1	**Discuss**[2] various Aircraft Systems
CO2	**Explain**[2] the working principle of the Flight Control System
CO3	**Explain**[2] the working principle of the Aircraft Electrical
CO4	**Explain**[3]the working principle of Engine System Aircraft Instruments and Health Monitoring Systems.
CO5	**Develop**[5]a model of aircraft emergency system.

Unit No	**Content**	**Hrs**
1	**Introduction to Aircraft Systems** Introduction- Hydraulic Circuit Design - Hydraulic Actuation - Hydraulic Fluid - Fluid Pressure- Fluid Temperature- Fluid Flow Rate - Hydraulic Piping -Hydraulic Pumps - Fluid Conditioning -Hydraulic Reservoir - Warnings and Status - Emergency Power Sources –proof of design-Civil Transport Comparison -Landing Gear Systems - Nose Gear- Main Gear - Braking Anti-Skid and Steering - Electronic Control -Automatic Braking - Multi-Wheel Systems- Brake Parachute	6
2	**Flight Control System** Introduction - Principles of Flight Control- Flight Control Surfaces - Primary Flight Control - Secondary Flight Control - Commercial Aircraft - Flight Control Linkage Systems - Push-Pull Control Rod System - Cable and Pulley System -High Lift Control Systems- Trim and Feel - Flight Control Actuation- Simple Mechanical/Hydraulic Actuation - Mechanical Actuation with Electrical Signalling - Multiple Redundancy Actuation - Mechanical Screwjack Actuator- Integrated Actuator Package (IAP)- Advanced Actuation Implementations -Civil System Implementations - Fly-By-Wire Control Laws –Interrelationship of Flight Control, Guidance and Flight Management.	8
3	**Aircraft Electrical System** Introduction - Aircraft Electrical System - Power Generation- DC Power Generation - AC Power Generation- Power Generation Control- Primary Power Distribution - Power Conversion and Energy Storage -Secondary Power Distribution - Power Switching - Load Protection -Typical Aircraft DC System- Typical Civil Transport Electrical System - Electrical Loads- Emergency Power Generation -Ram Air Turbine - Backup Power Converters- Permanent Magnet Generators (PMGs).	6

4	**Engine Control Systems** Introduction -Engine/Airframe Interfaces- Engine Technology and Principles of Operation - The Control Problem - Fuel Flow Control - Air Flow Control- Control Systems -Control System Parameters - Input Signals- Output Signals- Design Criteria- Engine Starting- Fuel Control- Ignition Control - Engine Rotation - Throttle Levers- Starting Sequence -Engine Indications -Engine Oil Systems - Engine Offtakes -Reverse Thrust- Engine Control on Modern Civil Aircraft	6
5	**Fuel Systems** Introduction -Characteristics of Fuel Systems - Description of Fuel System Components - Fuel Quantity Measurement - Fuel System Operating Modes - Integrated Civil Aircraft Systems-Bombardier Global Express- Boeing 777 - A340-500/600 Fuel System - Fuel Tank Safety - Principles of Fuel Inerting - Air Separation Technology - Typical Fuel Inerting System-Polar Operations Cold Fuel Management - Minimum Equipment List (MEL) -Cold Fuel Characteristics -Fuel Temperature Indication.	8
6	**Emergency Systems** Emergency Systems -Introduction - Warning Systems - Fire Detection and Suppression- Emergency Power Sources- Explosion Suppression - Emergency Oxygen - Passenger Evacuation -Crew Escape - Computer- Controlled Seats- Ejection System Timing - High Speed Escape - Crash Recorder - Crash Switch - Emergency Landing - Emergency System Testing .	6

Text Books:

1. E.H.J. Pallet, **Aircraft Instruments**, Person, 3rd Edition, 2017.

Reference Books:

1. E.H.J. Pallet, Aircraft Electrical Systems, Person, 3rd Edition, 2016.
2. Mike Tooley & David Wyatt, Aircraft Electrical & ElectronicSystem,ELSEVIER Publication, 1st Edition, 2009
3. Mike Tooley & David Wyatt, Aircraft Communication & NavigationSystem, ELSEVIER Publication, 1st Edition, 2007

Course Code	**AER4702**		Title	**Computational Fluid Dynamics**				
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**FET**	**CAT I**	**CAT II**	**ESE**
	3	-	-	3		20	15	15	50
						Minimum pass marks- 20			Minimum pass marks- 20

Course Outcomes: -The students will be able to

CO1 **Explain**[2] fundamentals CFD and its applications.

CO2 **Apply**[3] various governing equation for different applications

CO3 **Explain**[2] the importance of discretization and grid generation.

CO4 **Analyze**[4] flow problems using finite element techniques

CO5 **Analyze**[4] flow problems using finite volume techniques

Unit No	Content	Hrs
1	**FUNDAMENTAL CONCEPTS** Introduction - Basic Equations of Fluid Dynamics - Incompressible In viscid Flows: Source, vortex and doublet panel, methods - lifting flows over arbitrary bodies. Mathematical properties of Fluid Dynamics Equations -_ Elliptic, Parabolic and Hyperbolic equations - Well posed problems - discretization of partial differential Equations. Explicit finite difference methods of subsonic, supersonic and viscous flows.	7
2	**GOVERNING EQUATIONS** Introduction — Various applications, Governing equations — continuity, momentum, energy equations, Boundary conditions	5
3	**GRID GENERATION** Structured grids. Types and transformations. Generation of structured grids. Unstructured grids. Delany triangulation.	6
4	**DISCRETIZATION** Boundary layer Equations and methods of solution -Implicit time dependent methods for inviscid and viscous compressible flows - Concept of numerical dissipation –Stability properties of explicit and implicit methods - Conservative upwind discretization for Hyperbolic systems - Further advantages of upwind differencing.	7
5	**FINITE ELEMENT TECHNIQUES** Overview of Finite Element Techniques in Computational Fluid Dynamics. Strong and Weak Formulations of a Boundary Value Problem.	6
6	**FINITE VOLUME TECHNIQUES** Finite Volume Techniques - Cell Centered Formulation - Lax - Vendoroff Time Stepping - Runge - Kutta Time Stepping - Multi - stage Time Stepping - Accuracy -. Cell Vertex Formulation - Multistage Time Stepping - FDM -like Finite Volume Techniques – Centraland Up- wind Type Discretization - Treatment of Derivatives. Flux – splitting schemes. Pressure correction solvers – SIMPLE, PESO. Vorticity transport formulation. Implicit/semi-implicit schemes.	9

Text Books:

1. Fletcher, C.A.J., ―Computational Techniques for Fluid Dynamics‖, Vols. I and II,Springer - Verlag, Berlin, 1988.

Reference Books:

1. John F. Wendt (Editor), ―Computational Fluid Dynamics - An Introduction‖, Springer –Verlag, Berlin, 1992
2. Charles Hirsch, ―Numerical Computation of Internal and External Flows‖, Vols. I and II, John Wiley & Sons, New York, 1988.
3. Klaus A Hoffmann and Steve T. Chiang. ―Computational Fluid Dynamics for Engineers‖, Vols. I & II Engineering Education System, P.O. Box 20078, W.Wichita,K.S., 67208 - 1078 USA, 1993.
4. Anderson, Jr.D., ―Fundamentals of Aerodynamics‖, McGraw-Hill, 2000.

Course Code	**AER4703**			Title	**Space Flight Dynamics**		
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**CAT I**	**FET**	ESE
	2	-	-	2		30	20	50
						Minimum pass marks- 20		Minimum pass marks- 20

Course Outcomes :The students will be able to

CO1	**Explain**[2] basics of astronomy and space time systems.
CO2	**Analyze**[4]different orbits using two body orbital mechanics
CO3	**Apply**[3] concept of Orbital Maneuver and mechanics to solve the problems associatedwith them.
CO4	**Discuss**[2]the significance of orbital perturbations in different calculations.
CO5	**Apply**[3] principle of trajectories and their types with mission planning perspective

Unit No	Content	Hours
1	**Introduction to Astronomy** Solar system, comets and meteors, Kepler‘s laws and Newton‘s law ofgravitation, concept of celestial sphere, vernal equinox, ecliptic. Coordinate systems, ECI system, geographic coordinate system, azimuth elevation coordinate system, ecliptic system, Time systems-sidereal time, mean solar time, universal time, ephemeris time. Effect of orbital altitude on satellite lifetimes.	6
2	**Two Body Orbital Mechanics** N-body problem, two-body problem-simplifying assumptions. Equations of relative motion. Constants of the motion-conservation of angular momentum, Trajectory equation, elliptical orbit-Geometry of the ellipse, period of an elliptical orbit, circular orbit, parabolic orbit, hyperbolic orbit. Geometry of the hyperbola, hyperbolic excess speed, Basic Problems associated with two-body problem.	8
3	**Basic Orbital Maneuver** Low altitude earth orbits, effect of orbital altitude on satellite lifetimes,direct ascent to orbit. High altitude earth orbits, the synchronous satellite, launching a high-altitude satellite. In-plane orbit changes, adjustment of perigee and apogee height, Hohmann transfer, generalcoplanar transfer between circular orbits.	6
4	**Orbital Perturbations** General overview of orbit perturbations, Earth Gravity Harmonics, Luni, solar Gravitational attractions, Solar Radiation Pressure Effects, Atmospheric drag effects, Tidal friction effects and Mutual Gravitational attraction. Earth‘s Oblations (J2) effects, Critical Inclination. Sun- synchronous orbits, J3 effects and frozen orbit.	6

Text Books: Bate, R.R.,Mueller, D.D. and White,J.E., Fundamentals of Astrodynamics, Dover Publications

Reference Books:

1. Wiesel, W.E., Space flight Dynamics,2nd Edition, McGraw-Hill,NewYork,1995.
2. Hale, F.J., Introduction to Space Flight, Prentice Hall, 1994.

Course Code	**AER4704A**				Title	**Hypersonic Aerodynamics**			
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**CAT I**	**CAT II**	**FET**	ESE
	3	-	-	3		15	15	20	50
						Minimum pass marks- 20			Minimum pass marks- 20

Course Outcomes: -The students will be able to

CO1	**Explain**[2]the formation of shock waves due to the high speed flow over bodies
CO2	**Apply**[3] the concept of hypersonic aerodynamics
CO3	**Apply**[3] the hypersonic in viscid flow problems
CO4	**Analyze**[4] the viscous boundary layers and its interactions in the hypersonic flows
CO5	**Analyze**[4] the effect of high temperature on hypersonic flow

Unit No	Content	Hours
1	**Review of High Speed Aerodynamics** Normal shock relations, Prandtl's relation, Hugoniot equation, Rayleigh Supersonic Pitot tube equation, Moving normal shock waves, Oblique shocks, Reflection ofoblique shocks, left running and right running waves, Interaction of oblique shock waves, slip line, shock-boundary layer interaction – transonic lambda shock – compression corner effect –incidentshock interaction - Rayleigh flow, Fanno flow, Expansion waves,Prandtl-Meyer expansion, Maximum turning angle, Simple and non- simple regions.	6
2	**Fundamentals of Hypersonic Aerodynamics** Introduction to hypersonic aerodynamics, differences between hypersonic aerodynamics and supersonic aerodynamics, concept of thin shock layers and entropy layers, hypersonic flight paths, hypersonic similarity parameters, shock wave and expansion wave relations of inviscid hypersonic flows.	8
3	**Simple Solution Methods for Hypersonic Inviscid Flows** Local surface inclination methods, Newtonian theory, modified Newtonian law, tangent wedge and tangent cone and shock expansion methods, approximate methods, hypersonic small disturbance theory, thin shock layer theory.	8
4	**Viscous Hypersonic Flow Theory** Boundary layer equations for hypersonic flow, hypersonic boundary layers, self similar and non self similar boundary layers, solution methods for non self similar boundary layers, aerodynamic heating and its adverseeffects on airframe.	6
5	**Viscous Interactions in Hypersonic Flows** Introduction to the concept of viscous interaction in hypersonic flows, Strong and weak viscous interactions, hypersonic viscous interaction similarity parameter, introduction to shock wave boundary layer interactions.	6

6	**High Temperature Effects in Hypersonic Flows** Nature of high temperature flows, chemical effects in air – real and perfect gases, Gibb‘s free energy and entropy, chemically reacting boundary layers, recombination and dissociation.	6

Text Books: John D. Anderson. Jr., –Hypersonic and High Temperature Gas Dynamics‖, Mc.Graw hill Series, New York, 1996.

Reference Books:

1. John D. Anderson. Jr., –Modern Compressible flow with historical Perspective‖, Mc.Graw Hill Publishing Company, New York, 1996.
2. John T. Bertin, –Hypersonic Aerothermodynamics‖, published by AIAA Inc., Washington. D.C., 1994.

Course Code	**AER4704B**				Title	**Wind Tunnel Techniques**			
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**CAT I**	**CAT II**	**FET**	ESE
	3	-	-	3		15	15	20	50
						Minimum pass marks- 20			Minimum pass marks- 20

Course Outcomes: -The students will be able to

CO1 **Explain**[2] the Principle of model testing

CO2 **Investigate**[3] the Problem in testing at different wind tunnel

CO3 **Explain**[2] the technique used in calibration of wind tunnel

CO4 **Analyse**[4] different types of measuring techniques

Unit No	Content	Hours
1	**LOW SPEED WIND TUNNELS** Classification –non-dimensional numbers-types of similarities - Layout of open circuit and closed-circuit subsonic wind tunnels – design parameters-energy ratio - HP calculations -Calibration methods.	6
2	**HIGH SPEED WIND TUNNELS** Blow down, in draft and induction tunnel layouts and their design features -Transonic, and supersonic tunnels- peculiar features of these tunnels and operational difficulties - sample design calculations and calibration methods.	8
3	**SPECIAL WIND TUNNEL TECHNIQUES** Types of Special Wind Tunnels – Hypersonic, Gun and Shock Tunnels – Design features and calibration methods- Intake tests – store carriage and separation tests - wind tunnel model design for these tests	8
4	**WIND TUNNEL INSTRUMENTATION** Instrumentation and sensors required for both steady and unsteady measurements – Force measurements using three component and six component balances – calibration of measuring instruments – error estimation and uncertainty analysis.	6
5	**FLOW VISUALIZATION and NON-INTRUSIVE FLOW DIAGNOSTICS** Smoke and Tuft grid techniques – Dye injection special techniques – Oil flow visualization and PSP techniques - Optical methods of flow visualization – PIV and Laser Doppler techniques –Image processing and data deduction.	6
6	**ADVANCED WINDTUNNEL TECHNIQUES** Advanced wind tunnel techniques Intake tests store carriage and separation tests, Unsteady force and pressure measurements, wind tunnel model design. Hot wire anemometer working and principles	6

Text Books:	1. NAL-UNI Lecture Series 12:" Experimental Aerodynamics", NAL SP 98 01April 1998 2. Rae, W.H. and Pope, A., "Low Speed Wind Tunnel Testing", John Wiley Publication, 1984
Reference Books:	1. Bradsaw "Experimental Fluid Mechanics". 2. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008NAL, Bangalore 3. Pope, A., and Goin, L., "High Speed Wind Tunnel Testing", John Wiley, 1985. 4. Radhakrishnan, E., –Instrumentation, Measurements, and Experiments in Fluids,‖ CRC Press –Taylor & Francis, 2007

Course Code	**AER4704C**			Title	**Aircraft Condition Monitoring**			
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**CAT I**	**CAT II**	**FET**	ESE
	3	-	-	3		15	15	20	50
						Minimum pass marks- 20			Minimum pass marks- 20

Course Outcomes: -The students will be able to

CO1	**Explain**[2] the principles and practices of the aircraft Condition Monitoring
CO2	**Apply**[3] different maintenance strategies to inspect various aircraft systems
CO3	**Explain**[2] the condition Monitoring of the Rotary parts of the Aircraft
CO4	**Explain**[2] the Temperature and Chemical Monitoring
CO5	**Apply**[3] the Vibration Monitoring concept to monitor health of various aircraft systems

Unit No	Content	Hours
1	**Principles and Practices of Maintenance Planning** Basic Principles of maintenance planning, Objectives and principles of planned maintenance activity, Importance and benefits of sound Maintenance systems, Reliability and machine availability, MTBF, MTTR and MWT, Factors of availability, Maintenance organization, Maintenance economics. Maintenance categories, Comparative merits ofeach category, Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication, TPM.	6
2	**Maintenance and Condition Monitoring:** Importance and necessity of maintenance, different maintenance strategies like Breakdown maintenance, planned maintenance and condition based maintenance. Planned and preventive maintenance of transformer, induction motor and alternators. Insulation stressing factors, insulation deterioration, polarization index, dielectric absorption ratio. Insulation ageing mechanisms, Insulation failure modes, Definition of terms, Concept of condition monitoring of electrical equipments. Overview of Advanced tools and techniques of condition monitoring, Condition monitoring by thermography.	8
3	**Condition Monitoring Analysis** Condition Monitoring, Cost comparison with and without CM, On-load testing and offload testing, Methods and instruments for CM, Temperature sensitive tapes, Pistol thermometers, wear-debris analysis	6
4	**Condition Monitoring of Rotating Elements** Introduction to motor condition monitoring, The need for monitoring, What and when to monitor, Construction, operation and failure modes of electrical machines, Structure of electrical machines and their types, Machine specification and failure modes, Failure sequence and effect on monitoring, Typical root causes and failure modes, General, Root causes,Failure modes.	6
5	**Temperature monitoring** Instrumentation requirement for Temperature measurement, Local	8

