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 orientedthinking 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.

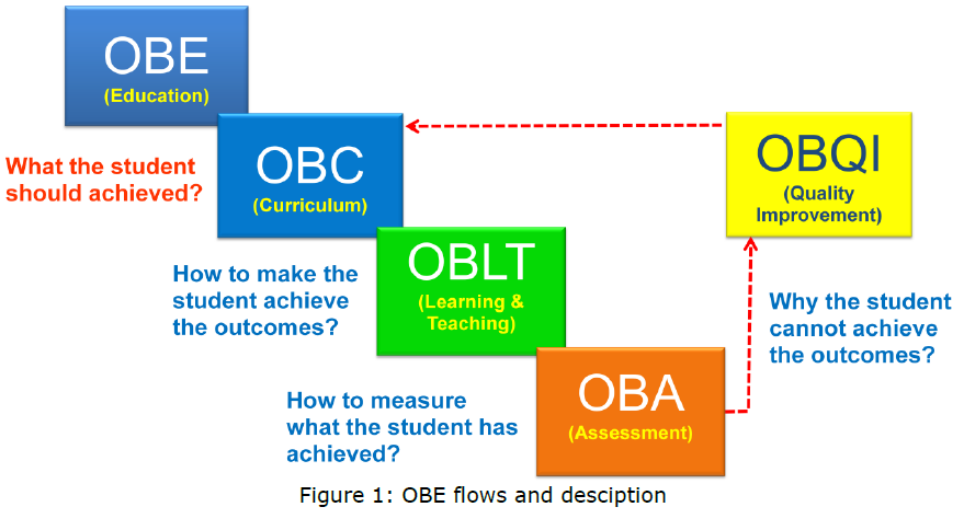
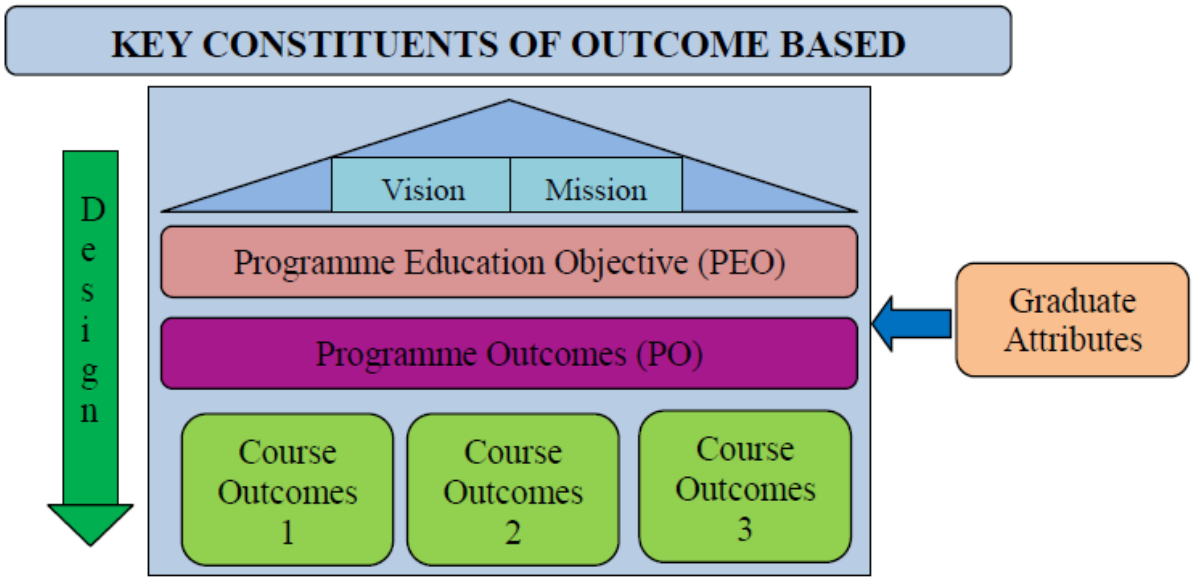


Figure 1: OBE flows and desciption

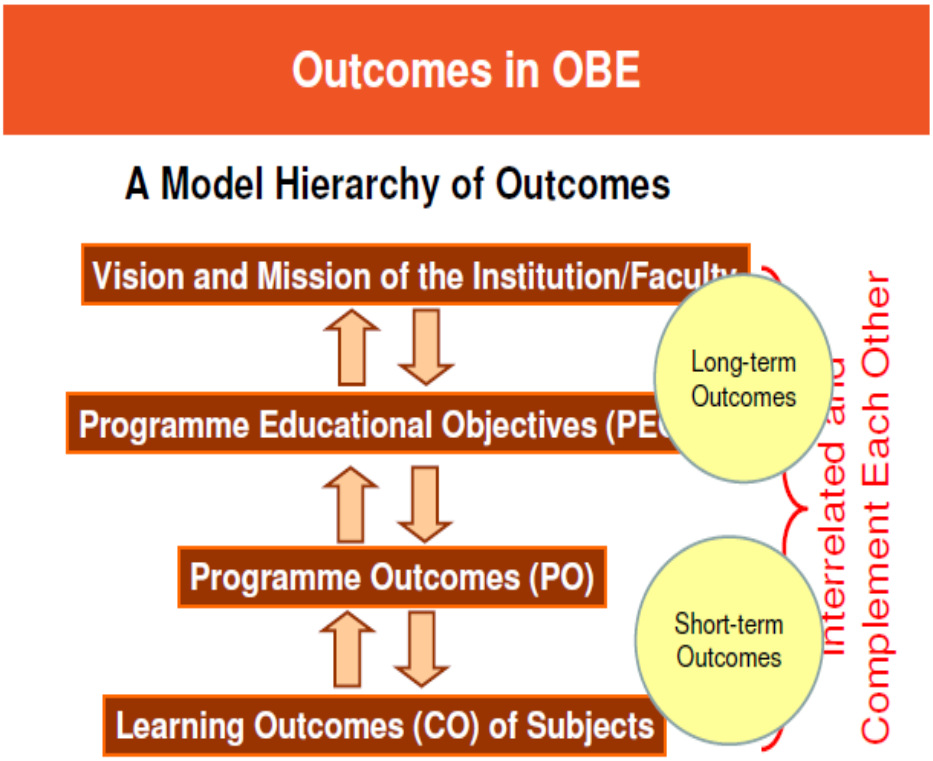


The OBE model measures the progress of the graduate in three parameters, which are

- 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

1.0 Preamble

The Sanjay Ghodawat University (SGU) stands as a beacon of light to guide the younger generation of the day on the right path to fulfillment in career and life. 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 will develop 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 here under are subjected 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 at 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.

2.0 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 20 weeks per semester including instructions, examination and evaluation. Total instructional days are 90 per semester.
5. **Course:** It is a Subject that is offered 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. For example B Tech in Mechanical Engineering, M Tech in Civil Engineering, Bachelor of Business Administration. Bachelor of Science etc.
7. **Department:** Department is a unit of the school which offers one or more programs.
8. **Contact Hours:** Time of students in class/laboratory with instructor. Usually in the range of 20-30 Hrs./Week. For the purpose of uniformity one contact hour is measured as 60 minutes
9. **Academic Council (AC):** Means apex academic body governing the academic programs responsible for framing policy , rules and regulations.
10. Board of Examination (BOE): Central body responsible for framing policy ,rules and regulations for Examination.
11. Board of Studies (BOS):Departmental academic body to govern the academics of programs(BOS)offered by department.

3.0 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.

3.1 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.

3.2 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

3.3 Audit Course:

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

3.3.2 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.

3.3.3 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.

4.0 Course Registration:

4.1 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.

4.2 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.

4.3 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.

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

4.5 For registration in an odd semester, the student must have earned all the credits of the pre-previous year and at least 75% 2/3rd of the credits previous year. For example, for registration of the 5th semester courses (i.e. 3rd year of program), a student must have earned all the credits of the first year and 2/3rd of the credit second year. Similarly for registration of the 7th semester courses (i.e. 4th year of program), a student must have earned all the credits of the second year and 2/3rd of the credits third year. However, if 2/3rd of the 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.

4.6 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 SGPA 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 (SGPA) and Cumulative Performance Index (CGPA) 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.

6.0 Change of Program:

This is applicable to B Tech Programs 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:

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

6.2 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.

6.3 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.

6.4 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. Facilitation to Students:

7.1 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 He/She 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.
o. 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:

8.1 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.

8.2 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.

8.3 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.

8.4 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.

8.5 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.

8.6 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.

8.7 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.

8.8 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.

8.9 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.

8.10 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.

8.11 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.

10. Attendance:

10.1 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.

10.2 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.

10.3 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.

10.4 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 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.

10.5 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**.**

10. Modes of Assessment:

10.1 Assessment of Theory Courses:

10.1.1 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).

10.1.2 The relative weightage for the theory courses having ESE shall be generally as shown in the Table 10.1.2

Table 10.1.2: Weightage for the theory courses in %

FET	CAT1	CAT 2	ESE
20	15	15	50

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

10.1.3 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.

10.1.4 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.

10.1.5 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.

10.1.6 ESE is of three hours comprehensive examination having the weightage of 60% for unit 5 and 6 and 40% to unit 1 to unit 4. It is of 100 marks

10.1.7 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 minimum grade.

10.1.8 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 reason which 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.

10.1.9 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.

10.2 Assessment of Laboratory Courses:

10.2.1 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 40% in both ISE and ESE separately shall be required to get the passing grade.

10.2.2 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.

10.2.3 Student failed in ESE of a laboratory course in a regular semester shall be eligible to appear for 100% examination conducted alongwith 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.

11.0 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.

11.1. Award of Grade (Regular Semester):

11.1.1 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.

11.1.2 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 11.1.2: 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

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

11.1.4 “FF" grade shall be awarded to a student in a course if he/she gets less than 40% 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.

12 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.

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

12.2 A student has not completed most of the Evaluations like FET, CAT1 and CAT2 due to 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).

12.3 The performance of a student is less than 40% in FET, CAT1 and CAT2 Combined.

12.4 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.

12.5 Grade "X" may be given to a student if

12.5.1 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.

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

In 12.5.2 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).

12.6 Following rules apply to the student who has obtained grade "X" in a regular semester:

12.6.1 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.

12.6.2 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.

12.6.3 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.

13. Award of Grades for Re-Examination:

13.1 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 student has to suffer one grade penalty

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

13.3 50% weightage similar to ESE shall be given to re-examination and there is one grade penalty.

13.4 **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:

13.5 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.

14. 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 4^{th} 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.

15. CALCULATION OF PERFORMANCE INDICES:

15.1. 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.

15.2 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.

15.3 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.

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

16.1 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.

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

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

16.2 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.

16.3 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.

16.4 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.

17 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

18 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.

19. Academic Progress Rules (ATKT Rules):

19.1 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 $2/3^{rd}$ credits of the current year. If $2/3^{rd}$ 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 $2/3^{rd}$ 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 minimum $2/3^{rd}$ of the 45 Credits i.e. A student can go to next higher class with a maximum backlog of $1/3^{rd}$ 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 $2/3^{rd}$ 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 $2/3^{rd}$ 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 $2/3^{rd}$ happens to be a decimal, it is rounded to only integer part.

20. Semester Grade Report:

20.1 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).

20.2 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.

20.3 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.

21 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 ≥ 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.

22 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.

23. 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

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

Semester V									
Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical: Compo-nent	Exam	WT %	% Pass
MET 301 (PC 17)	Product Design & Development	2	-	-	2	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
MET 303 (PC 18)	Dynamics of Machines	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
MET 305 (PC 19)	Mechanics of Metal Cutting and Tool Design	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
MET 307 (PC 20)	Heat & Mass Transfer	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
MET 309.X (PE 1)	Programme Vertical-01	2	-	-	2	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
MET 311 (PC 18)	Dynamics of Machines Lab	-	-	2	1	Lab	FEP	100	40
MET 313 (PC 20)	Heat & Mass Transfer Lab	-	-	2	1	Lab	FEP	50	40
							POE	50	40
MET 315.X (PE 1)	Programme Vertical 01-Lab	-	-	2	1	Lab	FEP	100	40
MET 317 (PC 21)	Workshop Practice –V (Adv. CNC)	-	-	2	1	Lab	FEP	100	40
MET 319.X (PC 22)	Software Proficiency - I	-	-	4	2	Lab	FEP	100	40
MET 320 (PC 23)	Internship *	-	-	-	-	Project	FEP	100	40
MET 321 (UE 01)	Foreign Language	3	-	-	NC	-	NA	NA	NA
	Total	**16**	**0**	**12**	**19**	Total Hrs.	**28**	Total Credits	**19**

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

* Students should undergo internship at the end of semester V during vacation & evaluation will be in Semester VI.

Semester V			
Programme Vertical	**MET 309.X**	**MET 315.X**	**Programme Vertical - 01 Courses**
Design & Analysis (D&A)	309.1	315.1	Experimental Stress Analysis
Manufacturing Technology & Management (MTM)	309.2	315.2	CAD/CAM
HVAC (Thermal)	309.3	315.3	Turbo machines
Automotive Technology (Auto)	309.4	315.4	Automobile Engineering

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

Semester VI									
Course Code	Course Title	L	T	P	C	Evaluation Scheme for Theory and Practical			
						Compo-nent	Exam	WT %	% Pass
MET 302 (PC 24)	Design of Machine Elements	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
MET 304 (PC 25)	Industrial Hydraulics and Pneumatics	2	-	-	2	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
MET 306 (PC 26)	Internal Combustion Engines	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
MET 308.X (PE 02)	Programme Vertical-02	3	-	-	3	Theory	FET	20	40
							CAT I	15	
							CAT II	15	
							ESE	50	40
MET 310 (PC 25)	Industrial Hydraulics and Pneumatics Lab	-	-	2	1	Lab	FEP	100	40
MET 312 (PC 26)	Internal Combustion Engines Lab	-	-	2	1	Lab	FEP	50	40
							POE	50	40
MET 314.X (PE 02)	Programme Vertical-02 Lab	-	-	2	1	Lab	FEP	100	40
MET 316 (PC 27)	Mini Project (Hard /Soft)	-	-	2	1	Lab	FEP	100	40
MET 318.X (PC 28)	Software Proficiency -II	-	-	4	2	Lab	FEP	100	40
MET 320 (PC 23)	Internship * (Evaluation of Sem. V)	-	-	-	1	Project	FEP	100	40
MET 322 (UE 02)	Scholastic Program	3	-	-	N C	-	NA	NA	NA
	Total	**14**	**0**	**12**	**18**	Total Hrs.	**26**	Total Credits	**18**

* Evaluation of undergone internship at the end of semester V during vacation in Semester VI.

Semester VI			
Programme Vertical	**MET 308.X**	**MET 314.X**	**Programme Vertical - 02 Course**
Design & Analysis (D&A)	308.1	314.1	Mechanical Vibrations
Manufacturing Technology & Management (MTM)	308.2	314.2	Operations Management
HVAC (Thermal)	308.3	314.3	Heat Exchangers
Automotive Technology (Auto)	308.4	314.4	Automotive Diagnostics

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET 301	**Product Design & Development**	L	T	P	Credits
		02	**--**	**--**	**02**

Prerequisites : Engineering Graphics, Machine Drawing, Manufacturing Processes, CAD

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Identify challenges of product development, customer needs.	02
CO 2	Identify innovative ways for product development process and planning.	02
CO 3	Identify most feasible way for design for manufacturing & assembly	04
CO 4	Identify ways of estimating cost for a product and economics for life cycle of a product.	03

Unit No.	**Contents**	Hrs
I	**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.	06
II	**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.	07
III	**Product Design Process and Tools and Techniques** Product Design process steps, Stage gate model, Design for manufacturing and assembly (DFMA), Product teardown and experimentation, Concurrent engineering, Quality function Deployment (QFD), Value engineering.	07
IV	**Design Considerations** Product dimensions, Aesthetic aspects- Symmetry, balance, contrast, continuity, rhythm, Form and styling, Color in product design, Ergonomic considerations, Anthropometry.	08

Sr. No.	**Text Books**
01	Product Design and Development: Ulrich, Eppinger, Anita Goel McGraw Hill Publishing.
02	Product Design : Otto &wood Pearson Education
03	Industrial Design in Engineering Charles Flurs cheim, the Design Council, London.
04	Design for product success: Devdas Shetty, Society for Manufacturing Engineering

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET 303	**Dynamics of Machines**	L	T	P	Credits
		03	**--**	**--**	**03**

Prerequisites FYT 108 (Engineering Mechanics), MET 206 (Kinematics of Machines)

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Indentify the various types of Gears and Gear Trains	03
CO 2	Explain basics of flywheel and its types	02
CO 3	Analyze forces in mechanisms.	04
CO 4	Solve numerical on balancing	03
CO 5	Analyze the gyroscopic effect on different objects	04

	Course Content	Hrs
I	**Gears :** Geometry of motion, Gear geometry, Types of gear profile- involute and cycloidal, Theory of Spur, Helical and Spiral gears, Interference in involute tooth gears and methods for its prevention, Path of contact, Arc of Contact, Contact ratio. Efficiency and center distance of spiral gears.	07
II	**Gear Trains :** Types of Gear trains - Simple, Compound, Reverted, Epicyclic gear train, Numericals on finding the speeds of elements in epicyclic gear train by tabular Method. Differential gear box, Torques in epicyclic gear train (Descriptive Treatment only).	07
III	**Flywheel :** Turning moment diagrams, Fluctuation of energy, Coefficient of fluctuation of speed, Rimmed flywheel.	06
IV	**Static and Dynamic Force Analysis of Mechanisms :** Velocity and acceleration of slider crank mechanism by analytical method, Inertia force and torque, D'Alembert's principle, Dynamically equivalent system, force analysis of reciprocating engine mechanism and four bar chain mechanism.	07
V	**Balancing :** Static and Dynamic balancing of rotary and reciprocating masses. Primary and Secondary forces and couples. Direct and Reverse cranks. Balancing of Single cylinder, Multi cylinder-In-line and Radial Engines for four wheeler.	07
VI	**Gyroscope :** Gyroscopic couple, Spinning and Precessional Motion, Gyroscopic couple and its effect on Aero plane, Ship, Four-Wheeler, Two –Wheeler vehicle. Stability conditions for four wheeler and two wheeler vehicles.	06

Reference /Text Books

Sr. No.	Name of Book	Author(s)	Publisher	Edition, Year of Publication, ISBN
01	Theory of Machines	Rattan S.S.	Tata McGraw Hill	3rd Edition
02	Theory of Machines	Dr. V.P.Singh	Dhanpat Rai Publications	
03	Theory of Machines	Ballaney	Khanna Publication.	

MET - 305	Mechanics of Metal Cutting and Tool Design	L	T	P	Credits
		03	--	--	03

Prerequisites Manufacturing Process MET-207, Workshop Practice – 1, Workshop Practice – 2

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	**Explain** metal cutting principle and tool geometry of single point and multi point cutting tool.	02
CO 2	**Identify** sources of Heat Generation and Economics of Machining	03
CO 3	**Design** drilling jigs and fixtures for simple components	04
CO 4	**Design** press tools and cutting/punching dies for simple components	04

	Course Content	Hrs
I	**Theory of metal cutting :** Cutting tools, tool geometry, concept of speed, feed, depth of cut & cutting action & effect of these on cutting forces, types of chips, Merchant circle of forces. Estimation of cutting forces. Empirical relations. Tool force dynamometers. Measurement of cutting forces and power required in turning&drilling.	08
II	**Cutting tool standards and materials :** Tool signature ORS & ASA methods, tool standards: Single point cutting tool, drills, broach, reamer, milling cutters. Cutting tool materials. Nonconventional tool geometry: Koleshov tool, Advance tool materials, coating on tool, throwaway inserts, tool selection catalogue.	06
III	**Heat generation, tool life & Economic of cutting tools :** Heat generation in cutting, cutting fluid, tool wear, Tool life equation of Taylor. Factors affecting tool life, Machinability and its rating, criteria for Machinability. Economics of machining. Criteria for minimum cost & maximum production.	06
IV	**Fundamentals of Jigs and fixtures :** Significance and purpose of jigs and fixtures and their functions in manufacturing processes. Classifications of jigs and fixtures. Designs features of main elements of Jigs and fixtures such as locating, clamping and guiding elements and their integrations. Indexing, locking and auxiliary elements. Bodies and bases or frames of Jigs and fixtures. Economics of Jigs and fixtures, Pneumatics & Hydraulics for jig & fixtures.	06

V	**Design of Jigs & fixtures :** A) Design of jigs: Principles of jig design, types of jigs- plate, template, box, channel, sandwich, latch, turn-over, tumble jig etc., types of bushes, selection of bushes and liners, construction of jig and fixture bodies, use of standard parts. B) Design of fixtures: Principles of fixture design, types of fixtures- gang, straddle, vertical, slot, string milling fixture etc, selection of the suitable type, design of milling fixtures, use of setting block, tennons, T-bolts etc, Concept of Modular Fixtures	08
VI	**Introduction to press tools :** Dies, punches, types of presses, types of dies, simple, compound, combination and progressive dies, press tools for operations like blanking, piercing, drawing, shaving, trimming, etc. **Design of die set for cutting operations :** Theory of metal cutting, cutting force and blank holding force estimation, punch and die clearance, scrap strip layout, design of punches, design of dies, pilots, strippers, stock stops, finger stops, auto stops, centre of pressure, selection of die set.	08

Reference/Text Books

Sr. No.	Name of Book	Author(s)	Publisher	Edition, Year of Publication, ISBN
01	Production Engineering	P. C. Sharma	S. Chand	ISBN812190421 8
02	Production Technology		HMT Handbook	
03	Machine tool Engg.	G.R. Nagapal	Khanna Publication,6th Edition	2nd Edition
04	Thoery of Metal Cutting-	Sen Bhattacharya	New central book agency pvt. Ltd.1st Edition 1984	
05	Principles of metal cutting	G. Kuppuswamy	university press	ISBN 81 73710287.
06	Die Design Fundamentals	J. R. Paquin, R. E. Crowley	Industrial Press Inc.	
07	Fundamentals of Tool Design	Ed. Frank Wilson	ASTME (TMH)	
08	Jigs and Fixture Design Manual	Henrikson	Industrial Press, NY	
09	Die Design Fundamentals	J. R. Paquin, R. E. Crowley	Industrial Press Inc.	