6	temperature measurement, Hot-spot measurement and thermal images, Bulk measurement. **Chemical monitoring** Insulation degradation, Factors that affect detection, Insulation degradation detection, Particulate detection: core monitors, Particulate detection: chemical analysis, Gas analysis off-line, Gas analysis on-line, Lubrication oil and bearing degradation **Vibration monitoring** Instrument required for Vibration measurement, Condition monitoring of rotating elements, Bearing response, Rolling element bearings, bearing geography, Bearing Monitoring techniques, Overall level monitoring, Frequency spectrum monitoring	6

Text Books:

1. Hamid A Toliyat, Subhasis Nandi, Seungdeog Choi, Homayoun Meshgin-Kelk,–Electric Machines: Modeling, Condition Monitoring and Fault Diagnostics, CRC Press

Course Code	**AER4704D**			Title	**Helicopter Maintenance**			
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**CAT I**	**CAT II**	**FET**	ESE
	3	-	-	3		15	15	20	50
						Minimum pass marks- 20			Minimum pass marks- 20

Course Outcomes: -The students will be able to

CO1	**Explain**[2] the various components and systems of Helicopter
CO2	**Apply**[3] the procedure of ground handling and servicing of helicopter
CO3	**Investigate**[3] the helicopter control surface components and its function
CO4	**Explain**[2] the power plants and tail rotor of helicopter
CO5	**Explain**[2] the airframe and engine system of helicopter

Unit No	Content	Hours
1	**INTRODUCTION** Introduction-Types-Main rotor- Tail rotor, clutch, Gear box, Flying controls, Landing gears, Electrical system, Heating and ventilating system, Instrumentation and Radio navigation aids pertaining to the helicopter	6
2	**HELICOPTER FUNDAMENTAL** Basic directions – Ground handling, bearing – Gears.	6
3	**MAIN ROTOR SYSTEM** Head maintenance – blade alignment – Static main rotor balance – Vibration – Tracking – Span wise dynamic balance – Blade sweeping – Electronic balancing – Dampener maintenance –Counter weight adjustment – Auto rotation adjustments – Mast & Flight Control Rotor - Mast – Stabilizer, dampeners – Swash plate flight control systems collective – Cyclic – Push pull tubes – Torque tubes – Bell cranks – Mixer box – Gradient unit control boosts – Maintenance & Inspection control rigging.	8
4	**MAIN ROTOR TRANSMISSIONS** Engine transmission coupling – Drive shaft – Maintenance clutch – Free wheeling units – Spray clutch – Roller unit – Torque meter – Rotor brake – Maintenance of these components – vibrations – Mounting systems – Transmissions.	8
5	**POWER PLANTS & TAIL ROTORS** Fixed wing power plant modifications – Installation – Different type ofpower plant components and maintenance. Tail rotor system – Servicing tail rotor track – System rigging	6
6	**AIRFRAMES AND RELATED SYSTEMS** Fuselage maintenance – Airframe Systems – Special purpose equipment	6

Text Books:	1.JEPPESEN, –Helicopter Maintenance‖, Jeppesons and Sons Inc., 2000
Reference Books:	1. –Civil Aircraft Inspection Procedures‖, Part I and II, CAA, English Book House, New Delhi, 1986. 2. LARRY REITHMIER, –Aircraft Repair Manual‖, Palamar Books Marquette, 1992.

Course Code	**AER4705A**			Title	**Rocket Propulsion**			
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**CAT I**	**CAT II**	**FET**	ESE
	3	-	-	3		15	15	20	50
						Minimum pass marks- 20			Minimum pass marks- 20

Course Outcomes: -The students will be able to

CO1	**Explain**[2] the fundamentals of rocket propulsion
CO2	**Apply**[3] the nozzle theory and thermodynamic relations to solve rocket propulsion problems
CO3	**Explain**[2] liquid and hybrid propulsion systems used in rockets
CO4	**Apply**[3]concepts of propulsion to solve solid propellant problems
CO5	**Explain**[2]advanced rocket propulsion systems and techniques

Unit No	Content	Hours
1	**Fundamentals of Rocket Propulsion** Operating principle –Applications – Definitions and fundamental parameters: Thrust, Exhaust Velocity, Energy and Efficiencies, Typical Performance Values	6
2	**Nozzle Theory and Thermodynamic Relations** Ideal rocket – Isentropic flow through nozzles – Nozzle Performance: nozzlearea ratio, characteristic velocity, thrust coefficient – Nozzle configurations, Under-expansion and over-expansion	7
3	**Liquid Propulsion** Classifications –Propulsion system components and its functions - Propellant feed systems and Turbo pump feed system - injectors and types - Thrust chamber and its cooling - Cryogenic propulsion system, special features of cryogenic systems	7
4	**Solid Propulsion** Application and Classification of Solid Propellant Rocket Motors - Propellantsand Characteristics - Ingredients and Processing - Propellant Burning Rate - Propellant Grains and Grain Configurations - Grain Design.	7
5	**Hybrid Propulsion** Classification - System Arrangement and Components - Typical Fuels and Oxidizers - Advantages and Disadvantages - Application Areas - Performanceand Limitations - Performance Parameters of selected existing Hybrid Rocket Engines - System Integration - Manufacturing Methods for Low and High-thrust Engines.	7
6	**Advanced Propulsion Techniques** Electric rocket propulsion– types of electric propulsion techniques - Ion propulsion – Nuclear rocket – comparison of performance of these propulsion systems with chemical rocket propulsion systems – future applications of electric propulsion systems - Solar sail.	6

Text Books:

Sutton, G.P., ―Rocket Propulsion Elements‖, John Wiley & Sons Inc., New York, 5th Edition, 1993.

Mathur, M.L., and Sharma, R.P., ―Gas Turbine, Jet and Rocket Propulsion‖, Standard Publishers and Distributors, Delhi, 1988.

Reference Books:

1. Sutton, G.P., ―Rocket Propulsion Elements‖, John Wiley and Sons Inc., New York, 8th Edn., 2012.
2. Cornelisse, J.W., Rocket Propulsion and Spaceflight Dynamics, Pitman Publishing, 1979.
3. Hill, P.G. and Peterson, C.R. ―Mechanics and Thermodynamics of Propulsion‖ Addison, Wesley Longman INC, 1999.

Course Code	AER4705B				Title	Fatigue and Fracture Mechanics			
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**CAT I**	**CAT II**	**FET**	ESE
	3	-	-	3		15	15	20	50
						Minimum pass marks- 20			Minimum pass marks- 20

Course Outcomes: -The students will be able to

CO1	**Explain**[2] the mechanical behavior of materials
CO2	**Analyze**[4] SN Curves for the Metals and Composites
CO3	**Solve**[3] numerical on Fatigue life of different components
CO4	**Analyze**[4] the Material behavior by applying cyclic loading to determine fatigue strength
CO5	**Evaluate**[5] the good fatigue life of components using different testing

Unit No	Content	Hours
1	**Mechanical Behaviour of Materials** Linear and nonlinear elastic properties – Yielding, strain hardening, fracture, Bauchinger's effect – Notch effect testing and flaw detection of materials and components – creep and fatigue - comparative study of metals, ceramics plastics and composites.	6
2	**Fatigue of Structures** S.N. curves - Endurance limits - Effect of mean stress, Goodman, Gerberand Soderberg relations and diagrams - Notches and stress concentrations – Neuber's stress concentration factors - Plastic stress concentration factors - Notched S.N. curves – Fatigue of composite materials.	7
3	**Statistical Aspects of Fatigue Behaviour** Low cycle and high cycle fatigue - Coffin – Manson's relation - Transition life - cyclic strain hardening and softening - Analysis of load histories - Cycle counting techniques -Cumulative damage – Miner'stheory - Other theories.	7
4	**Physical Aspects of Fatigue** Phase in fatigue life - Crack initiation - Crack growth - Final Fracture - Dislocations - fatigue fracture surfaces.	6
5	**Fracture Mechanics** Strength of cracked bodies - Potential energy and surface energy – Griffith's theory - Irwin - Orwin extension of Griffith's theory to ductilematerials - stress analysis of ‒cracked bodies - Effect of thickness on fracture toughness‖ - stress intensity factors for typical geometries.	8
6	**Fatigue Design and Testing** Safe life and Fail-safe design philosophies - Importance of Fracture Mechanics in aerospace structures - Application to composite materialsand structures.	6

Text Books:

Barrois W, Ripely, E.L., –Fatigue of aircraft structure," Pergamon press. Oxford, 1983.

Reference Books:

1. Sih C.G., –Mechanics of fracture.‖ Vol - I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
2. Knott, J.F., –Fundamentals of Fracture Mechanics,‖ - Buterworth& Co., Ltd., London, 1983.
3. KareHellan ,"Introduction to Fracture Mechanics", McGraw Hill, Singapore,1985

Course Code	**AER4705C**			Title	**Air Traffic Control**			
Teaching Scheme	L	T	P	C	Evaluation Scheme	CAT I	CAT II	FET	ESE
	3	-	-	3		15	15	20	50
						Minimum pass marks- 20			Minimum pass marks- 20

Course Outcomes: -The students will be able to

Course Outcomes	The students will be able to,
CO1	**Explain**[2] the concepts of Air Traffic need for aircraft operations
CO2	**Discuss**[2] the air traffic rules and regulations
CO3	**Apply**[3] the procedure of formation of aerodrome and its configuration and requirements
CO4	**Analyze**[4] the Aerodrome data, physical characteristics, obstacle restriction, and visualaids
CO5	**Explain**[2]the importance of Air traffic management and its operations

Unit No	Content	Hours
1	Basic Concepts Objectives of ATS, Parts of ATC, Service, Scope and Provision of ATCs ,VFR and IFR operations, Classification of ATS air spaces, Various kinds of separation, Altimeter setting procedures, Establishment, designation and identification of units providing ATS, Division of responsibility of control.	6
2	Air Traffic Services Area control service, Assignment of cruising levels, Minimum flight altitude ATS routes and significant points, RNAV and RNP, Vertical, lateral and longitudinal separations based on time/ distance, ATC clearances, Flight plans, position report	8
3	Flight Information Alerting Services, Coordination, Emergency Procedures And Rules of The Air Radar service, Basic radar terminology, Identification procedures using primary/ secondary radar, Performance checks, Use of radar in area and approach control services, Assurance control and co-ordination betweenradar/ non radar control, Emergencies, Flight information and advisory service, Alerting service, Co-ordination and emergency procedures, Rules of the air.	8
4	Aerodrome Data, Physical Characteristics and Obstacle Restriction Aerodrome data, Basic terminology, Aerodrome reference code, Aerodrome reference point, Aerodrome elevation, Aerodrome reference temperature, Instrument runway, physical Characteristics, length of primary/ secondary runway, Width of runways, Minimum distance between parallel runways etc., obstacles restriction.	6
5	Visual Aids for Navigation, Visual Aids for Denoting Obstacles Emergency and Other Services Visual aids for navigation Wind direction indicator ,Landing direction	6

	indicator, Location and characteristics of signal area, Markings, General requirements, Various markings, Lights, general requirements, Aerodrome beacon, identification beacon, Simple approach lighting system and various lighting systems, VASI and PAPI - Visual aids for denoting obstacles; Object to be marked and lighter, Emergency and other services.	
6	Air Traffic Management Services provided to aircraft carriers, Government responsibilities, Flightrules and airspace organization, Airways and procedures, Phases of flight, Subsystems, Facilities and operations, System capacity, Airborne Collision Avoidance Systems	6

Text Books:	Avionics Navigation Systems, 2nd Edition, Myron Kayton and Walter R. Freid,John Wiley and Sons, Inc, 1997, ISBN 0-471-54795-6
Reference Books:	

Course Code	**AER4705D**			Title	**Aircraft Technical Publication**			
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**CAT I**	**CAT II**	**FET**	ESE
	3	-	-	3		15	15	20	50
						Minimum pass marks- 20			Minimum pass marks- 20

Course Outcomes: -The students will be able to

Course Outcomes	The students will be able to,
CO1	**Explain**[2] about various aircraft Manuals
CO2	**Explain**[2] the different checklist Maintained for Aircraft
CO3	**Differentiate**[3] the various Programme used for Aircraft Maintenance
CO4	**Analyze**[4] different parameters needed to seek approval of various aviation organization
CO5	**Classify**[3] the different safety Regulations & Aircraft Documentation

Unit No	Content	Hours
1	**FUNDAMENTALS OF TECH PUBLICATIONS:** Knowledge of Aircraft manuals-Aircraft Rules-Air worthiness advisory circular- Aeronautical information circulars	6
2	**COCKPIT CHICK LIST, MEL, CDL AND DEFECTS:** Minimum equipment list-Preparation and use of concept and emergencycheck list-Defect recording, reporting-investigation-Rectification and analysis-Maintenance control by reliability method.	6
3	**AIRCRAFT MAINTENANCE PROGRAMMES AND THEIR APPROVAL:** Reliability program –AMP-On condition maintenance-TBO- revision program-Maintenance of fuel and oil consumption records-Fixing routinemaintenance periods and component-TBO,s initial and revision	8
4	**APPROVAL OF ORGANISATIONS**: Approval of organization - CAR 145- CAR-M-CAR-21-Approval of organization in Cat.E and Cat.G	6
5	**Aircraft Documentation:** Certificate of maintenance -Test report- Certificate of manufacturer-Maintenance check-Maintenance program-Inspection schedule-Maintenance manual-Maintenance documentation -Structural repair manual-Illustrated part catalogue-Test flight report	8
6	**Safety Management:** State Safety Program-Basic Safety Concepts-Hazards & Safety Risks-SMS Operation-SMS Safety performance-Safety Assurance	6

Text Books:

1. ―Indian Aircraft manual‖ DGCA Publication
2. Alexander T. Wells ―Air Transportation‖ Wadsworth Publishing Company, California, 1993

Course Code	AER4706				Title	Aircraft Systems Lab	
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**FEP**	**POE**
	-	-	2	1		50	50
						Minimum pass marks- 20	Minimum pass marks- 20

Course Outcomes: -The students will be able to

CO1	**Explain**[2] the functioning of the various critical aircraft systems
CO2	**Demonstrate**[3] the working of the aircraft systems
CO3	**Carryout**[4]the trouble shooting of the various aircraft systems
CO4	**Perform**[3] landing gear check
CO5	**Design**[5]an lighting system for aircraft

List of Experiments

1. Demonstration of Hydraulic Systems
2. Measure the deflection and movement of Flight Control System
3. Perform a test on Engine Control System
4. Perform a test on Flight Deck Instruments
5. Conduct an experiment on Aircraft Fuel System
6. Design an Aircraft Electrical System
7. Perform a test on Landing Gear System
8. Design an Aircraft Lighting System.

Course Code	**AER4707**			Title	**Python Programming Lab**		
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**FEP**	**POE**
	-	-	2	1		50	50
						Minimum pass marks- 20	Minimum pass marks- 20

Course Outcomes: -The students will be able to

CO1	**Determine**[3] the syntax and sematics and create functions in python
CO2	**Calculate**[3] the strings and files in python
CO3	**Verify**[3] the lists, Dictionaries and regular expressions in python
CO4	**Conduct**[3] object-oriented programming concepts in python
CO5	**Conduct**[3] web services and introduction to network and data base programmingin python

List of Experiments

1. Determination of indentation error and correct it
2. Determination of distance between two points taking input from the user (Pythagorean Theorem)
3. Determination of factorial of a number and print the prime numbers below 100
4. Determination of the numbers of characters in the string and store them in a dictionary data structure
5. Use of split and joints methods in the string and trace a birthday with a dictionary data structure
6. Determination of mean, median, mode for the given set of numbers in a list
7. Functions dups to find all duplicates in the list
8. Write a python script for addition of two square matrices
9. Write a python script for multiplications of two matrices
10. Write python program to over ride magic methods
11. Write python program to create a simple calculator where the user can identify the lift and drag force calculation for an aerofoil.