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET307	**Heat and Mass Transfer**	L	T	P	Credits
		03	**--**	**--**	**03**

Prerequisites MET-207 Thermodynamics

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Identifies the mode by which energy is transported. and Explain the concept of steady & Unsteady state heat conduction	03
CO 2	Explain the fundamentals of convective heat transfer process and heat transfer coefficients for natural & forced convection. and Illustrate heat transfer using Extended surfaces.	02
CO 3	Solve the radiation heat transfer between black body surfaces and heat exchange between gray body surfaces	03
CO 4	Identify the concepts of boiling and Condensation phenomenon.	03

Course Content Hrs

I **Introduction to Heat Transfer:**
Scope and application of heat transfer principles in engineering practice, Various Modes of heat transfer. Basic laws of heat transfer, combined modes of heat transfer, Thermal conductivity and its variation with temperature for various Engineering Materials. 3

II **Stead and Unsteady state heat conduction:**

I. **Conduction:** Fourier law-thermal conductivity of solids, liquids and gasses, factors affecting thermal conductivity, common conducting and insulating materials, generalized heat conduction equation in Cartesian, cylindrical and spherical co-ordinates and its reduction to Fourier, Laplace and Poisson's equations, one dimensional steady state conduction with and without heat generation, conduction through homogeneous and composite surfaces-plane wall, cylinders and spheres, concept of thermal resistance, critical thickness of insulation, overall heat transfer coefficient. (Numerical treatment)
II. Lumped Heat capacity Analysis, Biot and Fourier number and their significance, (Numerical based on Lumped Heat capacity Analysis), Use of Hiesler and Grober Charts. 8

III **Convection:**
Fundamentals of Convection:
Elementary ideas of hydrodynamic and thermal boundary layers, Newton's law of cooling, Local and average convective coefficient for laminar and turbulent flow for flat plate and pipe, factors affecting heat transfer coefficient in forced and natural convection heat transfer, application of dimensional analysis to free and forced convection, significance of Prandtl number, Reynold's number, Grashoff number and Nusselt number. (Numerical treatment) 8

	Forced Convection: Laminar and turbulent flow heat transfer in a circular pipe, Laminar and turbulent flow heat transfer in flow over a flat plate, flow across a cylinder. **Natural Convection:** Natural convection heat transfer from a plate kept vertical and horizontal-cylinder kept vertical and horizontal, description of natural convection heat transfer from enclosed spaces. (Numerical treatment)	
IV	**Extended Surfaces and Heat Exchangers:** **Extended Surfaces:** Temperature boundary conditions, heat flux boundary condition, convection boundary condition and radiation boundary condition. Governing equation and boundary conditions, Types and applications of fins, pin fin of uniform cross-sectional area, fin effectiveness, fin efficiency, Error estimation in temperature measurement in thermo well. (Numerical treatment)	8
V	**Radiation:** Nature of thermal radiation, definitions and concepts, monochromatic and total emissive power, absorptivity, reflectivity and transmissivity, definition of black, grey and real surfaces, concept of a black body, Plank's law, Kirchoff's law, Wein's displacement law and Stefan-Boltzmann law-geometric factor (shape factor) of simple geometries, Heat exchange by radiation between black surfaces of equal, parallel and opposite black squares and discs-black rectangles perpendicular to each other having a common edge, heat exchange between infinite parallel planes of different emissivity, radiation shield (no derivation) (Numerical treatment)	7
VI	**Condensation and Boiling:** Filmwise and Dropwise condensation, Nusselt's theory of condensation for vertical plate, Pool boiling and forced boiling, different regimes of pool boiling, Two dimensional steady state heat conduction-governing equation and boundary conditions. (descriptive treatment only)	6

Reference/Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*
01	Heat and Mass Transfer	R.K. Rajput	S. Chand and Company Ltd., New Delhi.
02	Heat and Mass Transfer	Dr. D.S. Kumar	S.K. Kataria and Sons, Delhi.
03	Fundamentals of Heat and Mass Transfer	R.C. Sachdeva,	Willey Eastern Ltd.,
04	Heat and Mass Transfer	M.M. Rathod,	Laxmi Publications.
05	Fundamentals of Heat and Mass Transfer	Frank P. Incropera, David P. Dewitt	Wiley India. 5/e.
06	Heat Transfer – A Practical approach	Yunus. A. Cengel,	Tata McGraw Hill
07	Heat Transfer	Chapman A.J.,	Tata McGraw Hill Book Company, New York.

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET 309.1	**Experimental Stress Analysis**	L	T	P	Credits
		02	**--**	**--**	**02**

Prerequisites Knowledge of stress analysis, Strength of Material MET-09

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Explain the concept of strain gauges and its applications	02
CO 2	Explain commercial strain indicators, potentiometer circuit, strain gaugerosettes and Transducer with their applications.	02
CO 3	Analyse photo elastic technique to stress analysis	03
CO 4	Elaboratethe concept of coating methods and Moiré fringes	02

Course Content Hrs

I **Strain Measurement Using Strain Gauges**

a. Electrical resistance strain gauge –Introduction, principle, types, construction, materials used in construction, sensitivity, gauge factor, cross sensitivity.
b. Semiconductor strain gauge, advantages and limitations Selection and mounting of strain gauge,
c. Criteria for selection, mounting of gauge and checking its installation 06

II **Strain Gauge Circuitry**

a. Wheatstone bridge circuit, its role in measurement of resistance change, condition for bridge balance, output voltage of Wheatstone bridge, relationship between output voltage and strain, Commercial strain indicators, potentiometer circuit.
b. Strain gauge rosettes and Numericals on it.
c. Transducer applications of strain gauge. 08

III **Strain Measurement using Photoelasticity**

I. Two Dimentional Photoelastisity

a. Principle of photoelasticity, Stress optics law, material fringe, Polariscope-various configurations of polariscope. Effect of stressed model in plane and circular polariscope, isoclinics, isochrometics, their significance in photoelastic stress analysis.
b. Compensation methods like babinetsoleil compensation method and Tardy's method (Derivation).

II. Analysis of Photoelastic Data

a. Determination of direction of principal stress at a given point, determination of exact fringe order N and difference of principal stresses at a given point. 10

b. Shear difference method, oblique incidence method. Photoelastic Materials and their properties, Photoelastic sheet casting and model making, Calibration of photoelastic material.

IV **Coating Method and Moire Fringe**

a. Brittle coating- interpretation of crack pattern data, crack detection techniques.
b. Birefringent coating:- Limitations and applications, use of reflection polariscope, merits and demerits
c. Moiré fringe method - stress analysis Mechanism of fringe formation, advantages, limitations and applications 06

Reference /Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Experimental stress analysis	Dally and Riley	McGraw Hill	ISBN-13: 978-0070152182
02	Experimental stress analysis	Dr. Sadhu Singh	Khanna Publications	ISBN:978-81-7409-182-3
03	Experimental stress analysis	L.S.Srinath	Tata McGraw Hill	ISBN13:9780074519264
04	Moiré fringes	Theocoris	Pergamon press limited	

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

		L	T	P	Credits
MET-309.2	**CAD/CAM**	**02**	**--**	**--**	**02**

Prerequisites Engineering Graphics, Machine Drawing and CAD, Linear Differential Equations, Computer Graphics, Derivatives and Integration, Matrix

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Interpret the 2D-3D Modeling Techniques through mathematical equations & behind screen terminology of graphics for the modeling.	02
CO 2	Explain the fundamentals of PLM, its architecture and role of CAD CAM in PLM.	02

	Course Content	Hrs
I	**Introduction to CAD/CAM & Fundamentals for PLC :** PLC – What is it? Background, Corporate Challenges, Product Data or Product Information, PLC – Concept, System architecture, Information Models and Product Structures, Information model, Product Information (data) Model, Reasons for the deployment of PLM systems. Types of 2D, 3D Modeling, Transformations & Matrices.	06
II	**Curves :** Introduction, Curve Entities, Curve Representation, Analytic Curves, Lines, Circles, Ellipses, Parabolas, Hyperbolas, Conics, Synthetic Curves, Hermit Cubic Spline, Bezier Curve, B-Spline Curve, Curve Manipulations.	07
III	**Surfaces :** Introduction, Surface Entities, Surface Representation, Surface Analysis, Analytic Surfaces, Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder, Synthetic Surfaces, Hermite Bicubic Surface, Bezier Surface, B-Spline Surface, Coons Surface, Blending Surface, Offset Surface, Triangular Patches, Surface Manipulations. **Nurbs :** Introduction, Basics, Curves, Lines, Arcs, Circles, Bilinear Surface, Ruled Surface.	08
IV	**Solids :** Introduction, Geometry and Topology, Solid Entities, Solid Representation, Fundamentals of Solid Modeling, Half – Spaces, Boundary Representation (B-rep), Constructive Solid Geometry (CSG), Sweeps, Solid Manipulations.	07

Reference /Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	CAD/CAM - Theory and Practice	Ibrahim Zeid, R. Sivasubramanian	Tata McGraw Hill Publishing Co.	2009
02	Mastering CAD/CAM	Ibraim Zeid	Tata McGraw Hill Publishing Co.	2000
03	Introduction to CAD/CAM	Rao P.N.	Tata McGraw Hill Publishing Co.	
04	Automation, Production Systems And Computer Integrated Manufacturing	Groover M.P.	Prentice Hall of India	
05	Product Lifecycle Management	Antti Saaksvuori, Anselmi Immonen	Springer Publications	2nd Edition
06	Product Lifecycle Management	Grieves, Michael	McGraw-Hill	2006. ISBN 0071452303

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

		L	T	P	Credits
MET 309.3	**Turbo Machines**	**02**	**--**	**--**	**02**

Prerequisites MET-207 Thermodynamics, MET-208 Fluid Mechanics

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	**Design** simple Impulse and Reaction turbines using design principles.	3
CO 2	**Calculate** various heads and efficiencies related to hydraulic pumps.	3
CO 3	**Compare** various methods to improve thermal efficiency and specific output of the gas turbines using mathematical equations.	3

Unit No.	**Contents**	Lecture Hrs
I	**Basic Concepts of Turbo machines and its applications** Definition, Classification, Dimensional analysis and similitude of incompressible and compressible flow in turbo-machines, Energy transfer-Euler turbine equation, Degree of reaction, Impact of jets.	04
II	**Hydraulic Turbines** Pelton turbine, velocity triangles at inlet and exit of buckets, performance calculations considering losses in nozzle and buckets, condition for maximum hydraulic efficiency. Francis Turbine- reaction, impeller shapes for different shape heads, calculations of impeller dimensions, blade angles and performance using velocity triangles, draft tube theory. Kaplan turbine-reaction, impeller blades (fixed and adjustable) and guide blades, calculation of performance using velocity triangles, Design parameters to be considered, Governing of turbines, utilization factor. Deriaz turbine - (theory only).	10
III	**Hydraulic Pumps** Centrifugal pumps, velocity triangles, work done by the impeller on water, types of casing, various heads and efficiencies related to it, priming and cavitations, various methods to prevent cavitations, minimum starting speed of the centrifugal pump, theoretical head-capacity relation for pumps, Multi staging, NPSH, Pump characteristics.	07

IV	**Gas turbines and Jet Propulsion** Classification, methods for improving the thermal efficiency and specific output with p-v and T-s diagram (detailed discussion). Introduction to Propulsion, various types (detailed discussion), Fuels used in rockets.	07

Reference /Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Principle of Turbo machinery	Shepherd D.G	Macmillan Co. New York	1956
02	Fluid Mechanics	Douglas J.F, Gasiorek J.M and Swaffield J.A	Addison-Weisly	1999
03	Energy Conversion Turbo machines	Kadambi and Prasad	Wiley Eastern,1997	Vol.-III
04	Turbomachines	Yahya S.M	Satya Prakashana, New Delhi	
05	Turbines, Compressors and Fans	Yahya S.M	TMH, New Delhi,	2005
06	Fluid Mechanics, Thermodynamics of Turbo machinery	Dixon S.L	Pergamon	2006
07	Fundamentals of Turbo machinery	Venkanna B.K	PHI Learning Pvt. Ltd., New Delhi	4th Edition 2011
08	Hydraulics and Fluid Mechanics including Hydraulic Machines	P.N. Modi and S.M. Seth	Standard Book House, Rajsons Publications Pvt. Ltd.	20th Edition
09	Fluid Mechanics and Hydraulic Machines	R.K. Bansal	Laxmi Publications Pvt. Ltd. New Delhi	9th Edition (reprint),
10	Principle of Turbo machinery	Seppo A. Korpela	John Wiley and Sons Ltd.	2012
11	Fluid Mechanics and Fluid Machines	Kumar D.S	S.K. Kataria and Sons.	

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET 309.4	**Automobile Engineering**	L	T	P	Credits
		02	**--**	**--**	**02**

Prerequisites Nil

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Explain components of automobile, its materials & various types of automobiles, transmission system & it's working.	01
CO 2	Demonstrate various automobile systems like, steering & suspension system, brake, wheels and Tyres, and its construction and working.	02
CO 3	Demonstrate various electrical and electronic systems like lighting, starting charging, electronic controlled management system and its construction and working principle, sensors used in automobile	02

	Course Content	Hrs
I	**Introduction and Transmission System** Automobile history, Components of an automobile, Classification, vehicle layouts- engine location and drive arrangement, Type of vehicle bodies, body parts and its advanced materials, Chassis types, constructional details & Chassis materials, Types of Frames, sub frames, frameless vehicles. Clutch – Function and requirements, Classification, Construction and working of Single-plate, Multi-plate, Semi-centrifugal and centrifugal clutches, Fluid flywheel. Gear Box – Necessity, classification, construction of manual gear boxes like Sliding mesh, constant mesh, Synchromesh, Epicyclic gear train, Automatic transmission, Torque convertor, Overdrive. Propeller shaft, Differential and final drive.	08
II	**Steering and Suspension Systems** Live and dead axles, live axle arrangement. Steering systems, function, principle of steering, Ackerman and Davis, steering geometry, center point steering, cornering force, slip angle, scrub radius, steering characteristic, steering gearbox, power steering, collapsible steering. Suspension system- Functions, Sprung and unsprung mass, Types of suspension linkages, types of spring - leaf, coil, air springs, telescopic shock absorber, hydro gas suspension, rubber suspension, interconnected suspension, self-leveling suspension (active suspension)Advances in suspension system, Air suspension	08
III	**Brakes, Wheels and Tyres** Brakes: Need, principle, types, Mechanical, hydraulic and pneumatic brakes disc and drum types, air brakes, servo and power braking, ABS,	08

	their relative merits, details of components, brake adjustments, defects and causes. Wheels and Tyres: Wheel construction, alloy wheel, Types, tyre construction, tread design, specification, factors affecting tyre performance, tyre wear and its causes, wheel balancing.	
IV	**Electrical and Electronic Systems** Automotive batteries - lead acid batteries, Advances in batteries, battery charging system, alternators, principle and operation of cut-out and regulators, starter motor, Bendix drive, solenoid drive, magneto coil and solid stage ignition systems, lighting and electrical accessories, automobile air conditioning, panel board instruments. Electronic Controlled Management (ECM) Systems, Automobile wiring. Sensors used in automobile.	08

Reference /Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Automobile Engineering	Dr. Kirpal Singh	Standard Publishers, New Delhi.	(Vol. I and II) ISBN-81-8014-119-5
02	Automobile Mechanics	N K Giri	Khanna Publication	
03	Automobile Engineering	G.B.S. Narang	Khanna Publication	3rd Edition
04	Automotive Technology	H.M. Sethi	Tata McGraw-Hill	2001
05	Automobile Engineering	Banga and Singh	Khanna Publication	
06	Automotive Mechanics	Joseph Heitner	Affiliated Eastern Law House	2ndEdition (1967)
07	Motor Vehicle Technology and Practical Work	Dolan. J.A.	ELBS	1978
08	Automobile Electrical Equipment	P.L.Kohali	Technical Education Series	1st Edition
09	Automobile Engineering	R.B.Gupta	Satya Prakasan	9th Edition
10	Automotive Excellence Volume 1 and 2	Gelncoe	Tata McGraw-Hill	

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET 311	**Dynamics of Machines Lab**	L	T	P	Credits
		--	**--**	**02**	**01**

Prerequisites FYT 108 (Engineering Mechanics), MET 206 (Kinematics of Machines)

Tools Used: Rack cutter Arrangement, Apparatus for gear train, Apparatus to calculate Gyroscopic Couple, Apparatus to calculate M I of Bifilar and Tri filar suspension system Apparatus to conduct Experiment on Balancing

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Examine different principles in Dynamics of machinery	04
CO 2	Solve critical numerical in Dynamics of Machinery	03
CO 3	Explain different procedures of Gear Manufacturing / Balancing	02

Course Content (Laboratory, Assignments, Mini Project, Seminar)

	Activity	Hrs
I	Generation of involute profile using rack cutter method	02
II	Experiment on Torque Measurement in Epicyclic Gear Train	02
III	Experiment on Gyroscope.	02
IV	Determination of M.I. using Bifilar suspension system.	02
V	Determination of M.I. using Trifilar suspension system.	02
VI	Experiment on Balancing of rotary masses.	02
VII	Problems on balancing of reciprocating masses. (Minimum 3)	02
VIII	Determination of M.I. of connecting rod by Compound pendulum method.	02
IX	Assignment on Flywheel.	02
X	Industrial visit based on above syllabus.	08

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book /Handbooks /Catalogues*	*Author (s)*	*Publisher /Organization*	*Edition, Year of Publication, ISBN*
01	Theory of Machines	Rattan S.S.	Tata McGraw Hill	3rd Edition
02	Theory of Machines	Dr. V.P.Singh	Dhanpat Rai Publications	
03	Theory of Machines	Ballaney	Khanna Publication.	

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

		L	T	P	Credits
MET-313	**Heat & Mass Transfer Lab**	**--**	**--**	**02**	**01**

Prerequisites MET-207 Thermodynamics

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Compare and Summarize the temperature distribution and their effect on different materials considering conduction mode of heat transfer and Interpret the heat transfer coefficient for natural and forced convection	02
CO 2	Compare the thermal emissivity between gray surface and black body and Experiment with the phenomenon of condensation and boiling.	02
CO 3	Analyze the effectiveness of heat exchanger.	04

Sr. No.	**List of Experiments / Assignments**
I	To find and compare the thermal conductivity of given Insulating materials.
II	To find the thermal conductivity and behaviour at different temperatures for Cu, Al and SS metal rods.
III	To find the total thermal resistance and temperature distribution in a given Composite wall.
IV	To find local and average heat transfer coefficient in Natural convection heat transfer from a vertical cylinder.
V	To find Heat Transfer Coefficient under forced convection.
VI	To find emissivity of a given gray surface and compare the results with Black Surface.
VII	To verify Stefan Boltzmann Constant.
VIII	To find heat transfer coefficient in dropwise and filmwise condensation.
IX	Analysis of extended surfaces.