Course Code	**AER4708A**			Title	**Hypersonic Aerodynamics Lab**	
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**FEP**	**POE**
	-	-	2	1		50	50
						Minimum pass marks- 20	Minimum pass marks- 20

Course Outcomes — The students will be able to,

CO1 **Explain**[2] the high temperature effects in the hypersonic flows

CO2 **Visualize**[3] the Hypersonic flow over bodies

CO3 **Analyze**[4] the shock wave and boundary layer interaction CO4 **Analyze**[4] the over expanded flow over a bodies

CO5 **Analyze**[4] the shock reflections at hypersonic speeds

List of Experiments

1. Measure Flow visualization techniques in high speed flows
2. Conduct Schlieren flow visualization over conical body at Hypersonic flow
3. Investigate the change in flow field over a conical body on introduction of spike
4. Perform Flow investigation of the surface of a conical body using oil flow visualization at Hypersonic speed
5. Obtain Flow field over a cavity at hypersonic flow using schlieren flow visualization
6. Perform Flow field on a protrusion using oil flow visualization
7. Obtain Shock wave and boundary layer interaction point
8. Perform over expanded flow studies on a jet
9. Measure Shock reflections inside an air intake at hypersonic speed

Course Code	**AER4708B**			Title	**Wind Tunnel Techniques Lab**	
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**FEP**	**POE**
	-	-	2	1		50	50
						Minimum pass marks- 20	Minimum pass marks- 20

Course Outcomes	The students will be able to,
CO1	**Explain**[2]the high temperature effects in the hypersonic flows
CO2	**Visualize**[3] the Hypersonic flow over bodies
CO3	**Analyze**[4] the shock wave and boundary layer interactionCO4
	Analyze[4] the over expanded flow over a bodies
CO5	**Analyze**[4] the shock reflections at hypersonic speeds

List of Experiments

1. Measure Flow visualization techniques in high speed flows
2. Conduct Schlieren flow visualization over conical body at Hypersonic flow
3. Investigate the change in flow field over a conical body on introduction of spike
4. Perform Flow investigation of the surface of a conical body using oil flow visualization at Hypersonic speed
5. Obtain Flow field over a cavity at hypersonic flow using schlieren flow visualization
6. Perform Flow field on a protrusion using oil flow visualization
7. Obtain Shock wave and boundary layer interaction point
8. Perform over expanded flow studies on a jet
9. Measure Shock reflections inside an air intake at hypersonic speed

Course Code	**AER4708C**			Title	**Aircraft Condition Monitoring Lab**	
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**FEP**	**POE**
	-	-	2	1		50	50
						Minimum pass marks- 20	Minimum pass marks- 20

Course Outcomes — The students will be able to,

CO1 **Explain**[2] the condition Monitoring if the Rotary parts of the Aircraft CO2

Analyze[3]the temperature and chemical performance at various conditionsCO3

Assess[4] the vibration performance at various conditions

CO4 **Analyze**[4] the conditions of shafts

CO5 **Evaluate**[5]performance of different components

List of Experiments

1. Perform frequency response analysis
2. Perform Vibration Analysis of Aircraft
3. Perform Spectrum/FET Analysis of Aircraft
4. Demonstration of Signature Analysis
5. Identification of methods of Mechanical Faults
6. Perform the thermography diagnosis
7. Demonstration of Engine Health Monitoring
8. Perform Ultrasonic Health Monitoring of shafts

Course Code	AER4708D				Title	Helicopter Maintenance Lab	
Teaching Scheme	**L**	**T**	**P**	**C**	Evaluation Scheme	**FEP**	**POE**
	-	-	2	1		50	50
						Minimum pass marks- 20	Minimum pass marks- 20

Course Outcomes The students will be able to,

CO1 **Explain**[2] the components of Helicopter

CO2 **Select**[3] the type of ground support equipment to be used for various ground handling operations

CO3 **Analyze**[4] the function of components in helicopter Rotor SystemCO4 **Assess**[4] the airframe and engine system of helicopter

CO5 **Analyze**[4] the helicopter preflight inspection data's

List of Experiments

1. Study on helicopter control system
2. Demonstration of Helicopter Flight Deck
3. Perform test using different Helicopter Blade Tracking Methods
4. Carryout Balancing of Helicopter Blade
5. Perform Vibration Check of Helicopter Gear Box
6. Inspection of Main Rotor Blade
7. Inspection of Tail Rotor Blade
8. Inspection of Landing Skid and Airframe
9. Perform Helicopter Pre-flight Inspection

B Tech (Common to all Programs) Semester - VII

OPTIONS to Students (TRACKS)

Choices are given to students in terms of tracks to pursue their interest of study. In the B. Tech Semester VII, students are required to undertake the pre-work in respect of chosen tracks and this activity is assigned one credit. The tracks available to students are:

Track	Details of Track	Credit Assigned
Track 1	Industry Internship Program (IIP II) with project.	1
Track 2	Entrepreneurship Venture Scheme (EVS)	1
Track 3	Undergraduate Research Opportunity Program (UROP)	1
Track 4	Capstone project with Vertical and University Open Electives	1

Each student should choose one of the tracks at the beginning of the seventh (VII) Semester and the same track will continue through the B. Tech VIII Semester. Once selected the track in the VII semester, no change in track is allowed as pre-work is assigned to each of the selected track.

As a part of preparation to the selected track, a pre work is designed to prepare the students for effectively completing the track in semester VIII and students are evaluated for their performance in assigned work through designed assessment schemes. This pre-work is assigned one credit.

B Tech (Common to all Programs) Semester - VII

Track 1: Industry Internship Program (IIP-II) with Project [Phase – I]

Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
						Component	Exam	WT	% Pass
II-2701	Industry Internship Program (IIP-II) with project.	-	-	2	1	Proj	FEP	100	40

Students who opt for Track 1: Industry Internship Program (IIP-2) with project are expected to complete the following activities during the semester VII and during the winter vacation once the company is assigned to the student for internship.

1.Student is required to collect all the relevant information about the company prior to making the first visit to the company. The following information is to be collected preferably through the secondary sources like company website, brochures, company annual reports, personal contact, and newspaper and magazine publications.

2. The information collection includes.

a. Company Profile, Vision, mission, establishment, promoters, location, organization structure, type of the business, turnover of the company.

b. Products and services, customers / clients.

c. Departments / Sections, production process / service process.

d. Positioning of the company with respect to competitors.

e. Product / Process /Service / Solution technologies deployed.

3. With permission from the company, on confirmation of internship, make the first visit to the company for familiarization and spend a day or two during the Semester on weekly holidays or if it is far off, during winter break make a scheduled visit. Make a visit report in a professional way and include in the report you submit to department.

4. The guide / supervisor will be assigned to you once your industry / company is finalized.

Eligibility Criteria Eligibility Criteria for allotment of the tracks.

1. Student should have a CGPA of more than 6.75 on a 10-point scale without any back logs.
2. Students are ready to move to a place of company allotted.
3. Required to follow all the rules and regulations of the company.
4. Ready to bear the expenses of internship if the company charges, accommodation and transport.
5. Should be able to complete the track I in the company including evaluation.

Evaluation:

This is a credit course (one credit). The scheme of evaluation will be based on the assessment rubrics.

Evaluation Component	Weightage	Minimum Passing
FET	100%	40%

B Tech (Common to all Programs) Semester - VII
Track II: Entrepreneurship Venture Scheme Phase – I

Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
						Component	Exam	WT	% Pass
ED-2701	Entrepreneurship Venture Scheme (EVS)	-	-	2	1	Proj	FEP	100	40

This track is designed for students aspiring for staring their own enterprise / new start up and has a burning desire to become an entrepreneur. Though CGPA is not the only criteria for selection, a student is required to go through a well- structured process of selection and also an interaction with parents.

During the 7th Semester, students are expected to be familiar with the traits t make a successful entrepreneur. Personal SWOT analysis and area in which he wants to think of taking up the business venture.

The activities for the Semester - VII include:

1. Self-analysis report and action plan for improvement of overall personality.
2. Interaction with minimum three entrepreneurs. Preferably one each from first generation entrepreneur, family business and women entrepreneur. Study and observe closely how they have built their units, their vision, planning, resource mobilization, style of working, risk taking ability and other personality dimensions make a brief report.
3. Study a unit started by a young entrepreneur and prepare a report with the following details:
   a. The beginning (start) Brief Profile of company, Products / Services, sources of Finance
   b. Customers
   c. What is special about the company? How they compete in the market
   d. What is the Financial Health?
   e. How they leverage technologies and all other aspects of running an enterprise

Eligibility for choice of this track

1. Student should possess the right attitude and mind set to start his venture assessed through the test and personal interview.
2. Interaction with parents is mandatory to seek the support and co-operation to their wards for starting a new venture.
3. Students are required to work hard to interact and connect with entrepreneurs. Complete the other course requirements mentioned in the track.

Evaluation:

Evaluation Component	Weightage	Minimum Passing
FET	50%	40%
Report & Presentation	50%	

During vacations, the student is expected to undergo the EDP program and produce the certificate.

B Tech (Common to all Programs) Semester - VII

Track III: Undergraduate Research Opportunity Program (UROP) Phase I

Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
						Component	Exam	WT	% Pass
RE-2701	Undergraduate Research Opportunity Program (UROP)	-	-	2	1	Proj	FEP	100	Min 40

Undergraduate Research Opportunity Program (UROP) track is specially designed for students who would like to make their career in research, wish to pursue graduate programs (M.Tech) in reputed institutes and want to study abroad for Master's program (MS) and get a good opportunity to work with R&D departments of company. At the beginning of the academic year, the department is going to publish the details like list of Faculty available to guide UROP, the number of candidates they can guide, Research area and the brief note of research projects they can offer.

Activities students are expected to carry out for Phase I

1. Selection of research project area and the research supervisor (to be confirmed by department based of prefixed criteria)
2. Make a literature survey by collecting the relent details and making a review of the literature.
3. Identify the research topic and decide the research project title under the guidance of a supervisor.
4. Make a research proposal which is to be worked out in Semester II in a standard format.

Eligibility requirements

1. The interest and passion for research judged through prior projects done, participated in research competitions and publications in conferences.
2. A good academic performance with a CGPA greater than 8.5 at the end Semester VI with no back logs.
3. Ready to work hard on a chosen topic to get the desired outcomes.
4. Students who get opportunity to carry out this track in premier institutions are required to meet the additional expenses incurred.

Evaluation

Evaluation Component	Weightage	Minimum Passing
FET	50%	40%
Research Proposal Report & Presentation	50%	

The final proposal evaluation will be evaluated by a committee appointed by the Head of the department. If the committee recommends the proposal, student can start the work in vacation and if the committee suggests modification, changes in scope, the student is required to complete and resubmit the same for final approval and on approval can start the work.

Students can take up the research projects outside the university premises like Government R&D laboratories, DRDO, Auto Vehicle Testing Labs, etc., reputed premier Institutes like IIT's and R&D Organizations.

B Tech (Common to all Programs) Semester - VII

Track IV : Capstone Project

Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
						Component	Exam	WT	% Pass
CP-2701	Capstone project with Vertical and University Open Electives	-	-	2	1	Proj	FEP	100	Min 40

As a part of the B. Tech curriculum, each student is required to undertake a project in a group during Semester VII which is continued throughout Semester VIII under the guidance of a supervisor. The activities to be completed during VII Semester towards earning prescribed credit are as follows:

1. Formation of a project team not exceeding Five Students.
2. Allotment of a Faculty Supervisor to each group.
3. Student group can choose the Projects offered by the faculty guides or can come out with project ideas to be finalized in consultation with project guide / supervisor or can carry out the industry sponsored projects in groups.
4. Student Group is required to prepare the project proposal in a standard format for approval.
5. Student group will present the project proposal to an evaluation committee appointed by the Head of the Department.
6. On approval of the Project Proposal, students can start the project. If there are any suggestions by committee, the students are required to rework on the project proposal and submit incorporating all suggestions.
7. Students have a choice to make their own groups

General guidelines for selection of a Project:

1. Design, Fabrication and testing of a product / machine.
2. Improvement in the existing system. Augment of performance of the existing system.
3. Solution to the existing problem using innovative problem-solving techniques.
4. Optimization techniques using heuristics.
5. Developing application software's.
6. Application of Industrial Engineering / Optimization tools to solve industry problems.
7. Modeling and analysis and Optimization Projects.
8. Projects with technical solutions to the Social Problems.
9. Solving Industry related problems.
10. Extensive data collection, data analysis using computers and optimal solution. The list is not exhaustive. Students can identify feasible of this project beyond the list.

Evaluation:

Evaluation will be based on the assessment rubrics designed to assess the project proposal

Evaluation Component	Weightage	Minimum Passing
FET	50%	40%
Project Synopsis	50%	

B Tech (Common to all Programs) Semester VIII

TRACK – I : Industry Internship Program (IIP) with Project

SEM VIII										
Track	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	Evaluation Scheme for Theory and Practical			
							Component	Exam	%WT	Pass
I	II2801	Industry Internship	-	-	-	6	Practical Training (OJT)	FEP	100	Min 40
	II2804	Industrial Project	-	-	-	6	Project	FEP	50	Min 40
								POE	50	
	II2802	Online Course in Advanced Technology (domain area)	-	-	-	4	Certifi - cation	FEP	100	Min 40
	II2803	Self-Study Course (Non-Instructional)	-	-	-	4	Report & Presenta - tion	FET	100	Min 40
	Total		**-**	**-**	**-**	**20**	Total Credits: **20**			

Note

Students are required to spend entire semester-VIII in industry allotted and complete the project in the University before going Internships.

Course Codes :
AER – Aeronautical Engineering & Technology; II – Industrial Internship; P –Project;

B Tech (Common to all Programs)
TRACK – I : Industry Internship Program (IIP-II) with Project

1 Industry Internship Program (IIP-II): II2801 Industry Internship

Sanjay Ghodawat University place high focus on the interaction with industries to give them adequate exposure to the practicing aspects of theoretical knowledge they learn in classroom. Moving a step ahead, in order to enhance the students experience with world of work, we are introducing industry internship with project after a through consultation with industry persons, academicians as a part of the major curricular reforms in the choice based credit system (CBCS).

Choice Based for students at Semester VIII for full semester (16 weeks) and pre-work at semester VII (Preparation).This track aims at giving students hands on experience with the world of work which imbibes in them the skills and competencies required to make them competent graduates for employment as per the expectation of the industry. It is a semester long (16 Weeks) course where the students are expected to work as interns and carry out the individual project assigned to them by the company. The students learning progress is monitored by both industry person concerned and the institutional Faculty assigned.

This course aims at giving students hands on experience to the world of work which imbibes in them the skills and competencies required to make them competent graduates for employment as per the expectation of the industry. It is a semester long course where the students are expected to work as interns and carry out the individual project assigned to them by the company. The students learning progress is monitored by both industry person concerned and the institutional Faculty assigned.

IIP track has two components

1. Internship training in the industry for full semester.
2. Individual Project Assignment in the same company

2 CRITERIA FOR SELECTION OF STUDENTS

The students who want to opt for IIP II and project track are required to fulfill the criteria specified below:

1. CGPI of students up to semester VI should be ≥ 6.75 (with no backlogs)
2. Ready to move to the place where industry assignment is allotted.
3. The entire cost of the Internship will be borne by the students (lodging boarding and any other cost).However, any facilities extended by the company like conveyance facility, subsidized canteen facility and stipend the students can avail.
4. They have to go through the selection process of the company if required.
5. Maximum number of students will be decided based on the policy guidelines prepared by

the university/Department and also availability of internships at industries from time to . time. Once the student is allotted the company (after final selection process) cannot be changed
and it is binding on the student to complete the assignment in that company.

3 CRITERIA FOR LISTING OF COMPANIES

1. It should be a medium or large scale industry having the functional departments and facilities to design develop and manufacture the products or offer services and potential to offer challenging projects.

2. Company should provide minimum 2-3 internship assignments along with projects and extend facilities to students the on the job training (OJT) as well as access to data & information and guidance to complete the assigned project.

3. Should be able to keep record of attendance and provide a mentor to monitor the project
And help the students to sort out problem/ issues.

4. Students who are eligible as per criteria and get the internship with their own contacts can
5. also be considered subjected to approval of the company by the University for Internship.

4 PROJECT ASSIGNMENT

A student doing internship in the company is required to carry out an individual project in the domain specific area with help of company mentor/Guide and faculty guide assigned to qualify for the credits mentioned in structure and also required to undergo self-study or online certification course approved by Department Program Committee of the host department.

The project proposal is to be prepared and get approved by the DPC of the department student is required select the problem for solution which requires a problem definition, data Collection, analysis and implementation of the solution, Design ,fabrication and testing as applicable (It is not a just company Internship Report)

5 INDUSTRY INTERNSHIP AND PROJECT MONITORING

A team of faculty members from the institute assigned will monitor closely the progress of training and project and helps to sort out any issues concerned. The institute faculty accountability includes proper orientation of student in the company, helping in finalizing project assignments, mentoring the student for overall effectiveness of internship program and a liaison between companies, student and the department.

6 OUTCOME EXPECTED AT THE END OF IIP II

After the successful completion of the IIP-2, the student should be able to

1. Understand the functioning of the company in the terms of inputs, transformation process and the outputs (products and services)
2. Develop an attitude to adjust with the company culture, work norms, code of conduct.
3. Understand and follow the safety norms, Code of conduct.
4. Demonstrate the ability to observe, analyze and document the details as per the industry practices.
5. Understand the processes, systems and procedures and to relate to the theoretical concepts that is being studied.
6. Improve the leadership abilities, communication.
7. Demonstrate project management and finance and cost management skills

7 OUTCOME EXPECTED FROM PROJECT

After the successful completion of the project, the student should be able to;

1. Identify the project/problem in the domain of program and relevant to the company.
2. Collect the information to the pertaining to the problem identified.
3. Analyze the information using the statistical tools/ techniques.
4. Suggest the feasible alternative solution and select the best solution.
5. Present the solution to the company and seek assistance in the implementation.
6. Measure the impact of the project on the performance of company/department/section.

8 INTERNSHIP MONITORING

Each student is assigned a faculty mentor by the program department who monitors the progress of both the internship and project and helps the student to sort out any issues/ problems faced by the students. The faculty is scheduled to make five visits during the internship

1	At the beginning of the program for orienting students to the company.	Prior to the program or during First week of program
2	Finalization of project proposal	During 4th week
3	Mid of the program (to review program)	Between 8th and 9th Week
4	Final progress review	During 15th week
5	At the end of the internship for evaluation	During16 ^{the} week

Note: Apart from these scheduled visits, the faculty on request of students/company will visit in case of any issue related to the internship /project.

9 WORK DIARY

Each student is provided with a diary which contains details regarding internship, do's and don'ts and evaluation scheme. Students is required to write the dairy regularly and get it signed by the industry guide periodically during the visit the faculty assigned to the student should be able to go through the dairy to access the work done and write the remarks/ instruction. At the end of the internship, the duly completed dairy to be submitted to the department.