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book /Handbooks /Catalogues*	*Author (s)*	*Publisher /Organization*	*Edition, Year of Publication, ISBN*
01	Heat and Mass Transfer	R.K. Rajput	S. Chand and Company Ltd. New Delhi	
02	Heat and Mass Transfer	Dr. D.S. Kumar	S.K. Kataria and Sons, Delhi	
03	Fundamentals of Heat and Mass Transfer	Frank P. Incropera, David P. Dewitt	Wiley India.	5/e
04	Heat Transfer – A Practical approach	Yunus. A. Cengel	Tata McGraw Hill	

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET-315.1	**Experimental Stress Analysis Lab**	L	T	P	Credits
		--	--	**02**	**01**

Prerequisites Knowledge of stress analysis, Strength of Material MET-09

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Explain the concept of strain gauges and its applications	02
CO 2	Explain commercial strain indicators, potentiometer circuit, strain gauge rosettes and Transducer with their applications.	02
CO 3	Analyze photo elastic technique to stress analysis	03
CO 4	Elaborate the concept of coating methods and Moiré fringes	02

Tools Used	*Required Tools /Machinery /Equipments /Software /Other*
1	Diffused light polariscope
2	Commercial and Digital Strain Indicators

Course Content (Laboratory, Assignments, Mini Project, Seminar)

	Activity	Hrs/ batch
I	Bonding Of Strain Gauge And Checking Its Installation	02
II	Determination of gauge factor for a. one arm sensitive and two arm sensitive configuration b. four arm sensitive and four arm sensitive two linear and two lateral configuration	02
III	Strain Measurement by Using Commercial Strain Indicator and Transducers.	02
IV	Strain Measurement by Using Digital Strain Indicator and Transducers.	02
V	Study of Photoelastic materials.	02
VI	Study of photoelastic stress analysis using diffused light transmission polariscope	02
VII	Calibration of photoelastic materials -determination of material fringe value	02
VIII	Determination of fractional fringe order using Tardy's method.	02
IX	Study of Moiré Fringe Technique.	02
X	Study of Brittle Coating Method.	02

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book /Handbooks /Catalogues*	*Author (s)*	*Publisher /Organization*	*Edition, Year of Publication, ISBN*
01	Experimental stress analysis	Dally and Riley	McGraw Hill	ISBN-13: 978-0070152182
02	Experimental stress analysis	Dr. Sadhu Singh	Khanna Publications	ISBN:978-81-7409-182-3
03	Experimental stress analysis	L.S.Srinath	Tata McGraw Hill	ISBN13:9780074519264
04	Moiré fringes	Theocoris	Pergamon press limited	--

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

		L	T	P	Credits
MET-315.2	**CAD/CAM Lab**	**--**	**--**	**02**	**01**

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Solve numerical based on 2D & 3D Modeling techniques, mathematically.	02
CO 2	Explain various case studies related to CAD/CAM & PLM system architecture and implementation issues.	02

	Activity	Hrs
I	Assignments on each topic with examples /numerical /derivations a. Curves b. Surfaces c. Nurbs d. Solids e. Introduction to PLM	
II	Case Study presentation on CAD/CAM & PLM Systems, Product Structures, Implementation issues, etc. (Group of 02 to 04 students)	

Reference /Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	CAD/CAM - Theory and Practice	Ibrahim Zeid, R. Sivasubramanian	Tata McGraw Hill Publishing Co.	2009
02	Automation, Production Systems And Computer Integrated Manufacturing	Groover M.P.	Prentice Hall of India	
03	Product Lifecycle Management	Antti Saaksvuori, Anselmi Immonen	Springer Publications	2nd Edition
04	Product Lifecycle Management	Grieves, Michael	McGraw-Hill	2006. ISBN 0071452303
05	www.sciencedirect.com			
06	Other relevant journals, websites			
07	Whitepapers from industry.			

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

		L	T	P	Credits
MET-315.3	**Turbo Machines Lab**	**--**	**--**	**02**	**01**

Pre-requisites: MET-222 Fluid Mechanics Lab

Course Outcomes	Student will be able to	Bloom's Level
CO 1	Explain the performance characteristics of impulse turbine and reaction turbine	2
CO 2	Interpret the characteristics of single stage and multi-stage centrifugal pumps and centrifugal air blower	2
CO 3	Interpret the characteristics of reciprocating pump.	2

Sr. No.	**List of Experiments**
I	Analyze Performance Characteristics of Pelton wheel.
II	Analyze Performance characteristics of Kaplan turbine.
III	Performance characteristics of Francis turbine.
IV	Trial on Centrifugal Pump (Rated speed).
V	Trial on Centrifugal Pump (Variable speed).
VI	Study and Trial on Air Blower.
VII	Performance characteristics of a Reciprocating pump.
VIII	Industrial visit to pump manufacturing unit/hydro-electric power station and submission of report

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Turbomachines	Yahya S.M	SatyaPrakashan, New Delhi.	
02	Turbines, Compressors and Fans	Yahya S.M	TMH, New Delhi,	2005.
03	Fluid Mechanics, Thermodynamics of Turbomachinery	Dixon S.L	Pergamon,	2006.

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET 315.4	**Automobile Engineering Lab**	L	T	P	Credits
		--	**--**	**02**	**01**

Prerequisites Nil

Tools Used: Required Tools /Machinery /Equipments /Software /Other

Demo models of four wheeler chassis
Demo models clutch, gearbox, brake, steering, suspension, electrical systems

Course Outcomes	Students will be able to,	Bloom's Level
CO 315.4.1	Demonstrate various types of automobile lay outs as per drive given to wheels, Vehicle body parts & its materials	02
CO 315.4.2	Demonstrate various automobile systems like transmission, brake, steering, suspension & electrical & its construction and working.	02

Course Content (Laboratory, Assignments, Mini Project, Seminar)

	Activity	Hrs
I	Demonstration of four wheeler chassis layout and vehicle body parts and its materials.	02
II	Demonstration of working of single plate automobile clutch and clutch plate lining materials.	02
III	Demonstration of synchromesh gearbox.	02
IV	Demonstration of final drive and differential.	02
V	Demonstration of front wheel steering geometry and steering mechanism.	02
VI	Demonstration of suspension system of a four-wheeler. (Any one suspension system from conventional or independent)	02
VII	Demonstration of working Hydraulic braking system.	02
VIII	Demonstration of Lead acid Battery.	02
IX	Demonstration of electrical charging system, starting system, D. C. Electric Horn, Electric Fuel Gauge, Flasher Unit. & Wiper Circuit	02

Course Content (Laboratory, Assignments, Mini Project, Seminar)

X	Industry visit to servicing station for study of vehicle maintenance, repairs, wheel balancing and front wheel alignment etc.	02

Reference /Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Automobile Engineering	Dr. Kirpal Singh	Standard Publishers, New Delhi.	(Vol. I and II) ISBN-81-8014-119-5
02	Automobile Mechanics	N K Giri	Khanna Publication	
03	Automobile Engineering	G.B.S. Narang	Khanna Publication	3rd Edition
04	Automotive Technology	H.M. Sethi	Tata McGraw-Hill	2001
05	Automobile Engineering	Banga and Singh	Khanna Publication	
06	Automotive Mechanics	Joseph Heitner	Affiliated Eastern Law House	2ndEdition (1967)
07	Motor Vehicle Technology and Practical Work	Dolan. J.A.	ELBS	1978
08	Automobile Electrical Equipment	P.L.Kohali	Technical Education Series	1st Edition
09	Automobile Engineering	R.B.Gupta	Satya Prakasan	9th Edition
10	Automotive Excellence Volume 1 and 2	Gelncoe	Tata McGraw-Hill	

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET 317	**Workshop Practice – V (Adv. CNC)**	L	T	P	Credits
		--	**--**	**02**	**01**

Prerequisites Workshop Practice I, II and IV, ESFYT 120, FYT126

Tools Used *Required Tools /Machinery /Equipments /Software /Other*

CNC Machine, VMC machine, Tool Inserts.

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	**Discuss** cycle time and selection of cutting tools and holders.	02
CO 2	**Develop** advance CNC part programming techniques.	04
CO 3	**Execute** a part program for a simple component on CNC lathe.	04
CO 4	**Inspect** different settings in CNC machine	04

Course Content (Laboratory)

	Activity	Hrs
I	Study construction and working of (CNC/VMC/HMC).	02
II	Study of cycle time sheet, Selection of cutting tools and holders	02
III	One job on CNC Machine with advance programming group of maximum four students, plain turning, step turning, Taper turning, Threading, drilling, radius turning, boring, parting.	08
IV	Preventive maintenances for CNC and VMC machine.	02
V	Chuck setting, chuck greasing, tailstock greasing and reverse-forward stroke setting in CNC machine (Actual performance).	04
VI	Checking, setting and filling the hydraulic oil, lubrication oil, cutting oil for CNC machine.	04
VII	Industrial visit to study operations of Vertical Machining centre, Horizontal Machining center and Turn-mill Centres.	02

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book /Handbooks /Catalogues*	*Author (s)*	*Publisher /Organization*	*Edition, Year of Publication, ISBN*
01	CAD/CAM- Principals and Applications	P.N. Rao	McGraw Hill	2nd Edition
02	Elements of Workshop Technology	S. K Hajra Choudhury	Media Promoters And Publishers, Mumbai	– Vol. II 3rd Edition
03	CAD/CAM- Concepts and Applications	Chennakesava R. Alavala	PHI	
04	Fundamentals of Tool Design		ASTME Publication	

MET 317	**Software Proficiency – I**	L	T	P	Credits
		--	**--**	**04**	**02**

Software Proficiency is a part for enhancing the design and manufacturing skills using advanced CAD/CAM/CAE as well as programming software.

Student has to learn the modules of software like Solid Modeling, Surface Modeling, Assembly Modeling, Analysis, Mechanism Design, Synthesis of Mechanism, Synthesis of Design, Programming, etc. by using software among like PTC-Creo, CATIA, ADAMS, ABACUS, ANSYS, C++, Java, etc.

These software & modules are been selected based on the level of learning for the students and requirements of the industry.

Some of the software modules are mentioned below and may change as per requirement.

Sr.	Code	Course Code	Course
01	PE-2	MET-317.1	CATIA /Creo- Wire Frame Modeling and Surfacing
02	PE-2	MET-317.2	ADAMS- Machinery

MET 320	**Internship**	L	T	P	Credits
		--	**--**	**--**	**01**

After the end of Semester V, student has to go for industry internship for the duration of minimum 03 weeks. The evaluation of the internship will be done in the Semester VI.

MET 321	**Foreign Language**	L	T	P	Credits
		03	**--**	**--**	**NC**

Student has to select any one of the following language for his/her language enhancement. And same language shall continue for next semester course.

Sr.	Code	Course Code	Course
01	UE-2	MET-321.1	German
02	UE-2	MET-321.2	Japanese
03	UE-2	MET-321.3	Adv. English

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET-302	**Design of Machine Elements**	L	T	P	Credits
		03	**--**	**--**	**03**

Prerequisites: Strength of Materials MET-09.