10 EVALUATION OF INTERNSHIP: (4 CREDITS)

The assessment of the internship will be done jointly by the industry and the faculty assigned to the students. The tentative scheme of assessment will be

1.	Punctuality, behavior and following code of conduct (to be assessed by the company personal)	20%
2.	Initiative, observation and interest in learning new things (faculty in charge)	20%
3.	Familiarization with specific Department/shop/function assigned to student (to be assessed by the company personal)	20%
4.	Final evaluation based on presentation of work, internship report (jointly by the company personnel and examiner appointed by institute & faculty guide.	40%

Minimum 50% is mandatory for successful completion of internship or else the extension will be given to make the student to come up to the expectation.

11 EVALUATION OF THE PROJECT (6 CREDITS) II2804:Industrial Project

1.	Project/Problem identification and preparation of project proposal approved by both the company and faculty endorsed by the DPC	20%
2.	Mid review of the project as per schedule specified jointly by company and faculty assigned.	30%
3.	Final examination of the project along with detailed project report (industry person + Faculty guide + External examiner, either at institute/company as per the convenience)	50%

The student is required to complete both internship and project successfully to become eligible for award of the degree along with the credits for the self-study/online/certification courses.

A special certificate will be awarded to student by the university along with B Tech Degree

After successful completion of IIP II and Project in industry.

Special Note: The terms of reference are subjected modifications as per the prevailing conditions at the time and academic council decision in this respect is final and binding to allthe concerned with this track I

II 2802 : Online Course (MOOCS)

Student should register for the online course of minimum 2 weeks offered by SWAYAM, NPTEL, Courseera or any other authorized platforms. The courses which the student registersshould be advanced in the domain area and should be able to help students in the project assignment they are doing in company. The courses are to be approved by the committee appointed by the department. Student should complete the course and after the examination should produce a certificate. Unless student produces the grade certificate to the department, the course will not be complete.
Course will be graded based on certificate credentials mentioned on the certificate by the authorized agency.

Evaluation

Certification with grades	**100%**

Note: The students should preferably register for the course in consultation with coordinator,MOOCS, Sanjay Ghodawat University Kolhapur.

II 2803 : Self Study Course

Students who choose Industry Internship Program (IIP II) and Project should undergo a self- study course of one credit. The objectives of this self-study course are to give freedom to choose the course of interest area and promote lifelong learning. It also helps to develop independent learning without the instructors.

The skills and outcomes expected at the end of the course is student will be able to choose the course from variety of courses available, plan and organize the study, Collect the information from relevant sources and prepare a concise report and give presentation about what he has learnt. A guide is allotted to the student to finalize the course title and contents. The courses student opts should not have been the part of curriculum for the program of study.
The following types of courses may be selected by the student:

1. Advanced technology courses from any domain area of technology.
2. Course in the area of Music, Drama, Fine arts and Literature. Journalism.
3. Courses in the area of sports, travel and tourism
4. Courses in contemporary issues in Management, economics and Social Issues.
5. Any foreign language or Indian Language (Which you do not know).
6. Courses on nature, philosophy and Indian history.

The list is not exhaustive and you can choose the courses other than areas listed here.

Evaluation

Student is evaluated based on the report and presentation with assessment rubrics.

FEP (Report and Presentation)	100%	Minimum Passing 40%

B Tech (Common to all Programs) Semester - VIII
TRACK – II : Entrepreneurship Venture Stream (EVS)

Track	Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
							Component	Exam	WT	Pass
II	ED2801	Product /Service identification & Feasibility Study of Project	3	-	-	03	Project Report & Presentation	FET	100	Min 40
	ED2802	Techno Economic Feasibility of Identified Venture & DPR	1	-	06	06	Assessment by Professiona l/s	FEP	50	Min 40
								ESE	50	
	ED2803	Marketing for Entrepreneurship	2	-	-	02	Theory	FET	20	Min 40
								CAT	30	
								ESE	50	Min 40
	ED2804	Finance for Entrepreneurs	3	-	-	03	Theory	FET	20	Min 40
								CAT 1	15	
								CAT 2	15	
								ESE	50	Min 40
	ED2805	Training in EDP Program (Minimum 1 Week)	1	-	-	01	Certification	FET	100	Min 40
	ED2806	Mentoring & Guidance by an Entrepreneur/s	1	-	-	01	Assessment by Mentor	FEP	100	Min 40
	ED2807	Online Course in Advanced Technology (domain area)	-	-	-	04	Certifi - cation	FEP	100	Min 40
	Total		**11**	**-**	**06**	**20**	Total Hrs: **17**, Total Credits: **20**			

Note Students are required to spend entire semester VIII in preparing DPR and the DPR will be evaluated by a competent Bank authority/Chartered accountant for feasibility individually in the company where the students is doing his internship.

Course Codes:

AE – Aeronautical Engineering & Technology; II – Industrial Internship Program with Project; ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program; CP – Capstone Project; UE – University Open Elective

CURRICULUM

B.Tech Semester - VIII (All Programs)

TRACK – II : Entrepreneurship Venture Stream (EVS)

ED2801: Product/Service Identification and Feasibility

L	T	P	Credits	Evaluation Scheme			
				Component	Exam	WT %	Pass
3	-	-	3	Theory (100)	FET	20	40
					CAT-1	15	
					CAT-2	15	
					ESE	50	40

Prerequisite: General knowledge of economics & clear concept about own business model.

Course description:

To improve and update knowledge of new entrepreneurs in the area of project preparation and appraisal techniques: decision-making process in the sector of industrial. Infrastructure & sustainable opportunities that would lead to improved viability. Returns and effective investment decision. Writing a business plan which can gain interest of the fund providers like venture capitalists and other source of funding.

Course Outcomes:

After successful completion of the course students will be able to.

CO1: Prepare business Plan for selected business.

CO2: Make risk analysis & Market analysis of selected project.

CO3: Make technical appraisal of selected project.

CO4: Make financial appraisal of selected project.

Unit No.	Course Description	Hrs.
1.	**Project appraisal Introduction:** Project Development Cycle. Identifying data requirement and analyzing their suitability for preparation feasibility studies. Project formulation, screening for pre-feasibility studies. Stages of feasibility report preparation. Project analysis including market Analysis. Technical Analysis & Financial Analysis. Applying various techniques and integrating the data gathered into a full-fledged business plan.	06
2.	**Project Analysis:** Environmental Analysis. Risk Analysis, Infrastructure Development & Financing, Risk Management, Risk identification, Qualitative risk Analysis, Quantitative risk Analysis, Risk planning, Risk control, Evaluating the rewards & risk for sustainable opportunities. National cost-Benefit Analysis, Financing Sustainable opportunities.	08
3.	**Business plan:** What is business plan, Entrepreneurial opportunities and business plan. Preparing business plan, (Practical Exercises on preparation of business plan) Components of business plan. Executive summary. Other components, Project report contents.	08

4	**Commercial Appraisal:** Economic feasibility and commercial viability. Market analysis, Market research, Industry analysis, Competitors analysis, defining the target market, market segmentation, market positioning, building a marketing plan, market strategy.	06
5	**Technical Appraisal:** Operation and production plan: Type of production systems, Product design and analysis, New product development, location and layout decision, project layout, plant and technologies choices, product specification and customer needs, production planning and controls, Commercializing Technologies.	06
6	**Financial Appraisal:** Pro forma income systems, financial projections, Working capital requirement, funds flow and cash flow statements. Ratio analysis.	06

Reference Books

1 Dwivedi, A.K., Industrial project and Entrepreneurship Development,Vikas publishing house.

2 Bangs Jr., D.H., The business planning guide, Dearborn publishing Co.

3 Mullins, J. and Komisar R., Getting to plan B, Harvard business press.

4 Katz, J.A. and green, R.P., Entrepreneurial Small business, McGraw Hill.

5 O'Donnell, M., The businesses plan: Step by Step, UND Center for innovation.

6 Scarborough, N.M. and Zimmerer, T.W., Effective small business management, pearson.

7 Pckle, H.B. and Abrahamson, R.L, Small business management, Wiley.

8 Desai,V., Dynamics of Entrepreneurial Development & management, Himalaya publishing.

9 Kao,j., Creativity and Entrepreneurship, Prentice Hall.

10 Singh, Narendra, Project Management & control, Himalaya publishing.

B.Tech Semester - VIII (All Programs)

TRACK – III : Entrepreneurship Venture Stream (EVS)

ED2802: Techno Economic Feasibility of Identified Venture &Detailed Project Report (DPR)

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT %	Min Pass (%)
-	-	12	6	Assessment by Professionals/ Agencies	ISE	50	40
					ESE	50	

Prerequisite: General knowledge of economics & clear concept about own business model.

Course Description:

Student will prepare technically feasible and economically viable detailed project report including market survey.

Course Outcomes : After successful completion of this course, students will be able to,

CO1: Apply the knowledge of engineering, finance and marketing to formulate a business plan for the new venture.

CO2: Illustrate the requirements for a detailed project report.

Students will work on collection of data required for business plan. Student is required to visit related industries, government organizations, regulatory authorities, raw material vendors bankers and financing institutions related to their business idea. For this student will need to take prior permission of the IEDC/mentor. Student will work independently with the guidance of the IEDC/Mentors/experts in view of implementing his business idea.

Complete record of the student's efforts and systematic execution work will be maintained and guided by the mentor.

At the end of the semester student will submit a Techno economic detailed project report for approving and financing agencies and present the same. The report and the presentation will be evaluated by expert committee recommended by IEDC and approved by COE.

B.Tech Semester - VIII (All Programs)

TRACK – III : Entrepreneurship Venture Stream (EVS)

ED2803 : Marketing for Entrepreneurship

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			Pass %
				Component	Exam	WT %	
2	-	-	2	Theory (100)	FET	20	40
					CAT	30	
					ESE	50	40

Course Description-

To familiarize the students with the marketing function & concept of marketing mix & study the marketing mix of some start-ups. Companies operation in India. This course will give overall understanding of marketing management **which** will help them in developing then own marketing decision & in understanding the importance of market survey techniques. It will also help them in conducting suitable market survey for then own selected products.

Prerequisite: General knowledge of market, sales, distribution & advertising & clear concept about own business model.

Course Learning Outcomes: After successful completion of the course, students will be able to,

CO1: **Describe basic principles of marketing for various products.**

CO2: Illustrate types of Market survey methods.

CO3: **Perform a market survey by applying techniques learned for the selected business.**

Unit No.	Course Description	Hrs.
1.	**Introduction (Nature & Scope of Marketing):** Evolution, core-marketing concept, selling concept, marketing concept, Holistic marketing concept, portfolio approach- BCG matrix.	04
2.	**Marketing Environment:** Demographic, economic, political, legal, social, cultural, technological environment (Indian Context): environmental scanning to discover marketing opportunities, Segmentation, Targeting and Positioning difference between segmentation, targeting & positioning, customer value proposition.	04
3.	**Marketing Research:** Concept & practice, steps in Marketing Research, Assessment of demand & supply, Preparation of survey questionnaire.	04

4.	**Product Decision:** Concept of PLC, product classification, product line decision, product mix decision, new product development, branding decision, packaging & labelling, Service as a part of product. **Pricing Decisions:** Determinants of price, pricing method (non-mathematical treatment). Adapting Price (Geographical pricing, promotional pricing & differential pricing), pricing strategies for start-ups.	04
5.	**Promotion Mix:** Factors determining promotion mix, promotional tools basics of advertisement, sales promotion, public relation & publicity & Personal selling. Place (Marketing channels): Channel function, channel level, types of intermediaries (types of retailers, types of wholesalers).	04
6.	**Digital Marketing:** Digital Marketing Overview, Seven "C" of digital marketing, Digital marketing vs e-marketing, Search Engine Optimization (SEO), Social Media Optimization(SMO), Pay per click (PPC), Email Marketing.	04

Reference Books

1 For B2C= Kolter,P.,Keller, K.L., Koshy, A, and Jha, Marketing Management Person.

2 For B2B= Sarin, S.: Strategic Brand Management for B2B Markets, Sage.

3 Kotler P. & Armstrong, G., Principals of Marketing, Person.

4 Amico, Z.D., Marketing, Cengage.

5 Boone, L.E. and Kurtz, D.L., Principles of Marketing, Thomson South-Western.

6 Hoffman, K.D. & Bateson, J.E.G., Marketing of services, Cengage.

7 EDP Resource material by EDI, Ahemadabad.

B.Tech Semester - VIII (All Programs)

TRACK – III : Entrepreneurship Venture Stream (EVS)

ED2804 : Finance for Entrepreneurship

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			Pass %
				Component	Exam	WT %	
3	-	-	3	Theory (100)	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description-

This course aims to familiarize students with accounting, mechanics of preparation of financial statements, understanding corporate financial statements, their analysis and interpretation.

Students will study the financing of small and medium sized businesses from the perspective of both the entrepreneur and investors. They will learn how the financing decisions of small and medium sized private companies differ from those of public firms. They will also see how the use of real option and milestones relate to the strategy and the value on an opportunity.

Prerequisite: General knowledge of economics & clear concept about own business model.

Course Learning Outcomes:

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

CO1: Describe basic principles of financing methods.
CO2: Analyze financial statements of various businesses
CO3: Calculate working capital requirement.
CO4: Perform Breakeven analysis for a business model.
CO5: Prepare a financial plan for a selected business/venture.

Unit No.	Course Description	Hrs.
1	**Accounting Terminologies:** Meaning, nature, functions, types of accounting: basic of financial statements, generally accepted accounting concepts, principles and conventions: double entry system. Accounting records: Fundamentals of record keeping .the accounting process, transactional analysis, the Adjusting and closing process. Accounting systems, Computer-based accounting systems, Accounting cycle.	06
2	**Financial Statements:** Balance sheet: Assets, liabilities, income statement: concept of income, concept of expenses, concept of gain and losses: Components of the income statement. Other concepts of income .cash flow statements: purpose, components, and categories, Preparation of cash flow statements: concept, activities, Accounting and pricing	06

3	**Financial Statement Analysis:** Business objectives, measuring, rations: Price earnings, profit margin, investment, capital asset intensity working capital measuring, liquidity and solvency Analysis of cash flow statements break-even analysis, CVP analysis. Full Cost: Cost concepts, direct and indirect costs, product costing systems, non-manufacturing costs, cost analysis, product pricing	08
4	**The concept of Financial management:** Definition nature, objectives, functions and scope of financial management, Preparation of financial plan its objectives, essential features, consideration in formulating financial plan. Capitalization: Over, under and fair capitalization concept of risk and returns, time value of money.	08
5	**Investment Decisions: Capital budgeting techniques**. Financing Decisions: Cost of capital-meaning definition, classification and computation of specific weighted and marginal cost of capital, capital structure- definition, factors determining the financial structure, leverage Analysis _ financial operating and combined leverages. Dividend decisions: Dividend policy, Dividend theories, Factors affecting dividend decisions, Long term financing, Sources of long- term financing.	06
6	**Working capital management:** Concept of working capital Classification, importance. Factors determining adequate value of working capital. Estimation of working capital requirements. Financing of working capital-Long_ medium_ short term. Trends in Financing of working capital by banks, inventory management. Cash management and Receivable management.	06

References:

1. Maheshwari.S.N. And Maheshwari, S.K., Financial Accounting,Vikas Publishing House
2. Leach.C.J and Melicher. R.W: Entrepreneurial Finance, Thomson.
3. Ghosh.T.P, Financial Accounting for Managers, Taxmann Allied Services
4. Balawani.N., Accounting and Finance for Managers,Excel Books
5. Gupta.A.,Financial Accounting for Management.Prentice Hall
6. bhattacharyya.A.K., Financial Accounting for Business Managers.PH1 Publishing.
7. jain.S.P. And Narang. K.L., Advanced Accountancy,kalyam Publishing.
8. Stanton.J.M.,Entrepreneurial Finance-for new and Emerging Businesses. Thomson
9. Smith.J.K. Smith.R.L and Bliss. R.T., Entrepreneurial Finance. Stanford University

B.Tech Semester - VIII (All Programs)
TRACK – III : Entrepreneurship Venture Stream (EVS)
ED2805 : Training in EDP Program

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT %	Min Pass (%)
-	-	-	1	Certificate	FET	100	50

Prerequisite: General knowledge of economics & clear concept about own business model.

Course Description:

Student will attend a short-term exclusive Entrepreneurship Development Program (EDP) organized by the university or by any authorized agency approved by IEDC. The Course duration can be one to two weeks.

Course Outcomes : After successful completion of this course, students will be able to,

CO1: Apply the knowledge of engineering, finance and marketing to formulate a business plan for the new venture.

CO2: Illustrate the requirements for a detailed project report.

Students will undergo training programs organized or approved by IEDC and submit the certificate of successful completion of the program.

Programs on marketing, finance management, project report presentation by professional and government agencies. Students are required to apply this knowledge for preparing final project report.

B.Tech Semester - VIII (All Programs)
TRACK – III : Entrepreneurship Venture Stream (EVS)
ED2806 : Mentoring and Guidance by an Entrepreneur/s

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			
				Component	Exam	WT %	Min Pass (%)
-	-	-	1	Assessment by Mentor	ISE	100	50

An expert from the related domain or an entrepreneur will be assigned as a mentor to individual student to guide and support the student throughout his journey from idea to business plan.