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Explain general design procedure of designing a machine element	2
CO 2	Design simple machine elements on the basis of static loading and strength concept.	3
CO 3	Design transmission shafts based on strength and rigidity, Keys and Couplings	3
CO 4	Select flat and V belt from manufacturers catalogue	2

	Course Content	Hrs
I	**Fundamentals of Machine Design:** Introduction to Machine design, Theories of elastic failure & their applications, Basic procedure of design of machine elements, Selection of various engineering materials, properties & I.S. coding for ferrous materials, Factors governing selection of engineering materials.	05
II	**Design against Static load:** Factor of safety- its selection & significance, Design of Knuckle joint, Turn buckle and bell crank Lever. Design of bolted joints subjected to following conditions- 1) Joints in shear 2) joints subjected to load perpendicular to the axis of bolt. Design of welded joints- 1)Strength of transverse and parallel fillet welds 2) Eccentric load in the plane of weld 3) Welded joint subjected to bending moment.	08
III	**Design of Shaft, Keys, and Couplings:** Design of solid & hollow shafts, Design of shaft based on strength & torsional rigidity. ASME code for shaft design, Types and Design of Keys, Design of Couplings- Types, Muff, Rigid, flexible bushed pin type flanged coupling.	07
IV	**Design of Springs:** Types of springs and their applications, Styles of end, Design of Helical Compression Spring subjected to static loading.	05
V	**Design of Power Screw:** Forms of threads, Terminology of Power screw, Torque requirement (lifting and lowering load), Self-locking and overhauling properties, Efficiency of square threaded & Self-locking screw, Trapezoidal and Acme	08

thread, collar friction torque, Design of Screw Jack, Introduction to re-circulating ball Screw.

VI **Design of Pulley and Selection of Belts:**
Belt Constructions, selection of flat and V- belt from Manufacturers Catalogue, Design of Pulley- flat and V belt pulley. 06

Reference/Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Design of Machine Elements	V.B.Bhandari	Tata McGraw Hill Publication	3rd Edition
02	Machine Design	R.K.Jain	Khanna Publication	9th Edition, ISBN: 978-81-7409-286-1
03	Machine Design	Pandya Shah	Charotar Publication	20th Edition, ISBN : 978-93-85039-10-2
04	Design of Machine Elements	P. Kannaiah	Scitech Publication	ISBN-9789352240296
05	Machine Design: A Basic Approach	Dr.S.S. Wadhwa, S S Jolly	Dhanapat Rai and Sons	
06	Machine Design	U.C. Jindal	Pearson Education	1st Edition

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET-304	**Industrial Hydraulics and Pneumatics**	L	T	P	Credits
		02	**--**	**--**	**02**

Prerequisites Fluid Mechanics

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	**Explain[2]**basic principles of hydraulics and pneumatics	02
CO 2	**Explain[2]** the different elements of hydraulic and pneumatic system	02
CO 3	**Develope[3]** hydraulic and pneumatic circuits for different simple applications	03
CO 4	**Utilize[2]** safety regulations and troubleshooting in hydraulic and pneumatic system applications	02

Course Content Hrs

I **Introduction to fluid Power.**

a. Principle of hydraulic system, Types of hydraulic fluids and their properties, selection of fluid, effect of temperature on fluids.
b. Introduction and Application of pneumatics, Physical properties, Principles, basic requirement of pneumatic system, comparison with hydraulic system. 06

II **Hydraulic System Elements:**

a. types of seals, sealing material, pipes, hoses, compatibility of seal with fluid, sources of contamination and its control, strainer, filter, heat-exchanger, reservoir, Types of Actuators and Accumulators.
Principle and types of Pressure control valves, Principle and types of direction Control valves, Principle and types of flow control valves.

Pneumatic System Elements:

b. Air compressor, Different valves used, Pneumatic actuators, Serving of compressed air – types of filters, regulators, lubricators (FRL unit), mufflers, dryers etc. 08

III **Hydraulic Circuits and its Application**

i. Speed control circuits – Meter-in, Meter-out, Bleed off, Regenerative, Fast approach and slow traverse.
ii. Sequence circuits – Travel dependent and Pressure dependent
iii. Synchronizing circuit.
iv. Regenerative circuit.

b) Pneumatic Circuits and its Application

i. Speed control circuits
ii. Impulse operation circuit.
iii. Sequence circuits.
iv. Time delay circuit. 08

IV	a) Hydraulic and Pneumatic servo system for linear and rotary motion. b) Maintenance, troubleshooting and safety of hydraulic and pneumatic systems. c) Introduction to fluidics – study of simple logic gates, turbulence, amplifiers. Pneumatic sensors, applications.	06

Reference/Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Hydraulics and Pneumatics	Shaikh and Khan	R.K. Publication.	
02	Oil hydraulics Systems	S. R. Mujumdar	Tata McGraw Hill Publication	
03	Industrial Fluid Power	S.S. Kuber	NiraliPrakashan	3rd Edition
04	Industrial Hydraulic	J. J. Pipenger	Tata McGraw Hill.	
05	Introduction to Hydraulic and Pneumatics	S. Ilango and V Soundararajan	Prentice Hall of India	2nd Edition
06	Pneumatic Control	Joji P.	Wiley Publication	1st Edition

Curriculum Structure for 'Third Year' B. Tech. Programme A.Y. 2019-20

MET-306	**Internal Combustion Engines**	L	T	P	Credits
		03	**--**	**--**	**03**

Prerequisites MET-207 Thermodynamics, MET-301 Heat & Mass Transfer

Course Outcome	Students will be able to,	Bloom's Level
CO 1	Explain functions of various parts of I.C. engines also working cycles & fuel supply systems of I.C. Engines.	02
CO 2	Explain S.I. & C.I. engine combustion mechanism	02
CO 3	Evaluate different engine performance parameters.	03
CO 4	Explain the impact of vehicular pollution and ways to reduce or control the pollution.	03

Unit No.	**Course Contents**	Hrs
I	**Introduction to I.C. Engines** Introduction: Basic Engine components and Nomenclature, Classification of Engines, The working principle of Engines, Comparison of 2-Stroke and 4-Stroke Engines; CI, and SI Engines, Ideal and Actual Working Cycles and their analysis, Valve timing Diagram.	05
II	**Fuel supply system for S.I. & C.I. engines** Air Fuel Mixture Requirements, Construction and Working of Simple Carburetor, Calculation of Air-Fuel Ratio, Parts of Carburetor, Electronic Petrol injection system (MPFI) – components such as sensors, ECU etc., merits and demerits, Classification of Injection Systems, Fuel Feed pump, Injection Pumps, Nozzles and Fuel Injector, Injection in SI and CI Engines.	06
III	**Combustion in S. I. Engines** Stages of combustion, Ignition lag, Flame propagation, Factors affecting flame speed, Abnormal combustion, Influence of engine design and operating variables on detonation, Fuel rating, Octane number, Fuel additives, HUCR, Requirements of combustion chambers of S.I. Engines and its types.	07
IV	**Combustion in C.I. Engines** Stages of combustion, Delay period, Factors affecting delay period, Abnormal combustion- Diesel knock, Influence of engine design and operating variables on diesel knock, Comparison of abnormal combustion in S.I. and C.I. Engines, Cetane number, Additives. Requirements of combustion chambers for C.I. Engines and its types.	07

V	**Performance parameters for IC Engines:** Measurement of performance parameters like torque, power, Volumetric Efficiency, Mechanical Efficiency, BSFC, Brake and Indicated Thermal efficiencies. Numerical on Heat Balance Sheet and engine performance, Performance curves.	08
VI	**Engine Emission and Control** S.I. engine emission (HC, CO, NOx) Control methods- Evaporative (ELCD), Thermal, Catalytic converters, C.I. Engines Emission (CO, NOx, Smog, Particulate), Control methods- Chemical, EGR, Standard pollution Norms like EURO, Bharat, Introduction to alternative fuels for I.C. engines, Introduction to Supercharging and Turbo-charging.	07

Reference /Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Internal Combustion Engines	V. Ganesan	Tata McGraw Hill Publication	2012
02	Internal Combustion Engines	Mathur and Sharma	DhanpatRai Publication , Delhi	
03	Internal Combustion Engines	Domkundwar	DhanpatRai Publication	
04	Internal Combustion Engines	Ramlingam,	SciTech Publication	
05	Internal Combustion Engines	Maleev	CBS Publication and Distributors	
06	Internal Combustion Engines	J. B. Heywood	Tata McGraw Hill Publication	
07	Internal Combustion Engines	Gills and Smith	Oxford and IBH Publishing Company	
08	Engineering Fundamentals of the I.C. Engines	W.W. Pulkrabek	Pearson Education	
09	Internal Combustion Engines Fundamentals	E. F. Obert	Harper and Row Publication, New York.	
10	Diesel and High Compression Gas Engines	P. M. Kates		

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MET 308.1	**Mechanical Vibrations**	L	T	P	Credits
		03	**--**	**--**	**03**

Prerequisites Types of motions, Force analysis, Free body diagrams, matrices, etc

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Develop mathematical model to represent dynamic system	04
CO 2	Estimate natural frequency of mechanical system.	04
CO 3	Analyze vibratory response of mechanical system	04
CO 4	Estimate the parameters of vibration isolation system	04
CO 5	Carryout measurement of various vibration parameters	03
CO 6	Understand relevance of noise in mechanical systems	02

	Course Content	Hrs
I	**Introduction:** Vibration and oscillation, Causes and effects of vibrations, Vibration parameters – spring, mass, damper, Damper models, Motion – periodic, non-periodic, harmonic, non- harmonic, Degree of freedom, Static equilibrium position, Vibration classification, Steps involved in, vibration analysis, Simple harmonic motion, Vector and Complex method of representing, vibration, Fourier series and harmonic analysis.	04
II	**Single DOF System :** a) Undamped free vibrations, Damped free vibrations, Types of damping, Logarithmic decrement and damping materials. b) Forced Vibrations: Types of excitation, Forced excitation, Support excitation, Excitation due to unbalance in machines, Response of systems to above types of harmonic excitations, Transmissibility-Force transmissibility and motion transmissibility, Vibration isolators, commercial isolation materials and shock mounts.	08
III	**Two DOF System :** a) Free undamped vibrations – Principal modes and natural frequencies, Co-ordinate coupling and principal co-ordinates. b) Forced vibrations (Undamped) – Harmonic excitation, Vibration Dampers and absorbers, Dynamic vibration absorber – Tuned and Untuned type	08

IV	**Introduction to Multi DOF System :** a) Free vibrations of Multi DOF System-Flexibility and stiffness influence coefficient matrix, Equation of motion b) Rayleigh's method, Matrix iteration method and Holzer method	07
V	**Vibration Measuring Instruments :** Instruments for measurement of displacement, velocity, acceleration and frequency of vibration, Sensors and Actuators, Introduction of X – Y plotter, Spectral analyzers, Exciters FFT analyzer. Introduction to Condition Monitoring and Fault Diagnosis	05
VI	**Introduction to Noise :** **a) Sound Level and Subjective Response to Sound** Frequency dependent human response to sound, Sound pressure dependent human response, Decibel scale, Relation among sound power, Sound intensity and sound pressure level, Octave Band Analysis. **b) Noise- Effects, Rating and regulation** Non auditory effects of noise on people, Auditory effects of noise, Noise standards and limits, Ambient emission noise standards in INDIA, Hazardous noise explosion, Day night noise level, Noise sources and control, Automotive noise control principles, Sound in enclosures, Sound energy absorption, Sound transmission through barriers.	08

Reference /Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Mechanical Vibrations	Singiresu S.Rao	Pearson Education,	ISBM –81-297-0179-0 -(2004).
02	Mechanical Vibrations	G. K. Grover,	Nemchand and Brothers, Roorkee	
03	Mechanical Vibrations	Dr. V. P. Singh,	S. Chand and Sons New Delhi.	
04	Theory of Vibrations with Applications	W. Thomson	Pearson Education,	2nd Edition
05	Mechanical Vibration and Noise Engineering	A. G. Ambekar	Prentice Hall of India	

MET 308.2	**Production & Operations Management**	L	T	P	Credits
		03	**--**	**--**	**03**

Prerequisites Engineering Management, Basic Mechanical Engineering, Production Engineering Courses.