Mentor will observe, review and keep complete record of the student's efforts and systematic execution will evaluate time to time and award a credit after successful completion of the assigned work.

ED2807 : Online Course (MOOCS)

Student should register for the online course of minimum 2 weeks offered by SWAYAM, NPTEL, Courseera or any other authorized platforms. The courses which the student registersshould be advanced in the domain area and should be able to help students in the project assignment they are doing in company. The courses are to be approved by the committee appointed by the department. Student should complete the course and after the examination should produce a certificate. Unless student produces the grade certificate to the department, the course will not be complete.
Course will be graded based on certificate credentials mentioned on the certificate by the authorized agency.

Evaluation

Certification with grades	**100%**

Note: The students should preferably register for the course in consultation with coordinator,MOOCS, Sanjay Ghodawat University Kolhapur.

Semester – VIII

B Tech (Common to all Programs) Semester - VIII

TRACK – III : Undergraduate Research Opportunity Program (UROP)

Track	Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
							Component	Exam	WT	Pass
IV	RE2801	Research Methodology	3	1	-	04	Theory	FET	20	Min 40
								CAT 1	15	
								CAT 2	15	
								ESE	50	Min 40
	RE2802	Research Project	-	-	12	06	Project	ISE	50	Min 40
								ESE	50	
	RE2803	Research Elective	3	-	-	03	Theory	FET	20	Min 40
								CAT 1	15	
								CAT 2	15	
								ESE	50	Min 40
	RE2804	Research Laboratory (As per Elective)	-	-	2	01	Practical	FEP	50	Min 40
								ESE	50	
	RE2805	Research Outcomes (Patents, Publications, Presentations)	-	-	-	02	Outcomes	ISE	50	Min 40
								ESE	50	
	RE2806	Online Course in Advanced Technology (domain area)	-	-	-	04	Certifi - cation	FEP	100	Min 40
		Total	**06**	**01**	**14**	**20**	**Total Hrs: 21, Total Credits: 20**			

Note

Students are required to spend minimum 12 hours on research project under the instructions from supervisor as per the time table.

Course Codes :

AET – Aeronautical Engineering & Technology; II – Industrial Internship Program with Project;

ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program;

CP – Capstone Project; UE – University Open Elective

B.Tech Semester - VIII (All Programs)
Track -III : Undergraduate Research Opportunity

RE2801 : Research Methodology

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			Pass %
				Component	Exam	WT %	
3	1	-	4	Theory (100)	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description

This course is designed help students develop the research skills required to competently undertake and complete research projects. It will provide students with the training required to develop the skills to review and critically analyze literature on topics related to their research projects, justify the rationale for research, develop effective research designs for their projects, understand the role of theories in research, and learn to write research proposals. Students will acquire skills in both qualitative and quantitative research techniques and learn to report research findings (empirical work) with implications and draw conclusions.

Prerequisites Basic knowledge of statistics.

Course Outcomes

After completion of this course, students will be able to,

1. Select the literature in the chosen area, analyze and interpret research evidence published on a topic to establish a suitable research problem / issue or opportunity to explore further;
2. Design the research study using a suitable paradigm, associated methodologies and methods of data collection and analysis.
3. Write a research proposal (research blueprint) describing the topic.
4. Demonstrate the ability to use the statistical software to process the data to get meaningful conclusion

Unit No.	Content	Hrs.
1	Overview of research Definition of research and characteristics of research; Types of research; Research Process, Preparing a research design, Problem Identification Problem definition, Models used in research.	6
2	Literature survey Importance of literature review, types of literature review, selection of the review topic, searching for the literature, analyzing and synthesizing the literature, writing the review report	6

3	Data Analysis using Statistical tools, Hypothesis Formulation and testing, Analysis of variance, regression analysis, Response surface methods for process optimization, SPSS/MINITAB software	8
4	Creativity in Research, report preparation with Latex and white smoke, Group discussion on Ethics in Research, Plagiarism check	6
5	Design of experiments Strategy of experimentation, Statistical design of experiments, replication randomization and blocking. Guidelines for designing experiments, Factorial designs. Factorial designs. The two-factor factorial design, Statistical analysis of factorial design, Taguchi design	8
6	Intellectual Property Rights Introduction to IPR; Overview & importance; IPR in India and IPR abroad; Patents; What can be patented, process their definition; granting; infringement, searching & filing: Utility Models an introduction: Copyrights; their definition; granting infringement; searching & filing. Trademarks, role in business, importance, protection, registration;	6

Tutorials

Tutorials are to be designed to work on the statistical packages and also design and analysis of experiments. Students should learn to make reports in Latex.

Reference Books

1. Kothari C. K (2004)2/e, Research Methodology - Methods and Techniques (New Age International, New Delhi).
2. Krishnaswamy, K.N., Shivkumar, AppaIyer and Mathiranjan M. (2006) Management Research Methodology: Integration of Principles, Methods and techniques (Pearson Education, New Delhi)
3. Douglas C. Montgomery, Design and analysis of experiments, John Wiley and Sons, New York.
4. TapanBagchi, Taguchi Methods Explained: Practical steps to robust design, Prentice Hall.
5. AjitParulekar and Sarita D'Souza, Indian patents Law- Legal & Business Implications: Macmillan India Ltd., 2006
6. P.Narayanan ; Law of copy right and Industrial Designs; Eastern law House,Delhi,2010

B.Tech Semester - VIII (All Programs)
Track - IV : Undergraduate Research Opportunity

Phase II RE2802 : Research Project

Teaching Scheme				Evaluation Scheme		
L	T	P	Credits	Scheme	Theory (%)	
					WT %	Min % for passing
-	-	12	06	FET	50	40
				ESE	50	40

Course Description

Research Project course aims to develop research skills in UG students. The acquired skills shall be useful to pursue higher level research at M. Tech/M. S or Ph. D level. This course may also help students to get admission in reputed foreign universities for M. S. program as research project completed at UG is one of the selection criteria.

Course Objectives:

After completion of this course, the student will be able to

1 Identify and define research problem.
2 Understand and critically evaluate theories, practices, and / or research on a chosen topic by conducting a.
3 thorough literature review and submitting a written integrative, critical summary of the current literature.
4 Approach a research problem and develop a methodology.
5 Perform searches for relevant information.
6 Develop and implement solution to the research problem defined.
7 Develop the ability to explain the conceptual viability of the project and describe the major components involved.
8 Develop the ability to explain how the project will impact the relevant body of work.
9 Develop advanced discipline-relevant skills and competencies.
10 Properly keep an accurate record of research performed.
11 Write a research report and technical paper.

Guidelines

1 Students opting URE module must finalize research advisor, area of research and research project in Vil semester of UG program.
2 Credit Hours: Students are expected to devote 12 hours a week in research project. Students should carefully.
3 discuss with their research advisor the time expectations for completion of the requirements research project.

Assessment:

FET Component:

Research advisor is encouraged to strongly consider the following grading rubric:

Degree to which students meet expectations. Expectations are to be established by the research advisor and student a minimum of one semester in advance of the student's enrollment in the research course. The following is a minimum set of expectations for every student enrolled in this course for credit: i) perform a background literature search and review, i) develop a project plan, i) perform experimental work or applied experimental work, iv) write and present a research report. All four of these minimum expectations as well as additional expectations (e.g. attendance at departmental and/or college, research seminars, participation in research group meeting, etc) are to be clearly established and articulated to the student by the research advisor prior to commencement of the research project.

Quality of the final report and oral presentation. The research advisor will provide clear expectations of the desired format, content, and deadlines of the final report. The research advisors and DPC will jointly grade the final report.

Attendance.

In order to provide the students a measure of performance, the research advisor is expected to complete a mid-term evaluation of the student, accompanied by recommendations for Improvement for the remainder of the term. The mid-term evaluation of the student should be accompanied by a one-on-one meeting between the research advisor and the student. Student is required to report his/her research advisor every week and brief about the work done for that week. Maintain separate diary for that purpose.

Absences and Make-up Work: Requirements for attendance is as per University norms.

ESE

1. End semester evaluation on all aspects (Scheduled before the end of term dates as notified by DPC)
2. A project report on the activity in prescribed format is to be submitted for evaluation.
3. A technical paper based on research work must be submitted on or before ESE to suitable journal.

B. Tech Semester - VIII (All Programs)
Track - IV : Undergraduate Research Opportunity

RE2803 : Research Elective

Lect.	Tut.	Pract.	Credits	Evaluation Scheme			Pass %
				Component	Exam	WT %	
3	-	-	3	Theory (100)	FET	20	40
					CAT I	15	
					CAT II	15	
					ESE	50	40

Course Description

Students enrolled in Undergraduate Research opportunity Program Phase l must select a course at UG or PG level which is relevant to his/her research project. The selected course preferably should have lab course associated with it. Examination scheme of the course and evaluation will be done as per the academic regulations of the institute. In case if relevant course is not offered in the department then research advisor is required to design the course content.

Course Objective

After completion of Research Elective 1 student should be able to develop fundamental knowledge, required to pursue selected research project and understand the concepts principles and application.

Guidelines / Criteria for selecting Research Elective 1;

1 Student must finalize research advisor in the VII semester of UG Program

2 Research project area must be identified in the VII semester

3 Based on research project area identified, student must decide Research Elective course in consultation with research advisor

4 Research elective I course selected by students must be related to area of research project. Student can opt for M. Tech course if offered

5 If course offered at PG level has less no of credits, then credits will be matched to 4

B.Tech Semester - VIII (All Programs)
Track - IV : Undergraduate Research Opportunity

Phase II RE2804 : Research Elective Laboratory

Teaching Scheme				Evaluation Scheme		
L	T	P	Credits	Scheme	Theory (%)	
					WT %	Min % for passing
-	-	2	01	FEP	50	40
				ESE	50	40

Course Description

Research Laboratory is related to Research Elective I. Examination scheme of the course and evaluation will be done as per rules of University. Student must choose research Elective - 1 course which has laboratory course associated with it. In case if relevant lab course is not available to the Research Elective I, then research advisor shall assign practical work in line with research area. Type of this work may be testing, analysis, measurement, Programming etc,

Course Outcomes:

After completion of Research Laboratory (Elective 1) student should be able to Gain the practical knowledge required to pursue selected research project.

Assessment:

FEP: Evaluation is to be done based on regular work done and performance in the laboratory/field work ESE: ESE must be conducted jointly by research advisor and one DPC member based on Lab report on the activity is to be prepared and submitted for evaluation

B.Tech Semester - VIII (All Programs)
Track - IV : Undergraduate Research Opportunity Phase II
RE2805 : Research Outcomes (Patents and Publications)

The outcome of the Undergraduate Research Opportunity Phase Il is measured with the help of

1. Patents provisionally registered based on outcome of research.
2. Publication of research in refereed Journal
3. . Presenting the paper in reputed conferences at national or International level
4. Writing a working paper based on research undertaken

Evaluation

Grading Rubrics with measurement criteria are designed for grading purpose. Student will earn credits at minimum level i.e. 50% is declared as completed the UROP Track Requirement.

RE2806 : Online Course (MOOCS)

Student should register for the online course of minimum 2 weeks offered by SWAYAM, NPTEL, Courseera or any other authorized platforms. The courses which the student registersshould be advanced in the domain area and should be able to help students in the project assignment they are doing in company. The courses are to be approved by the committee appointed by the department. Student should complete the course and after the examination should produce a certificate. Unless student produces the grade certificate to the department, the course will not be complete.
Course will be graded based on certificate credentials mentioned on the certificate by the authorized agency.

Evaluation

Certification with grades	**100%**

Note: The students should preferably register for the course in consultation with coordinator,MOOCS, Sanjay Ghodawat University Kolhapur.

Semester – VIII
B Tech (Common to all Programs) Semester - VIII
TRACK – IV : Capstone Project with Program Verticals & University Open Electives

Track	Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
							Component	Exam	WT	Pass
IV	AER285X	Programme Elective – V (as per Vertical)	03	01	-	04	Theory	FET	20	Min 40
								CAT I	15	
								CAT II	15	
								ESE	50	Min 40
	UE285X	University Open Elective I	03	-	-	03	Theory	FET	20	Min 40
								CAT I	15	
								CAT II	15	
								ESE	50	Min 40
	UE287X	University Open Elective II	02	-	-	02	Theory	FET	20	Min 40
								CAT	30	
								ESE	50	Min 40
	CP2801	Capstone Project	-	-	12	06	Project	FEP	50	Min 40
								POE	50	
	CP2802	Career Planning & Corporate Readiness Program	-	-	02	01	Student Portfolio Grading	FET	100	Min 40
	CP2803	Online Course in Advanced Technology(domain area)	-	-	-	04	Certification	FET	100	Min 40
	Total		**08**	**01**	**14**	**20**	Total Hrs: **23**, Total Credits: **20**			

Note
Students are required to spend minimum 12 hours on project under the instructions from supervisor as per the time table.
Course Codes :
AET – Aeronautical Engineering & Technology; II – Industrial Internship Program with Project; ED – Entrepreneurship Venture Scheme; RE – Undergraduate Research Opportunity Program; CP – Capstone Project; UE – University Open Elective

AER-285X Programme Elective – V

Semester – VIII		
Programme Verticals	**Course Code** AER285X	**Programme Elective – V Courses** (select as per respective Vertical)
Design & Analysis	AER2851	Satellites and space system design
Maintenance	AER2851	Airlines and Airport Management

UE285X : University Open Elective – I

	Course Code UE285X	**University Open Elective – I (03 Credit Course)**
University Open Elective – I	UE2851	Engineering Management
	UE2852	Marketing for Engineers
	UE2853	Finance for Engineers
	UE2854	AI and ML Fundamentals
	UE2855	Project Management
	UE2856	Electrical Vehicles
	UE2857	Optimization Techniques

UE287X : University Open Elective – II

	Course Code UE287X	**University Open Elective – II (02 Credit Course)**
University Open Elective – II	UE2871	Design Thinking
	UE2872	Creativity and Innovation
	UE2873	Total Quality Management
	UE2874	Industry 4.0
	UE2875	Costing & cost Control
	UE2876	Autotronics
	UE2877	Sensor Technology
	UE2878	Nano Technology
	UE2879	Leadership
	UE2880	Entrepreneurship Development
	UE2881	Human values & professional ethics

Course Code	AER2851				Title	SATELLITES AND SPACE SYSTEM DESIGN	
Teaching Scheme	L	T	P	C	Evaluation Scheme	FET	ESE
	3	1	0	4		50	50
						Minimum pass marks- 20	Minimum pass marks- 20

Course Outcomes: -The students will be able to

CO1 **Explain**[2] the concepts of Space system design

CO2 **Analyze**[4] the Space craft environment and its effects on design at various conditions

CO3 **Examine**[3] the various Space craft systems

CO4 **Investigate**[3] the Product assurance of satellite systems and component

CO5 **Investigate**[3] the design aspects of Satellite engineering and applications

Unit No	Content	Hours
1	**SPACE SYSTEM DESIGN** Payloads and missions, system view of spacecraft propulsion system, launch vehicles, spacecraft mechanisms.	6
2	**SPCAECRAFT ENVIRONMENT AND ITS EFFECTS ON DESIGN** Preoperational spacecraft environment, operationalspacecraft environments, Environmental effects on design, the sun, the earth, and spacecraft effects, spacecraft structure, thermal control.	6
3	**SPACECRAFT SYSTEMS** Attitude control, Electrical power systems,Telecommunications, telemetry command, data handling and process.	7
4	**PRODUCT ASSURANCE** Failures, Reliability, material and process, safety, configuration control, build and verification, system engineering, case studies	7
5	**SATELLITE ENGINEERING AND APPLICATIONS** Satellite design philoshopy, satellite system design, COTS components in the space environment. Micro satellites, mini satellites and nano satellites, in orbit operation, satellite application for meteorology, navigation, communication, geo observation, and space environment study.	7
6	**THERMAL CONTROL OF SPACECRAFT** Thermal environment, Thermal balance, Thermal analysis, Thermal design, Thermal technology, Thermal design verification, Satellite thermal design.	7

Text Books: P. Fortescue J. Stark, and G.Swinerd, "Spcaecraft systems engineering", John Wiley and sons, 2002

Reference : 1.P. Fortescue, J. stark, and G. Swinerd, " Spacecraft Systems Engineering" AIAA Series, 2005
2.W.J. Larson and J. R. Wertz., "Space Mission Analysis and design", AIAA Series, 1998

Course Code	AER2852				Title	AIRLINES AND AIRPORT MANAGEMENT	
Teaching Scheme	L	T	P	C	Evaluation Scheme	FET	ESE
	3	1	-	4		50	50
						Minimum pass marks- 20	Minimum pass marks- 20

Course Outcomes: -The students will be able to

CO1 **Explain**[2] the aviation challenges and its environment

CO2 **Perform**[4]airport planning and organizational structure design.

CO3 **Investigate**[3] the trends and scenario in aviation

CO4 **Examine**[3]the economics in aviation

CO5 **Analyze**[4] the maintenance management in hanger

Unit No	Content	Hours
1	**INTRODUCTION** Evolution of Management-History of Aviation-Organization, Global, Social, and Ethical Environment-History of Indian Airline Industry - Major Players in Airline Industry - SWOT analysis in Airline Industry- MarketpotentialonIndianAirlineIndustry- CurrentChallenges in Airline Industry- Completion in Airline Industry	6
2	**AIRPORT MANAGEMENT** Airport Planning-Terminal Planning, design and operation-Airport Operation Airport Functions- Organization Structure of Airline sectors- Airport Authoritie Global and Indian Scenario of Airport Management	6
3	**AIRTRANSPORT SERVICES** International Trends-Emerging Indian Scenario-Private Participation: Internation Developments- Private Participation in Indian Airports-Environmental regulation Regulatory Issues-Meteorological Services in Aviation-Airport fees, rates a charges	7

4	**INSTITUITIONAL FRAME WORK:** Safety Regulation - Economic Regulation - Management of Bilaterals - Aviation Security	7
5	**CONTROLLING** Traffic Control-Airspace and Navigational aids-Controlling Process-Coordinatio Response to emergencies and airport Securities-Case Studies in Airline Industry	7
6	**MAINTENANCE MANAGAMENT** Need for maintenance-Objective-Concepts-Types of maintenance-Organization- Trade force mix, type and location-Maintenance costs-Benefits-Computer Aided Maintenance management-Total productive maintenance	7

TEXT BOOKS

1. Graham. A.“Managing Airports: An International Perspective”-Butterworth-Heinemann, Oxford2001.
2. Wells. A.“Airport Planning and Management”,4thEditionMcGraw-Hill,London 2000

REFERENCES

1. Doganis.R.“The Airport Business”Routledge,London1992
2. Alexender T. Wells , SethYoung, “Principles of Airport Management” , McGraw Hill2003
3. PS Senguttavan “Fundementals of Air Transport Management”,ExcelBooks2007
4. Richard de Neufille, “Airport Systems: Planning, Design and Management”, McGraw-Hill London2007.

UE-402.X : University Open Elective – I

	Course Code	University Open Elective – I (03 Credit Course)
	UE285X	
University Open Elective – I	UE2851	Engineering Management
	UE2852	Marketing for Engineers
	UE2853	Finance for Engineers
	UE2854	AI and ML Fundamentals
	UE2855	Project Management
	UE2856	Electrical Vehicles
	UE2857	Optimization Techniques

B Tech (Common to all Programs) Semester – VIII
Course work with Capstone Project
University Open Elective I

UE2851 Engineering Management

Teaching Scheme				Evaluation Scheme			
L	**T**	**P**	**Credits**	**Component**	**Exam**	**WT %**	**Pass %**
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description:

Engineering management gives overview of business environment the factors affecting the business environment. The effect of global environment on different business activities. It also focuses Business development framework and world class business practices. In its second part it highlights business functions and its integration to make the business profitable. In addition, it gives the guidelines about engineering economics and the different accounting principle used in industry to evaluate business performance

Course Learning Outcomes:

After successful completion of this course, students will be able to

1. Identify the factors that influence business environment.
2. Discus different business growth strategies
3. Justify importance of business excellence models on world class business development
4. Appraise the scope and objectives of functional areas of business and their integration
5. Apply engineering economics for evaluation of business

Course Content

1. Overview of Business Environment (6)

Definition of Engineering Management, Engineering Managers

Business Environment- Nature, scope and objectives of business, National & Global Perspective, Environmental Analysis and Forecasting. Factors Affecting the Business Economic Environment, Political and government Environment, natural and Technological Environment, Business and Society, Industrial Policies and Regulations, Economic planning and Development,

Global Environment- GATT/WTO and Global Liberalization, international Investments, Multinational Corporations, Globalization

2. Business Development Framework (6)

Vision, Mission, Objectives, Goals, Strategic Planning. SWOT Analysis, Policy formation, Procedure, Steps in Development Framework, Roles of Engineering Managers, Decision Making. Organizing. Leading. Engineer as a leader, Engineer as a manager, leadership skills for 21 century, Controlling setting performance standard, benchmarking

3. World Class Business Development (6)

Understanding Business Excellence, Core Values and Concepts, Business Excellence Introduction to Baldrige Model and EFQM Model, Detailed Study and Case Studies on EXIM Bank relationship between Business Excellence Models and Core Values and Business Excellence Assessment, Criterion, Competitiveness) Growth Collaboration, Acquisition, Merger, Joint Ventures

4. Integration of Business Functions (6)

Product Production and Sales Planning. Materials Management Purchasing. Marketing Management, Finance Resource Management, Supply Chain Management, Human Resource Management, Customer Relationship Management, Manufacturing Planning, Inter-relationship of all Business Functions (ERP Modules) Case Studies

5. Engineering Economics (6)

Engineering Economics - Introduction, Cost Analysis, Time value of money and compound interest Cash flows, Annuity, Depreciation, Methods of Computing Depreciation(Sinking Fund Method, Declining Balance Method, Sum of Years Digit Method). Investment decision for capital assets, Evaluation Criterion for Investment Decisions-Payback Period, Average Rate of Return, Net Present Benefit Cost Internal Rate of Return(IRR)

6. Financial Accounting, Analysis & Management (6)

Introduction, Accounting Principles, Types of Accounts, Key Financial Statements, Fundamentals of Financial Analysis, Balance Sheet, Elements of Market Economy, Capital Sources of finance, Financial Institutions, Financial statements, Balance sheet and P&L accounts

Reference Books

1. Dr M. T. Telsang, Industrial Engineering and Production Management, S. Chand & Co.
2. C. M. Chang, Engineering Management, Pearson Education Inc, 2012.
3. J.P. Bose, S. Talukdar, Business Management -, New Central agencies (P) Ltd.
4. Francis Cherunilam, Business Environment, Himalaya Publishing House, 1997.
5. K. Shridhara Bhat, World Class Manufacturing. Himalaya Publishing House, 1" edition, 2013.
6. James A. F. Stoner, R. Edward Freeman, Management, Prentice Hall of India New Delhi, 6 edition, 2009.
7. 4 Gene Burton and Manab Thakur, Management, Today Principles and Practice, Tata McGraw Hill Publishing Company, New Delhi, 1995.
8. Koontz & O'Donnell, Essentials of Management, McGraw-Hill, 10 edition, 2015.
9. Philip Kotler, Marketing Management, Prentice Hall of India New Delhi, 155 edition, 2016.Program Elective-IV MEE2110: Logistics and Supply Chain Management

B Tech (Common to all Programs) Semester - VIII

Course work with Capstone Project

University Open Elective I

UE 2852 Marketing for Engineers

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass %
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description

To familiarize the students with the marketing function & concept of marketing mix & study the marketing mix of some start-ups, companies operating in India. This course will give overall understanding of marketing management which will help them in developing their own marketing decisions & in understanding the importance of market survey techniques. It will also help them in conducting suitable market survey for their own selected products

Course Learning Outcomes:

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

1. Apply basic principles of marketing for various products,
2. Prepare market survey.
3. Select proper product mix & pricing decision.
4. Select proper digital marketing technique for selected business

Prerequisite:

General knowledge of market, sales, distribution & advertising & clear concept about own business model.

Course Content

1 **Introduction to marketing** 6

Evolution; core marketing concept, selling concept, marketing concept, Holistic marketing concept, portfolio approach-BCG matrix; Marketing Environment: Demographic, economic, political, legal, socio cultural, technological environment (Indian context); environmental scanning to discover marketing opportunities

2 **Market segmentation & marketing Research** 6

Targeting and Positioning. difference between segmentation, targeting and positioning, customer value proposition. Marketing Research- Concept & practice,

	Steps in Marketing Research, Assessment of demand & supply, Preparation of survey questionnaire	
3	**Product Decisions** Concept of PLC, product classification, product line decision, product mix decision, new product development, branding decisions, packaging & labeling, Service as a part of Product	6
4	**Pricing Decisions** Determinants of price, pricing methods (non-mathematical treatment). Adapting Price (Geographical pricing, promotional pricing and differential pricing), pricing strategies for startups	6
5	**Promotion & Place Decisions** Factors determining promotion mix, promotional tools basics of advertisement, sales promotion, public relations & publicity and personal selling. Distribution Channel functions, channel levels, types of intermediaries (types of retailers, types of wholesalers	6
6	**Digital Marketing** Digital Marketing Overview, Seven "C" of Digital Marketing. Digital Marketing vs e-marketing, Search Engine Optimization (SEO), Social Media Optimization (SMO). Pay per Click (PPC), Email Marketing	6

Reference Books

1. For B2C , Kotler, P., Keller, KL, Koshy, A and Jha, M.: Marketing Management, Pearson
2. For B2B , Sarin, S.: Strategic Brand Management for B2B Markets, Sage References:
3. Kotler P. & Armstrong, G., Principles of Marketing. Pearson
4. Amico, Z.D., Marketing, Cengage
5. Boone, L.E and Kurtz, D.L Principles of Marketing. Thomson South-Western
6. Hoffman, K.D. and Bateson, J.E.G., Marketing of Services, Cengage
7. EDP Resourse material by EDI. Ahmedabad

B Tech (Common to all Programs)

Semester – VIII Course work with Capstone Project

University Open Elective I

UE2853 Finance for Engineers

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass %
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course description -

To familiarize students with accounting, mechanics of preparation of financial statements, understanding corporate financial statements, their analysis and interpretation.

The objectives of the course are to build the skills, frameworks and knowledge in finance. Students will study the financing of small and medium sized businesses from the perspective of both the entrepreneur and investors. They will learn how the financing decisions of small and medium sized private companies differ from those of public firms. They will also see how the use of real options and milestones relate to the strategy and the value on an opportunity

Course Learning Outcomes:

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

1. Understand basic Financial Terminologies.
2. Prepare & analyze financial statements.
3. Prepare financial Plan for venture.
4. Make & analyze investment decisions.
5. Calculate working capital requirement

Prerequisite: General knowledge of economics & clear concept about own business model.

Course Content

1 **Accounting Terminologies** 6

Meaning, nature, function, types of accounting, basics of financial statements, generally accepted accounting concepts, principles and conventions: double entry system. Accounting Records, Fundamentals of record keeping, the accounting process, transactional analysis, the Adjusting and Closing process. Accounting systems. Computer based accounting systems. Accounting cycle.

2 **Financial Statements** 6

Balance sheet: assets, liabilities. Income statement: concept of income, concept of expenses,

concept of gain and losses Components of the income statement. Other concepts of income Cash Now statements: purpose, components, and categories. Preparation of cash flow statements concept activities Accounting and pricing

3 **Financial Statement Analysis** 6

Business objectives, measures Ratios:Price Earnings, Profit margin, investment, capital asset intensity, working capital measures, liquidity and solvency. Analysis of cash flow statements Break-even analysis, CVP analysis, Total Cost: cost concepts, direct and indirect costs, product costing systems, non-manufacturing costs, cost analysis, product pricing

4 **The concept of Financial Management** 6

Definition, nature, objectives, functions and scope of financial management, Preparation of financial plan its objectives, essential features, consideration in formulating financial plan, Capitalization over, under and fair capitalization. Concept of risk and returns, Time value of money.

5 **Investment Decisions** 6

Capital budgeting technique.

Financing Decision Cost of Capital - Meaning, definition classification and computation of specific weight and marginal cost of capital. Capital structure - Definition, factors determining the financial structure, Leverage Analysis - Financial operating and combined leverage.

Dividend decision: Dividend policy, Dividend Theories. Factors affecting dividend decisions. Long term financing. Sources of long term financing.

6 **Working Capital Management** 6

Concept of working capital - Classification, importance, factors determining adequate value of working capital. Estimation of working capital requirements. Financing of working capital - Long- medium-short term. Trends in Financing of working capital by banks, Inventory management. Cash Management and Receivable Management

Reference Books

1. Maheshwari, S.N. and Maheshwari, S.K, Financial Accounting, Vikas Publishing House
2. Leach, CJ. andMelicher, R. W: Entrepreneurial Finance. Thomson.
3. Ghosh, T.P.. Financial Accounting for Managers, Taxmann Allied Services
4. Balwani, N., Accounting and Finance for Managers, Excel Books
5. Gupta, A., Financial Accounting for Management, Prentice Hall
6. 4 Bhattacharyya, A.K., Financial Accounting for Business Managers, PHI Publishing
7. Jain, S.P. and Narang. K.L, Advanced Accountancy, Kalyani Publishers,
8. Stanton, J.M., Entrepreneurial Finance - For New and Emerging Businesses, Thomson
9. Smith, J.L. Smith, R.L. and Bliss, R.T. Entrepreneurial Finance, Stanford University

B. Tech. (All Programs) Semester VIII

Course work with Capstone Project

University Open Elective I

UE 2854 Artificial Intelligence & Machine Learning Fundamentals

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass%
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description:

This course gives a basic introduction to machine learning (ML) and artificial intelligence (AI). Through an algorithmic approach, the students are given a practical understanding of the methods being taught, in particular through making their own implementations of several of the methods. The course covers supervised classification based on e.g., artificial neural networks (deep learning), as well as unsupervised learning (clustering), regression, optimization (evolutionary algorithms and other search methods). Course gives overview of neural network and deep learning techniques. Number of case studies are expected to be covered to have better understanding of applications of AI and ML.

Course Objectives

The Open elective aims to equip students as follows:

1. Understand different ways of modeling data and real-world scenarios computationally;
2. Be able to model a real-world problem into the appropriate form (such as optimization, classification, regression, clustering, or association);
3. Be able to apply the appropriate artificial intelligence or machine learning techniques to solve the problem;
4. Understand common pitfalls and limitations of existing techniques

Course Learning Outcomes:

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

1. Discuss[2] the pros and cons for choosing ML & AI methods for different applications
2. Develop[3] problem solving methodology for selected ML & AI methods
3. Use[3] popular AI & ML tools like Python, Tensorflow and Keras to develop applications

Prerequisite:

Probability Distributions, Python Basics

Course Content

UNIT 1: Machine Learning: Introduction 07

Overview of Machine learning concepts – Types of Machine learning, Supervised learning, Unsupervised learning, Reinforced learning, Data preprocessing techniques

UNIT 2: Machine Learning: Prediction Techniques 07

Linear Regression, Naive Bayes classifier, K-Nearest Neighbors, Decision trees, Random forest, Clustering k-means

UNIT 3: Artificial Intelligence: Introduction 06

Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, agents, environments, Problem solving as state space search, production system, control strategies and problem characteristics; Search techniques: Breadth First and Depth-first, Hill-climbing, Heuristics and Meta- heuristics, Best-First Search

UNIT 4: Artificial Intelligence: Genetic Algorithms and Fuzzy Logic 06

Genetic algorithms - Encoding, Crossover, Selection, Mutation, etc., Solving single-objective optimization problems using GAs, Fuzzy logic – introduction, operations, Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzifications&Defuzzifications, Fuzzy Controller

UNIT 5: Artificial Neural Networks and Model Evaluation 07

Introduction to ANN, Perceptron, Deep Learning – Introduction, convolution neural networks, Deep learning framework – Tensorflow, Model evaluation techniques

UNIT 6: Applications of AI and ML 07

Use of AI in banking and finance, Fraud detection, AI in manufacturing industry: Deep learning for smart manufacturing, Machine learning for quality control in manufacturing, IoT: Prevention first Predictive analytics, Machine learning in government administration: Type of government problems appropriate for AI applications, AI for Answering questions, Routing requests, Chat bots for communication between citizen and government, Introduction to Smart grid, Machine learning applications in smart grid.

Reference Books

1. www.coursera.com - online course on Machine Learning by Andre NG
2. Artificial Intelligence: A Modern Approach, 3rd edition,Stuart J. Russell and Peter Norvig, Publisher: Pearson
3. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press http://www.deeplearningbook.org
4. AurélienGéron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media

B Tech (Common to all Programs) Semester – VIII
Course work with Capston Project
University Open Elective I
UE 2855 Project Management

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass%
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description

The course covers key components of project management including project integration, project scope management, project time and cost management, quality management, human resource considerations, communications, risk management, and procurement management.

Student Learning Outcomes: Upon satisfactory completion of the course, the learner should be able to

1. Recognize issues in a realistic project scenario.
2. Employ work breakdown structures (WBS) in a project application.
3. Demonstrate the use of appropriate network scheduling techniques.
4. Produce a project proposal
5. Discuss the implementation of a proposed plan

Course Contents

1. Basics of Project Management (6)

Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles

2. **Project Identification, Selection and planning (6)**

Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point, Project Planning, Need of Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)

3. PERT and CPM (6)

Introduction, Development of Project Network, Time Estimation, Determination of the Critical Path, PERT Model, Measures of variability, CPM Model, Network Cost

System, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, Cost Forecasts

Project Risk Management **(6)**

Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks, Project Management Information System (PMIS), Planning of PMIS, Design of PMIS

4. **Project Performance Measurement and Evaluation** **(8)**

Introduction, Purchase Cycle, Contract Management, Procurement Process, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects

5. Project Execution and Control **(8)**

Introduction, Project Execution, Project Control Process, Purpose of Project Execution and Control, Project Close-out, Steps for Closing the Project, Project Termination, Project Follow- up.