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Select appropriate production and operation strategies based on situation.	03
CO 2	Estimate the demand using appropriate forecasting techniques.	03
CO 3	Plan the capacity based on the demand pattern and prepare the manufacturing schedule based on the production plan.	03
CO 4	Apply lean tools for manufacturing and services operations	03

	Course Content	Hrs
I	**Operations Management Trends and Issues:** Scope and Objectives of POM. Products and services, Services as part of operations. Operations as key functional area in organization, Operations challenges, Operations strategy relevance, order qualifying and order winning criteria, core competence, Strategy formulation process, Strategic options for operations, Choice of strategy.	07
II	**Designing Operations:** Designing of processes, Determinants of process characteristics, Types of processes and operations systems, Process-productmatrix.Process design issues in services, Technology issues in process design, Choice of Technology and processes, economic considerations in process choice, Costing of processes.	06
III	**Forecasting and Planning:** Need and importance of Forecasting, Forecasting Techniques: Delphi Method, Simple and Moving average, Exponential Smoothing, Correlation and Regression Analysis, Different types of Planning, Capacity measures,capacityplanningframework,capacitystrategies,capacityestimation,Aggregate planning, strategies Pure and mixed strategies, Level and chase strategies.	07

IV	**Job Sequencing and Operations Scheduling:** Master Production Schedule, MRP, Detail scheduling, Machine loading and sequencing: Johnson's rule and GANTT chart, Assembly line balancing: Line efficiency, balance delay, smoothing index, Different techniques of balancing,	06
V	**Lean and JIT manufacturing:** Philosophy of lean, concept of lean machine, Toyota Manufacturing system, Tools and techniques of lean manufacturing and applications-5S program, SMED, VSM, TPM, Core logic of JIT, Elements of JIT manufacturing, IT implementation steps, impact of JIT on performance of firms, Issues in implementation	07
VI	**Global Manufacturing Practices and New Trends:** Manufacturing practices in developed and developing nations, Technologies for Industry 4.0, quality issues, Quick Response Manufacturing (QRM), Cellular manufacturing.	06

Reference Books

Sr. No.	Name of Book	Author(s)	Publisher
01	Industrial Engineering and Production Management	Martand Telsang	S. Chand & Co. NewDelhi,2006
02	Operations Management	Amol Gore, Robert Pannizolo	Cengage Learning
03	Production & Operations Management	S.N. Chary	McGraw Hill Publication
04	Production & Operations Management – An applied modern Approach	Joseph S. Martin	John Wiley and Sons (Asia) Pvt. Ltd., Singapore
05	Operations Management	B. Mahadevan	Pearson Education
06	Logistics Engineering & Management	Bejamin S. Blanchard	Pearson Education Asia
07	Modern Production Management	E.S. Buffa	John Wiley
08	Production Management	Lockyer	ELBS
09	Production Management	R. Mayer	McGraw Hill

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		L	T	P	Credits
MET – 308.3	**Heat Exchangers**	**03**	**--**	**--**	**03**

Prerequisites MET-207 Thermodynamics, MET -307 Heat & Mass Transfer

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Understand the design variable and thermodynamics of each component of a heat exchanger.	2
CO 2	Understand the linked system performance of all kinds of heat exchangers	3
CO 3	Understand the basis of air cooled heat exchanger.	2

Course Content Hrs

I **Introduction To Heat Exchanger Design:**
Types of heat exchangers and their applications. Flow arrangements and temperature distributions in transfer type of heat exchangers. Overall heat transfer coefficient;- Clean overall heat transfer coefficient, dirt factor dirt overall heat transfer coefficient, dirt factors for various process services. Basic design equation. Mean temperature difference Concept: - LMTD for parallel flow and counter flow arrangement, correction factor for LMTD for cross flow and multi –pass heat exchangers. 06

II **Shell And Tube Heat Exchangers:**
Constructional features. Applications. Effectiveness-NTU method for heat exchanger design/ analysis. Rating and sizing problem. Correlations for tube side pressure drop and heat transfer coefficients. Pressure drop and heat transfer coefficient correlations for shell side flow. 06

III **Effect Of By – Pass And Leakage Calculation Procedure For Shell And Tube Heat Exchanger:**
Heat balance equations: LMTD: reference temperature calculations: evaluation of fluid properties: flow assignments: tube side flow area calculations; viscosity correction factor, shell side equivalent diameter, calculation of shell side heat transfer coefficient, evaluation for wall temperature, evaluation of overall heat transfer coefficient, Calculation of surface area. Calculations of tube side and shell side pressure drops. 08

IV **Steam Condensers:**
Specifications of other details as per TEMA standards. Flow arrangement for increased heat recovery: - lack of heat recovery in 1-2 exchangers true temperature difference in a 2-4 exchanger. Calculation procedure for steam condensers. 06

V **Double Pipe Heat Exchangers:**
Constructional features. Applications. Design parameters :- tube side and shell side film coefficients cut and twist factor, fin efficiency, overall heat transfer coefficient, mean temperature difference, available surface area, fin geometry fin height, number of fins, tube side and shell side pressure drop. Calculation procedure for the design/analysis of double pipe heat exchanger. 06

VI **Compact Heat Exchangers:**
Introduction; definition of Geometric Terms: plate fin surface geometries and surface performance data; correlation of heat transfer and friction data; Goodness factor comparisons;
Air-Cooled Heat Exchangers:
Air as coolant for industrial processes; custom-built units; fin-tube systems for air coolers; fin-tube bundles; tube side flow arrangements; cooling air supply by fans; cooling air supply in natural draft towers. 08

Reference /Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Process Heat Transfer	G F Hewuttm G L Shires and T R Bott	CRC Press	1994
02	Fundamentals of Heat Exchanger Design	R K Shah and D P Sekulic	John Wiley & Sons	2003
03	Heat Exchangers	A Kakac, H Liu	CRC Press	2002
04	Handbook for Heat Exchangers and Tube Banks Design	D. Annaratone	Springer Verlag	2010
05	Compact Heat Exchangers	J.E. Hesselgreaves	Pergamon	2001.
06	Advances in Thermal Design of Heat Exchangers	Eric M Smith	John Wiley & Sons, Ltd	2005

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MET-308.4	**Automotive Diagnostics**	L	T	P	Credits
		03	**--**	**--**	**03**

Prerequisites Nil

Course Outcomes	Course Outcome	Bloom's Level
CO 1	Compare different types of maintenance records.	2
CO 2	Identify faults in engine, transmission systems, to improve tune up	1
CO 3	Choose appropriate chassis maintenance method	3
CO 4	Explain electrical system maintenance	1

Unit No.	**Course Contents**	Hrs
I	**Maintenance record and schedule** Need for maintenance, types of maintenance: preventive and breakdown maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance: General safety, tool safety.	06
II	**Engine subsystem maintenance** Servicing and maintenance of fuel system, cooling system: water pump, radiator, thermostat. Lubrication system maintenance, Lubrication Charts, Anticorrosion and anti freeze additives	06
III	**Engine maintenance** Tools used for engine disassembly, dismantling of engine components: cylinder head, valve train, cylinder block, connecting rod, piston and crankshaft assembly; cleaning and inspection of engine components, reconditioning of components, engine tune-ups	07
IV	**Transmission System maintenance** Servicing and maintenance of clutch, gear box, universal joints, propeller shaft, differential system, wheel balancing, wheel alignment, maintenance of tyre and tyre rotation	07
V	**Chassis maintenance** Servicing and maintenance of brake – disc and drum brakes, steering wheel and suspension systems, servicing and maintenance of front and rear axle	07

VI	**Electrical system maintenance** Servicing and maintenance of battery, starter motor, alternator and generator, ignition system, lighting system, electric horn, and wiper motor	06

Reference /Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Auto Service & Repair: Servicing, Troubleshooting, and Repairing Modern Automobiles: Applicable to All Makes and Models	Martin W. Stockel, Martin T. Stockel, Chris Johanson	Goodheart-Willcox Publisher	1996
02	Advanced Engine Performance Diagnosis	James D Halderman	PHI	1998
03	Everyday Automobile Repair	Crouse W	Intl. student edition, TMH, New Delhi	1986
04	Car maintenance and repair	A. W. Judge	Motor manual	
05	Auto Diagnosis, Service, And Repair	Martin T. Stockel, Chris Johanson	Goodheart-Willcox Publisher	2003

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MET-310	**Industrial Hydraulics and Pneumatics Lab**	L	T	P	Credits
		--	**--**	**02**	**01**

Prerequisites Fluid Mechanics

Tools Used	Required Tools /Machinery /Equipments /Software /Other
1	Hydraulic trainer kit
2	Pneumatic trainer kit
3	Fluid simulation software

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	**Explain**[2]basic principles of hydraulics and pneumatics	02
CO 2	**Explain**[2] the different elements of hydraulic system	02
CO 3	**Demonstrate** [2]control of fluid power using valves	02
CO 4	**Explain**[2]the different elements of pneumatic system	02
CO 5	**Develope**[3] hydraulic and pneumatic circuits for different simple applications	03
CO 6	**Utilize**[2] safety regulations and troubleshooting in hydraulic and pneumatic system applications	02

Course Content

	Activity	Hrs
I	Study of ISO/JIC Symbols for hydraulic and pneumatic systems	02
II	Study of Hydraulic and Pneumatic system components	02
III	Study of different types of valves used in hydraulic and pneumatic system.	02
IV	Circuit preparations on hydraulic trainer kit.	02
V	Circuit preparations on pneumatic trainer kit.	02
VI	Circuit preparations using fluid simulation software	02
VII	Troubleshooting and maintenance of Hydraulic and Pneumatic systems & Study of fluidics	