Reference Books

1. Cleland, David I. and William R. King, Systems Analysis and Project Management, McGraw- Hill Book Company, New York,
2. Moder, Joseph J. and Cecil R. Phillips, Project Management With CPM and PERT, Van Nostrand-Reinhold Company, New York, (2nd. ed.)
3. Martino, R. L., Project Management and Control in three volumes: “Finding the Critical Path,” “Applied Operational Planning,” and “Allocating and Scheduling Resources,” American Management Association, New York
4. Archibald, Russell D. and Richard L. Villoria, Network Based Management Systems (PERT/CPM), Wiley, New York,
5. Wiest, J. D. and F. K. Levy, A Management Guide to PERT/ CPM, Prentice Hall, Inc., New York,
6. Woodgate, H. S., Planning by Network, Project Planning and Control Using Techniques, Brandon Systems Press, New York,
7. Graham, Robert J., and Randall L. Englund. Creating an Environment for Successful Projects. San Francisco: Jossey-Bass
8. Lewis, James. Team-Based Project Management. Beard Books
9. Lewis, James. Mastering Project Management. New York: McGraw-Hill
10. Lewis, James. The Project Manager’s Desk Reference, Third edition. New York: McGraw-Hill

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective I
UE2856 Electric Vehicles

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass%**
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description

This course shall equip the students to avail emerging opportunities in the area of HEV & EV technology in automotive industry. This course goes deeper into the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used, energy storage devices, etc.

Pre-requisites :FYT107 Elements of Electrical Engineering

Course Objectives

- To introduce the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
- To study various energy sources and motor drives for Electric & Hybrid vehicle

Course Outcomes: Students will be able to

CO 1 Identify need of Electric & Hybrid vehicle

CO 2 Design Electric vehicle for given requirement

CO.3 Design Hybrid Electric vehicle for given requirement

CO 4 Elaborate different Energy sources for Electric & Hybrid vehicle

CO 5 Choose suitable motor drive for Electric & Hybrid vehicle

Course Contents

1. Hybrid Vehicles Technology **07**

Hybrid electric drive-train, Classification, operating modes, Various architectures of EVs, Parallel hybrid drive-train with torque coupling & speed coupling

2. Design of HEVs **07**

Control strategies, Design principle for series hybrid electri drive train, Sizing of elements of series & parallel hybrid electric drive trains

3. Energy Sources and Propulsion **06**

Batteries for EVs & HEVs, Battery Management, Ultra Capacitors, Mechanical flywheel, Electronic devices for EVs & HEVs, Fuel cell concept & characteristics, Fuel cell technology for EVs & HEVs, Hydrogen storage & reforming.

4. **Electric Vehicle Motors** **06**

Types of Motors, DC Motors, Induction Motor, BLDC Motor, Permanent Magnet Motors – Principle, Construction, Selection & sizing of motors,RPM and Torque calculation of motor, Motor Controller, Motor ratings

Reference Books

Sr.No.	Name of Book	Author(s)	Publisher	Edition, Year ofPublication, ISBN
01	Modern Electric, Hybrid Electric & Fuel cell Vehicles-Fundamentals, Theory & Design	MehrdadEhsani, Yimin Gao, Ali Emadi	CRC press, New York,	2010
02	Electric & Hybrid Vehicles-Design Fundamentals	Iqbal Hussain	CRC press, New York	2003
03	Electric & Hybrid Vehicles	Robin Hardy, Iqbal Hussain	CRC press	ISBN 0-8493-1466-6
04	Electric Vehicle Technology Explained	James Larminie, John Lowry,	John Wiley & Sons Ltd. England	2003
05	Electric Vehicle Battery Systems	Sandeep Dhameja	Newness, Massachusetts	2002
06	The electric car: Development & Future of Battery, Hybrid & Fuel-Cell Cars,	Dr Mike Westbrook, M H Westbrook	British library cataloguing in publication Data,UK,	ISBN0852960131

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective I
UE 2853 Optimization Techniques

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass%
3	-	-	3	Theory (100)	FET	20	40
					CAT 1	15	
					CAT 2	15	
					ESE	50	40

Course Description:
This course deals with Fundamental optimization methods, operations research, heuristic optimization techniques, evolutionary or population-based hyperi metaheuristics, parallel optimization techniques. Application of these methods to complex science engineering domains

Course Learning Outcomes
After successful completion of the course, students will be able to

1. Optimize performance of given problem under a set of resource constraints
2. Identify suitable mathematical programming techniques to optimize performance of given problem
3. Apply suitable mathematical programming techniques to optimize performance of given problem under a set of resource constraints where either objective function or set of constraints may be linear or non-linear.
4. Apply artificial intelligence (AI) techniques (meta-heuristics) to improve the efficiency of manufacturing systems.

Prerequisite:
Students with knowledge of basic mathematics and statistics can opt this course.

Course Content

1 Linear Optimization **6**

Simplex Method Revised Simplex Method. Sensitivity Analysis. Duality, and Queuing Theory

2 Nonlinear Optimization **7**

Introduction, Lagrange Method, Kuhn-Tucker conditions, Quadratic programming, separable programming, chance constrained programming or stochastic programming

3 Introduction to Integer programming and decision theory **6**

Introduction to Integer Programming; Cutting Plane Method; Branch and Bound method. Decision theory, Decision under certainty, Decision under risk, Decision under uncertainty, Decision Tree

4 Introduction to Dynamic Programming **7**

Concept of Sub optimization and the principle of optimality: Linear and Continuous Dynamic Programming with Applications in capital budgeting, reliability improvement, cargo loading and minimizing total tardiness in single machine scheduling problem etc.

5 Advanced Optimization Methods-I **7**

Multi-criteria Decision Making, AHP, Meta-heuristic algorithms: Genetic algorithms

6 Advanced Optimization Methods-II **7**

Neural networks, Particle Swarm Theory & Ant colony optimization.

Reference Books

1. Rao S.S. Engineering Optimization Theory and Practice, New Age Int. Pub., 3rd Ed., 1996.
2. Haug, E. J. and Arora, J.S., Applied optimal design Wiley Inter Science Publication, NY, 1979
3. Douglas J. Wilde, Globally optimal design John Wiley & Sons, New York, 1978
4. Johnson Ray C., Optimum design of mechanical elements, John Wiley & Sons, 1981.
5. S.D. Sharma, "Operations Research", Khanna Publications, 2001.
6. David Goldberg, Genetic Algorithms, pearson publications, 2006.
7. Gen, M. and R. Cheng, Genetic Algorithms and Engineering Optimization, Wiley Interscience,1999

UE287X : University Open Elective – II

	Course Code	University Open Elective – II (02 Credit Course)
	UE287X	
University Open Elective – II	UE2871	Design Thinking
	UE2872	Creativity and Innovation
	UE2873	Total Quality Management
	UE2874	Industry 4.0
	UE2875	Costing & cost Control
	UE2876	Autotronics
	UE2877	Sensor Technology
	UE2878	Nano Technology
	UE2879	Leadership
	UE2880	Entrepreneurship Development
	UE2881	Human values & professional ethics

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective II
UE2871 Design Thinking

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass%**
2	-	-	2	Theory (50)	FET	20	40
					CAT 2	30	
					ESE	50	40

Course Description

It includes identification of opportunity for development of new product based on requirement of customer. Starting from the generation of concepts and its evaluation, preparation of prototype, Product design and testing all aspects of product design are covered. Emphasis is given of aesthetic and ergonomic consideration in design

Pre-requisites

Engineering Graphics Lab

Course Outcomes

Students will be able to

1. **List** challenges/ problems of customer and specify customer needs
2. **Compare** different ways for Concept selection & testing
3. **Apply** different tools and techniques of product design
4. **Review** aesthetic and ergonomic consideration for design of Product

Course Contents

1	**Discovery- Opportunity identification for new products** Product life cycle, need for new products, strategic planning and new product opportunity, sources of new product ideas,. Steps in NPD Product idea generation, creativity and innovation. **Identifying Customer Needs**, Voice of the customer, gathering customer needs, organizing and prioritizing needs, Product mission statement, Benchmarking and establishing product specifications	**6**

2	**Product Concept Generation, Selection and Testing** Concept generation process and methods, Concept selection mechanism and techniques, Concept Testing-Purpose, process and methods. Product Architecture-types, establishing architecture, Modular design.Prototyping	6
3	**Product Design Process and Tools and Techniques** Product Design process steps, Stage gate model, Product teardown and experimentation, Concurrent engineering, Quality function Deployment (QFD), Value engineering	6
4	**Design Considerations** Product dimensions, Design for manufacturing and assembly (DFMA), Design for Sustainability, Aesthetic aspects- Symmetry, balance, contrast, continuity, rhythm, Form and styling, Color in product design, Ergonomic considerations, Anthropometry	6

Reference Books

1. DrMartandTelsang, Industrial Engineering and Production Management, S. Chand & Co. NewDelhi,2006
2. Ulrich, Eppinger, Anita Goel, Product Design and Development, McGraw Hill Publishing
3. Otto & Wood, Product Design, Pearson Education
4. Seider, Lewin,Widagdo, Product and Process Design Principles: Synthesis, Analysis and Evaluation, Wiley Publication
5. Don Norman, The Design of Everyday Things, Basic Books
6. Michael G. Luchs, Scott Swan, Design Thinking: New Product Development Essentials from the PDMA, Wiley Publication
7. Richard Morris, The Fundamentals of Product Design, Bloomsbury Publishing
8. Cooper, Robert G, Winning at New Products, Basic Books

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective II
UE2872 Total Quality Management

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass%
2	-	-	2	Theory (50)	FET	20	40
					CAT 2	30	
					ESE	50	40

Course Description

It gives the students an overview of quality and TQM and explaining the salient contributions of Quality Gurus like Deming, Juran and Crosby. General barriers in implementing TQM.

Course Outcomes

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

1. State importance of assuring quality in the service or manufacturing sector and explain Quality assurance system
2. Identify and solve the quality related problems in manufacturing or service sector at various stages by using various TQM tools and techniques,
3. Calculate reliability of system
4. Interpret various quality attributes and discuss the various quality approaches. 6. Comment on quality using Taguchi Philosophy.

Course Contents

1	**INTRODUCTION** Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.	**6**
2	**TQM PRINCIPLES** Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplierselection, Supplier Rating.	**6**
3	**TQM TOOLS AND TECHNIQUES I** The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector	**6**

	including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types., Control Charts - Process Capability- Concepts of Six Sigma	
4	**QUALITY SYSTEMS** Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures .Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sector	**6**

Reference Books

1. Dale H.Besterfield et al, Total Quality Management, Third edition, Pearson Education
1. (First Indian Reprints 2004).
2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing
3. House, First Edition 2002.
4. Implementing Juran's Road Map for Quality Leadership: Benchmarks and ResultsBy Al Endres, Wiley, 2000
5. Understanding, Managing and Implementing Quality: Frameworks, Techniques and CasesByJiju Antony; David Preece, Routledge, 2002
6. Organizing for High Performance: Employee Involvement, TQM, Reengineering, and Knowledge Management in the Fortune 1000: The CEO ReportBy Edward E. Lawler; Susan Albers Mohrman; George BensonJossey-Bass, 2001
7. Total Quality Control Feigenban - McGraw Hill Book Company, New York 2
8. " Fundamentals of Quality Control and Improvement", AmitavaMitra, Pearson Education.
   Six Sigma Black Belt Handbook – Thomas McCarty, Michael Bramer& Praveen Gupta, Tata McGraw Hill
9. Six Sigma Performance Hardware by Praveen Gupta, Tata McGraw Hill Pub.

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective II
UE2873 Industry 4.0

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass%
2	-	-	2	Theory (50)	FET	20	40
					CAT 2	30	
					ESE	50	40

Course Description

This course provides a comprehensive overview of the role of digitization, big data, cyber-physical manufacturing systems, robots, human robot collaboration, artificial intelligence and all relevant Industry 4.0 technologies. In particular, we focus on applications and case studies in order to make the audience understand the new technologies and demonstrate the benefits of Industry 4.0. We also include contributions from researchers and industry to the opportunities and challenges of Industry 4.0. One of the greatest challenges in upgrading to Industry 4.0 is education, without young academics the transition to Industry 4.0 won't be sustainable.

Course Outcomes

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

1. State basics, drivers and enablers of Industry 4.0 2
2. Explain modern methods and techniques of planning, dimensioning, design and optimization of Industry 4.0 production systems
3. Identify value chains in Industry 4.0
4. Develop skills in dealing with methods and techniques for various production system

Course Content

1. **Introduction to Industry 4.0 & Basic principles and technologies of a Smart Factory (6)** Definition of Industry 4., Developments in India, Germany. USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and today's Factory, Difference between conventional automation and Industry 4.0, Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Big Data, Cyber-Physical Systems, Value chains in manufacturing companies, Customization of products , Digital Twins, Cloud Computing / Cloud Manufacturing, Security issues within Industry 4.0 networks

2. **Cyber-Physical Systems (CPS) and Cyber-Physical Production Systems (CPPS) (6)** Definitions, demarcation to embedded systems, ubiquitous computing, etc., Core elements of Cyber-Physical Systems and Cyber-Physical Production Systems, Control theory and real-time requirements, Self-organization principles, Communication in cyber-physical systems, Design Methods for Cyber-physical Systems (Modelling, Programming, Model-Integrated Development), Applications for cyber-physical systems

3. **Assistance systems for production** (6)

The connected worker within the Industry 4.0 scenario, Diversity-driven workplaces (barrier free workplaces, accessibility in production), Human-and task-centered assistance systems, Technical tools, Mobile information technologies, Shop floor information systems, Production line support systems (pick by light, assembly display systems, assembly control by vision), Manipulator systems and intelligent chairs, Human work support by using exoskeletons, Applications assistance systems in production

4. **Human-Robot Collaboration, Safety and Security** (6)

Human-Robot Collaboration in Industry, Collaborative Robots, examples Yumi, IIWA, UR, Panda, Types of Human-Robot Collaboration, Applications with Collaborative Robots, Safety with Industry 4.0, Safety for connected Machines and Systems, Safety in Human Robot cooperation, Security & Security Risks with Industry 4.0, Security and privacy risks in AI, Approach to Cyber-Physical Security in Industry 4.0

1. "Industry 4.0: The Industrial Internet of Things" by Alasdair Gilchrist
2. "Dynamic Factory Automation: Creating Flexible Systems for Competitive Manufacturing (IbmMcgraw-Hill Series)" by Alastair Ross
3. Quick Start Guide to Industry 4.0: One-stop reference guide for Industry 4.0 by Mr Kiran Kumar Pabbathi
4. Industry 4.0 for SMEs: Challenges, Opportunities and RequirementsDominik T. Matt, VladimírModrák, Helmut Zsifkovits, Springer Nature, 2020

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective II
UE2873 Costing & Cost Control

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass%
2	-	-	2	Theory (50)	FET	20	40
					CAT 2	30	
					ESE	50	40

Course Description

To provide an in depth study of the Cost Accounting Principles and Techniques for identification, analysis and classification of cost components to facilitate managerial decision making. Learning aims **Course Learning Outcomes**:

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

1. Understand and explain the conceptual framework of Cost Accounting
2. Explain the basic concepts and processes in determination of cost of products and services
3. Understand the Cost Accounting Standards (CAS)
4. Apply marginal costing in decision making
5. Apply the concept of Standard Costing for variance analysis

Course Content

1. **Introduction to Cost Accounting(6)**
   Definition, Scope, objectives and significance of cost accounting, its relationship with financial accounting and management accounting, Cost Objects, Cost centers and Cost Units, Elements of cost, Classification of costs
2. **Cost Ascertainment - Elements of Cost(6)**
   Material Costs - Inventory Accounting & Valuation, Physical Verification, treatment of losses Scrap, spoilage, defectives and wastage.
   Labour Costs - Principles and methods of remuneration and incentive schemes, Employee cost reporting and measurement of efficiency.
   Direct Expenses & Overheads- Collection, classification and apportionment and allocation of overheads, Absorption and treatment of over or under absorption of overheads, Reporting of overhead costs
3. **Methods of Costing** (6)
   Job Costing, Batch Costing, Contract Costing, Process Costing – Normal and abnormal losses, equivalent production, Joint and By Products, Operating Costing or Service Costing
4. **Cost Accounting Techniques** (6)
   Marginal Costing, Standard Costing & Variance Budget and Budgetary Control (simple problems only) (i) Concepts, Types of Budgets (ii) Budgetary Control Vs Standard Costing (iii) Advantages and

limitations (iv) Preparation of Budgets (simple problems only), Cost control, Cost Reduction, Introduction to activity based costing.

References

1. Principles & Practice of Cost Accounting – N. K. Prasad (Book Syndicate Pvt. Ltd.)
2. Costing Simplified: Wheldom Series – Brown &Owier (ELBS)
3. Cost Accounting: B. Jawaharlal (TMH)
4. Cost Accounting: R.R. Gupta.
5. Cost Accounting, 13/e - B. K. Bhar, (Academic Publishers, Kolkata)
6. Cost Accounting: Jain, Narang (Kalyani Publishers)
7. A Text Book of Estimating and Costing Mechanical – J.S. Charaya& G. S. Narang, (Satya Prakashan)

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective II
UE2873 Autotronics

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass%
2	-	-	2	Theory (50)	FET	20	40
					CAT 2	30	
					ESE	50	40

Course Description

This course introduces the students about fundamentals of electronic engine & chassis management system & their components, various types of sensors, Methods & controls of electronic fuel injection & ignition system, various automotive Electrical, Comfort & Safety systems and the system approach to control & instrumentation & Electromagnetic Interference Suppression.

Course Outcomes

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

1. Identify different areas of Autotronics, Sensors & Actuators
2. Differentiate various electronic fuel injection & control methods
3. Explain Automotive Electrical, Comfort & Safety system
4. Explain system approach control & instrumentation

1. Fundamentals of Automotive Electronics, Sensors & Actuators (6)

Microprocessor and micro Computer applications in automobiles, components for engine management System, electronic management of chassis system, vehicle motion control, and electronic panel meters. Basic sensor arrangement; Types of Sensors such as oxygen sensors, Crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow Sensors, throttle position sensors, solenoids, stepper motors, relays.

2. Electronic Fuel Injection & Ignition System & Digital Engine Control (6)

Introduction; feedback carburetor system; throttle body injection and multi point fuel injection System; injection system controls; advantage of electronic ignition systems; types of solid state system and their principle of operation; electronic spark timing. Open loop and closed loop control system; engine cooling and warm-up control; acceleration, deceleration and idle speed control; integrated engine control system; exhaust emission control engineering; on-board diagnostics

3. Automotive Electrical, Comfort & Safety (6)

Batteries, starter motor & drive mechanism; D.C. generator and alternator; regulation for charging; lighting design; dashboard instruments; horn, warning system and safety devices. Seats, mirrors and sun

roofs; central locking and electronic Windows; cruise control; in-car multimedia; security; airbag and belt tensioners; other safety and comfort systems; new developments.

4. The system approach to control & instrumentation & Electromagnetic Interference Suppression (6)

Fundamentals, electronic components and circuits, digital electronics, microcomputer instrumentation and control, sensors and actuators, digital engine control systems, vehicle motion control, automotive instrumentation and telematics, new developments.

Electromagnetic compatibility Electronic dash board instruments - Onboard diagnosis system, Security and warning system.

Reference Books

1. Automotive Electronics Handbook, Ronald K. Jurgen, McGraw Hill Publishing Co.,

2. Automotive Electricity and Electronics, Al Santini, Delmar Publishers,

3. Automobile Electrical & Electronic Equipments, Young, Griffitns, Butterworth Publication, London.

4. Understanding Automotive Electronics, Bechfold, SAE 1998

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective II
UE2873 Sensor Technology

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass%
2	-	-	2	Theory (50)	FET	20	40
					CAT 2	30	
					ESE	50	40

Course Description

This course introduce the various types of sensors, technology, and their applications The lectures cover the principles and operation of a variety of sensor architectures and modalities, including sensors used for mechanical quantities such as pressure, strain, displacement, proximity, and thermal, electric and magnetic field, optical, acoustic. Simple sensor signal processing algorithms and wired are also discussed. Additionally, the lecture also introduces the methods of interfacing sensors to electronic systems.

Course Outcomes

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

1. Explain the principles of operation of the main types of sensors
2. Utilize the merits of various types of sensors for a wide range of applications
3. Analyze the specifications of various types of sensors
4. Select appropriate sensors for a given application and design simple electronic sensor interface systems

Course Contents

1. Measurements, instrumentation and sensors (6)

Review of Static characteristics of Instrument systems, dynamic characteristics of Instrument systems, Sensors, Signals and Systems; Sensor Classification; Units of Measurements; Sensor Characteristics Physical Principles of Sensing, Dynamic Models of Sensor Elements

2. Thermal Sensors (6)

Definition of Temperature: Thermal Energy, absolute and relative Temperature, · Metal resistance versus temperature devices: Resistance versus Temperature Approximations, · Resistance-Temperature Detectors (RTD)Thermistors: Semiconductor Resistance versus Temperature, Thermistor Characteristics, · THERMOCOUPLES: Thermoelectric Effects, Thermocouple Characteristics, Thermocouple Sensors · Other thermal sensor: Bimetal Strips, Gas Thermometers, VaporPressure Thermometers, Liquid-Expansion Thermometers · Solid-State Temperature Sensors · Design considerations

3. Mechanical Sensors (6)

Displacement, Location, or Position Sensors: Resistive-, Capacitive-, and Inductive Sensors · Variable-Reluctance Sensors, LVDT · Level Sensors · Metal Strain Gauges and Semiconductor Strain Gauges (SGs) · Load CellsMotion sensors: Types of Motion, Accelerometer Principles, Types of Accelerometers · Pressure sensors: Pressure Principles, · Pressure Sensors (p > 1 atmosphere), · Pressure Sensors (p < 1 atmosphere) · Flow sensors: Solid-Flow – and Liquid Flow Measurement · Pipe Flow Principles, Restriction Flow Sensors, Obstruction Flow Sensor · Magnetic Flow Meter

4. Optical Sensors (6)

Fundamentals of EM radiation · Nature of EM Radiation, Characteristics of Light, · Photometry · Photodetectors: Characteristics, Photoconductive Detectors, Photovoltaic Detectors, ·Photodiode Detectors ·Photoemissive Detectors · PYROMETRY: Thermal Radiation, Broadband Pyrometers, Narrowband Pyrometers

Reference books:

1. "Process Control Instrumentation Technology, 6th Edition", Author: Curtis D. Johnson, Publisher:
2. Prentice Hall International Edition, ISBN: 0-13-978-200-3
3. "Measurement, Instrumentation, and Sensors Handbook", John G. Webster., Publisher: CRC – Press – Taylor and Francis Group,
4. "Introduction to Instrumentation and Measurement, 3rd Edition", Authors: Robert B. orthrop, ublisher: CRC – Press – Taylor and Francis Group, ISBN: 13: 978-1-4665-9679
5. Handbook of Modern Sensors:Physical, Designs, and Applications, J. Fraden, AIP Press, pringer Sensors and Transducers, D. Patranabis, PHI Publication, New Delhi
6. Mechatronics- Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited)

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective II
UE2877 Nanotechnology

Teaching Scheme				Evaluation Scheme			
Lect.	**Tut.**	**Pract.**	**Credits**	**Component**	**Exam**	**WT %**	**Pass%**
2	-	-	2	Theory (50)	FET	20	40
					CAT 2	30	
					ESE	50	40

Course Description

Nanotechnology is the emerging technology and has touched almost all engineering areas like spintronics, sensors and actuators, small materials for building constructions, enhancing the capacity of memory devices, fabrication of nanodevices for medical fields etc. So this course is designed to provide the basic knowledge of nanoscience to technology students so that they can find proper application of nanoscience in their technical filed.

Course Outcomes

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

1. **Explain** basic science of nanomaterials.
2. **Identify** different methods of synthesis of nanomaterials.
3. **Compare** properties of materials in bulk form with the nanomaterials.
4. **Discuss**the role of nanomaterials in various applications.

Units	Description	Hrs
1	**Introduction to Nanoscience** Introduction, why nanoscience: particle size versus surface area, scientific revolutions, basic science behind nanotechnology, nanometer, materials at nanoscale, surface chemistry of materials: surface energy, concept of density of states, quantum confinement in nanomaterials.	06
2	**Synthesis of Nanomaterials** Introduction to approaches of synthesizing nanomaterials. **Top-down approach:** Examples of methods like Ball milling method, laser ablation method **Bottom-up approach:** Examples of methods like spray pyrolysis, chemical vapor deposition Introduction to lithography.	06

3	**Properties of Nanomaterials** **Physical Properties:** Melting point,Elasticity, Young's modulus of nanomaterials with examples, effect of size on physical properties of nanomaterial **Electronic and optical properties:** band structure of nanomaterials, effect of size on band structure, effect of band structure on optical properties. **Magnetic Properties:** GMR effect, particle size and coercivityrelation, superparamagnetism of nnaomaterials	06
4	**Rising Nanomaterials and applications of nanomaterials** Introduction, carbon: graphite, diamond, fullerenes, graphene, band structure of graphene in brief (no derivation) **Carbon Nanotubes** Structure and types of carbon nanotubes, properties of CNTs. **Applications of Nanomaterials** Nanoelectronics, MEMS/NEMS, nanosensors, nanocatalysts, food and agricultural industry, cosmetics and consumer goods, structure and engineering, automobile, water treatment and environment, medical field, textile, paint, energy, defense and space applications, structural applications, Applications of CNTs and graphene	06

Reference Books

1. M. A. Shah and K. A. Shah, Nanotechnology, The Science of Small, Wiley Publishers, Edition 1, 2013.
2. M. S. Rao and Sgubra Singh, Nanoscience and Nanotechnology: Fundamentals to Frontiers, Wiley Publishers, Edition 1, 2013.
3. Introduction to Nanoscience and Nanotechnology, K. K. Chattopadhyay, A.N Banerjee, PHI Publications
4. Edward L. Wolf, Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Wiley-VCH (2006).

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective II
UE2878 Leadership

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass%
2	-	-	2	Theory (50)	FET	20	40
					CAT 2	30	
					ESE	50	40

Course Description

Engineers wanting to advance their careers must be able to lead teams effectively. This Specialization is designed for professional engineers who are interested in advancing into leadership and management roles.

Course Outcomes

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

1. Develop awareness of their own strengths and weaknesses as a leader, and learn to leverage their strengths and overcome their weaknesses when they are placed in charge of a team or project.
2. Learn to manage relationships with team members and colleagues through proven coaching, mentoring, and conflict resolution techniques.
3. Establish goals and planning methods designed for success.
4. Learn learn how to set up a creative environment for their team, and motivate each team member to reach his or her potential.

Course Contents

1. Introduction to Leadership: (6)

Significance and components of leadership, Personal characteristics that support effective leadership. Types of leadership Styles, Trait approach in theories of leadership. Leader and values. The significance of self-knowledge for the role of leader (identity and integrity of leader). Emotions and self-management, emotional intelligence and its significance in the role of leader.

2. Leadership of workgroups and teams: (6)

Group structure and dynamics. Formation of teams and team work. Group problem-solving. Team excellence. Participative leadership. Leadership development. Skills for leaders and performance management: Goal setting, support for employee development and communication of feedback; delegation; resolving conflict situations and negotiation, Coaching and mentoring.

3. Creative leadership: (6)

Influence on the creative potential of work groups and teams; formation of innovative

climate in organizations, Developing Leader-Follower trusting relationships.

4. Leading change in organizations:

Trust, Integrity and Ethics, Transactional and transformational leadership.
Models of well balanced

and authentic leadership, Organizational Culture (What makes great places to work), Effective Workplace Communication, Personal Code of Ethics, Valuing Diversity.

Reference Books

1. Art and Science of Leadership. AfsanehNahavandi. Prentice-Hall, 7th Edition. ISBN-10:0133546764 ISBN-13:9780133546767
2. Leadership for Engineers: The Magic of Mindset (Basic Engineering Series and Tools). Ronald Bennett, Elaine Millam. McGraw-Hill Education – Europe. ISBN10 007338593X, ISBN139780073385938
3. Dubran A,J. Principles of leadership [Mason] Southwestern/Cengage Learning 2013
4. Achua C.F – Lussier R N. Effective leadership [Mason] Southwestern/Cengage Learning 2010
5. Kouzes J.M., Posner B. Z. Learning Leadership. The Five Fundamentals of Becoming an Exemplary Leader. Wiley. 2016
6. Yuki G. Leadership in Organizations. Eighth Edition. Pearson Education. 2013. ISBN 978-0132771863

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective II
UE2879 Entrepreneurship Development

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass%
2	-	-	2	Theory (50)	FET	20	40
					CAT 2	30	
					ESE	50	40

Course Description

To familiarize students with fundamentals of Entrepreneurship and to encourage them to become successful entrepreneurs.

Course Outcomes:

The students shall demonstrate the knowledge of Entrepreneurship and shall be motivated to become successful entrepreneurs.

1. Entrepreneurship & SSI (6)

Definition of Entrepreneur and entrepreneurship, entrepreneurial process, Entrepreneurship and economic development, job creation, Indianscene

Entrepreneurial Motivation: Self-disclosure, personality effectiveness, risk aking, entrepreneurial competencies,casestudies.

Small Scale Units: Concept and definition, role of S.S.I. in Indian economy, government policies and facilities.

Planning Small Scale Business: Business opportunity identification, idea generation, ideas from marketplace, market assessment, demand estimation.

Small Business Management: Techniques of marketing, materials, production, manpower and financial management, crisis management, working capital management, fixed capital assessment, cash flow analysis, ROI, techniques of decision making.

2. Managerial Economics & Business Accounting (6)

Introduction to Economics, Kinds of Economic Decisions, Significance and applicability of Managerial Economics in decision making, Role and responsibilities of Managerial

Economics, Economic principles relevant to managerial decision making, Opportunity cost, Production possibility curve, Concept of increments and Margin, Discounting principle

Business Accounting: Study of Balance sheets, Profit and Loss statements. Need, format of Trading and Profit and Loss A/c., Items to be recorded on the Debit and Credit Side of Trading and Profit and Loss A/c, Preparation of Trading and Profit and Loss A/c. Need, format of Balance Sheet, identification of Accounts to be written on liabilities and Assets

side, Preparation of Balance sheet. (Analytical Problems)

3. Government Support Organizations (6)

The detailed study of the government support system for the entrepreneurship development

a) Central Government
b) Stategovernment
c) Financial supportorganizations
d) Government schemesandprocedures

4. Business plan preparation & Statutory Requirements (6)

Meaning of business plan, project parameters, information sources of economical and technical knowhow, Preparation of project report

Factories Act 1948, Industrial disputes Act 1947, Indian Contract Act, Indian sales and Goods Act, Indian Partnership Act, Central Excise, Sales tax, Income Tax Act, Value Added Tax(VAT). Business ethics, export environment, procedure and documentation, venture capital financing, intellectual property act,patents

References

1. Developing New Entrepreneurs - Entrepreneurship Development Institute of India, Ahmedabad.
2. Handbook of NewEntrepreneurs
3. Management of Small Scale Industry - Vasant Desai (HimalayaPublication)
4. Entrepreneurship Playing to Win- Gordon Betty (Taraporwala&Co.)

B Tech (Common to all Programs) Semester - VIII
Course work with Capstone Project
University Open Elective II
UE2880 Human Values and Professional Ethics

Teaching Scheme				Evaluation Scheme			
Lect.	Tut.	Pract.	Credits	Component	Exam	WT %	Pass%
2	-	-	2	Theory (50)	FET	20	40
					CAT 2	30	
					ESE	50	40

Course Description

The objective of the course is an exploration of human values which go into making a good human being, a good human society and a good life. The context is the work life and the personal life of modern Indian professionals. The movement to identify and promote the values shared by societies around the world is relatively new. It is only in recent years as globalization extended its reach to even remote corners of the earth that he needs to refocus and build upon what we as a human society have in common, has become apparent. Increased contact between peoples and nations enhances awareness of our kinship and the shared code of ethics and conduct that underlies all civilization. It's the Human values that we must now promote to create a common vision and means for moving forward toward a more peaceful and sustain able world.

The course also aims to have students appreciate the vastness of the Universe and the wonder of its parts, and the philosophical significance of this for improving the quality of human life through value clarification.

Course Outcomes:

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

1. Understand the role of cognitive and moral values in world views, by discussing and writing about the ethical implications of modern scientific and technologicalresults
2. Recognize the difference between matters of fact and matters of value, while understanding the important ways in which facts influence value assessments and how value judgments shape our vision of "the facts"
3. Understand ethical methodologies and competency in ethical deliberation on rationally

   applying these methodologies to contemporary ethical questions related to scientific progress and technologicalpower
4. Understand why ethics plays an important role in science and technology

Course Content

1. **Human Values** (6)

The value-crisis in the contemporary Indian Society-The Indian system of values-Values in the Indian constitution-Aesthetic values: perception and enjoyment of beauty-Relative and absolute values-Morals- Values and Ethics – Integrity-Service – Work Ethic –Service Learning – Civic Virtue – Respect for Others –Respect for the Environment-Quest for Living Peacefully and happily– Attitude of Nonviolence-Innate dignity for human life – Bring out the best in oneself - caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality

2. **Engineering Ethics** (6)

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - theories about right action- Self-interest - customs and religion - uses of ethical theories.

3. **Engineering as Social Experimentation** (6)

Engineering as experimentation - engineers as responsible experimenters - Research Ethics - codes of ethics - a balanced outlook on law - the challenger case study, Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - The Government Regulator’s Approach to Risk- the three mile island, Chernobyl and Bhopal case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime

4. **Responsibilities, Rights and Global Issues** (6)

Multinational corporations -Business Ethics -Environmental ethics –Role in Technological Development- computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -Honesty-moral leadership-sample codes of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE), India,etc.

Reference Books

1. "Professional Ethics and Human Values", M.P. Raghavan,Scitech Publications (India) Pvt Ltd.
2. "Human Values and Professional Ethics", Jayashri and Suresh B S ,S Chand.
3. "Ethics in Engineering", Mike Martin and Roland Schinzinger, , Tata McGraw-Hill, New York,(1996).
4. "Engineering Ethics(Including Human Values)",Govindarajan M, Natarajan S,Senthil Kumar V. S, Prentice Hall of India, NewDelhi.
5. "ATextbookonProfessionalEthicsandHumanValues",Naagarazan,R.S.,NewAge Publishers.
6. "Professional Ethics and Human Values",AAlavudeen,RKalil Rahman MJayakumaran ,Laxmi Publisher .
7. "Understanding Human Values :Individual and Societal",MiltonRokeach ,Free Press Publication .
8. "Human Values" A N Tripathy, New Age International.
9. "A Foundation Course in Value Education",R R Gaur,RSangal,(2009).
10. "Science and humanism", P L Dhar and R R Gaur, Common wealth Publishers.
    "Wisdom for The New Millennium",H.H .Sri Sri Ravishankarji, founder ,Art of Living, Vyakti Vikas Kendra, Bangalore.
11. "The Monk Who Sold his Ferrari",Robin Sharma, Jaico Publishing House.
12. "Mega Living",Robin Sharma, Jaico Publishing House. sach