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book /Handbooks /Catalogues*	*Author (s)*	*Publisher /Organization*	*Edition, Year of Publication, ISBN*
01	Hydraulics and Pneumatics	Shaikh and Khan	R.K. Publication.	
02	Oil hydraulics Systems	S. R. Mujumdar	Tata McGraw Hill Publication	
03	Industrial Fluid Power	S.S. Kuber	NiraliPrakashan	3rd Edition
04	Industrial Hydraulic	J. J. Pipenger	Tata McGraw Hill.	
05	Introduction to Hydraulic and Pneumatics	S. Ilango and V Soundararajan	Prentice Hall of India	2nd Edition
06	Pneumatic Control	Joji P.	Wiley Publication	1st Edition
01	Hydraulics and Pneumatics	Shaikh and Khan	R.K. Publication.	
02	Oil hydraulics Systems	S. R. Mujumdar	Tata McGraw Hill Publication	

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MET-312	**Internal Combustion Engines Lab**	L	T	P	Credits
		--	**--**	**02**	**01**

Prerequisites 207 Thermodynamics, MET-301 Heat & Mass Transfer

Tools Used — Required Tools /Machinery /Equipments /Software /Other

Single cylinder four stroke Diesel engine test rig
Multi cylinder four stroke Petrol engine test rig
Computerized I C Engine software

Course Outcome	Students will be able to,	Bloom's Level
CO 1	Demonstrate fuel supply systems, ignition and governing systems of IC Engines.	02
CO 2	Measure operating characteristics of IC Engines.	05
CO 3	Compare the experimental results with theoretical trends	02
CO 4	Make use of AVL gas analyzer for measurement of emissions.	03

	Activity	Hrs
I	Constructional detail of I.C. engines, dismantling and assembly	02
II	Study and Demonstration of Engine systems: Air intake, Exhaust, Cooling, Lubrication systems	02
III	Study and Demonstration of Ignition systems, Starting systems	02
IV	Study and Demonstration of fuel supply systems for IC Engines. (S.I & C.I)	02
V	Test on four stroke Diesel Engine and compare the analytical solution using computer controlled I.C. Engine	02
VI	Test on four stroke Petrol Engine	02
VII	Morse Test on Multi Cylinder Engine	02
VIII	Measurement of exhaust emissions of SI / CI Engines.	02
IX	Visit to an engine manufacturing company / repairing unit	02

Reference /Text Books

Sr. No.	Name of Book	Author(s)	Publisher	Edition, Year of Publication, ISBN
01	Internal Combustion Engines	V. Ganesan	Tata McGraw Hill Publication	2012
02	Internal Combustion Engines	Mathur and Sharma	DhanpatRai Publication , Delhi	
03	Internal Combustion Engines	Domkundwar	DhanpatRai Publication	
04	Internal Combustion Engines	Ramlingam,	SciTech Publication	
05	Internal Combustion Engines	Maleev	CBS Publication and Distributors	
06	Internal Combustion Engines	J. B. Heywood	Tata McGraw Hill Publication	
07	Internal Combustion Engines	Gills and Smith	Oxford and IBH Publishing Company	
08	Engineering Fundamentals of the I.C. Engines	W.W. Pulkrabek	Pearson Education	
09	Internal Combustion Engines Fundamentals	E. F. Obert	Harper and Row Publication, New York.	
10	Diesel and High Compression Gas Engines	P. M. Kates		

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MET 314.1	Mechanical Vibrations	L	T	P	Credits
		--	--	**02**	**01**

Prerequisites Types of motions, Force analysis, Free body diagrams, matrices, etc

Tools Used Required Tools /Machinery /Equipments /Software /Other

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Explain concepts of vibration and single degree of freedom systems.	02
CO 2	Solve numerical on two degree of freedom systems.	02
CO 3	Explain multi degree of freedom systems.	02
CO 4	Explain working principle of various vibration measuring instruments.	02
CO 5	Explain concepts of noises and the ways to control it	02

Course Content (Laboratory, Assignments, Mini Project, Seminar)

	Activity	Hrs
I	Experiment on equivalent spring mass system	02
II	Experiment on study of forced vibration characteristics	02
III	Determination of logarithmic decrement for single DOF damped system	02
IV	Experiment on torsional vibration of two rotor without damping	02
V	Experiment on free vibration of a coupled pendulum and/or double pendulum	02
VI	Use of different types of exciters for vibration analysis	02
VII	Measurement of vibration parameters using vibration measuring instruments	02
VIII	Introduction to FFT analyzer, and prediction of spectral response of vibrating machine from workshop.	02
IX	At least two case studies in detail based on Conditioning Monitoring and Fault Diagnosis	02
X	Measurement of Noise by using noise measuring instruments	02

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	Name of Book /Handbooks /Catalogues	Author (s)	Publisher /Organization	Edition, Year of Publication, ISBN
01	"Mechanical Vibrations"	Singiresu S.Rao	Pearson Education,	ISBM –81-297-0179-0 - (2004).
02	"Mechanical Vibrations",	G. K. Grover,	Nemchand and Brothers, Roorkee	
03	"Mechanical Vibrations",	Dr. V. P. Singh,	S. Chand and Sons New Delhi.	
04	"Theory of Vibrations with Applications",	W. Thomson	Pearson Education,	2nd Edition
05	"Mechanical Vibration and Noise Engineering",	A. G. Ambekar	Prentice Hall of India	

MET 314.2	**Production and Operations Management Lab**	L	T	P	Credits
		--	**--**	**02**	**01**

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Plan capacity planning and aggregate planning	2
CO 2	Recommend strategy for inventory control	2
CO 3	Select an appropriate inventory control technique	2
CO 4	Calculate OEE	2

	Activity	Hrs.
I	Operations strategy of a form study and analysis A case study	02
II	Application of Breakeven analysis for process/machine selection	02
III	Capacity estimation of machines/equipment.	02
IV	Aggregate planning strategies- problems and preparation of an aggregate plan.	03
V	Draw and analyze different charts for production planning and control	03
VI	Case study of production scheduling techniques.	03
VII	Case study on JIT implementation- in medium context.	02
VIII	Computation of OEE and total productive maintenance.	04
IX	Industry assignment to understand the practical/ application aspects of production and operation management.	02

Reference Books

Sr. No.	Name of Book	Author(s)	Publisher
01	Industrial Engineering and Production Management	Martand Telsang	S. Chand & Co. NewDelhi,2006
02	Operations Management	Amol Gore, Robert Pannizolo	Cengage Learning
03	Production & Operations Management	S.N. Chary	McGraw Hill Publication
04	Production & Operations Management – An applied modern Approach	Joseph S. Martin	John Wiley and Sons (Asia) Pvt. Ltd., Singapore
05	Operations Management	B. Mahadevan	Pearson Education
06	Logistics Engineering & Management	Bejamin S. Blanchard	Pearson Education Asia
07	Modern Production Management	E.S. Buffa	John Wiley
08	Production Management	Lockyer	ELBS
09	Production Management	R. Mayer	McGraw Hill

		L	T	P	Credits
314.3	**Heat Exchangers Lab**	**--**	**--**	**02**	**01**

Prerequisites MET-207Thermodynamics, MET -307Heat & Mass Transfer

Course Outcomes	Students will be able to,	Bloom's Level
CO 1	Understand the design variable and thermodynamics of each component of a heat exchanger.	02

Course Content (Laboratory, Assignments, Mini Project, Seminar)

	Activity	Hrs
I	Demonstration of different types of heat exchangers	02
II	Trial on tube in tube type Heat exchanger (parallel flow)	02
III	Trial on tube in tube type Heat exchanger (counter flow)	02
IV	Data collection for Specifications of heat exchangers details as per TEMA standards	02
V	Calculation of surface area. Calculations of tube side and shell side pressure drops.	02
VI	Demonstration of Air cooled condenser.	02
VII	Industrial visit for special type of heat exchangers.	02

Reference /Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Process Heat Transfer	G F Hewuttm G L Shires and T R Bott	CRC Press	1994
02	Fundamentals of Heat Exchanger Design	R K Shah and D P Sekulic	John Wiley & Sons	2003
03	Heat Exchangers	A Kakac, H Liu	CRC Press	2002
04	Handbook for Heat Exchangers and Tube Banks Design	D. Annaratone	Springer Verlag	2010

MET-314.4	Automotive Diagnostics Lab	L	T	P	Credits
		--	--	02	01

Prerequisites Automobile Engineering, Auto chassis & Body Engineering

Tools Used Required Tools /Machinery /Equipments /Software /Other

Single cylinder four stroke SI/CI engine
Wheel balancing & wheel alignment machine
Components of Transmission system

Course Outcomes	Students will be able to,	Bloom's Level
CO 314.4.01	Inspect different engine & Chassis components during overhauling	4
CO 314.4.02	Make use of machine for wheel alignment, wheel balancing and head light beam alignment.	3

Course Content (Laboratory, Assignments, Mini Project, Seminar)

	Activity	Hrs
I	Petrol/diesel engine tune up	02
II	Engine top overhaul	02
III	Cleaning and testing of spark plug	02
IV	Cleaning and testing of injector	02
V	Wheel alignment and balancing	02
VI	Headlight beam alignment	02
VII	Overhauling of clutch	02
VIII	Overhauling of gearbox	02
IX	Overhauling of differential and axles	02
X	Overhauling of braking system	02

Reference /Text Books

Sr. No.	Name of Book	Author(s)	Publisher	Edition, Year of Publication, ISBN
01	Auto Service & Repair: Servicing, Troubleshooting, and Repairing Modern Automobiles: Applicable to All Makes and Models	Martin W. Stockel, Martin T. Stockel, Chris Johanson	Goodheart-Willcox Publisher	1996
02	Advanced Engine Performance Diagnosis	James D Halderman	PHI	1998
03	Everyday Automobile Repair	Crouse W	Intl. student edition, TMH, New Delhi	1986
04	Car maintenance and repair	A. W. Judge	Motor manual	
05	Auto Diagnosis, Service, And Repair	Martin T. Stockel, Chris Johanson	Goodheart-Willcox Publisher	2003

		L	T	P	Credits
MET-316	**Mini Project (Hard / Soft)**	**--**	**--**	**02**	**01**

Students are required to prepare an output based task through Mini Project. The Mini Project may consists of Mechanism based (Hard) or Software based (Soft).

		L	T	P	Credits
MET-318	**Software Proficiency – II**	**--**	**--**	**04**	**02**

Software Proficiency is a part for enhancing the design and manufacturing skills using advanced CAD/CAM/CAE as well as programming software.

Student has to learn the modules of software like Solid Modeling, Surface Modeling, Assembly Modeling, Analysis, Mechanism Design, Synthesis of Mechanism, Synthesis of Design, Programming, etc. by using software among like PTC-Creo, CATIA, ADAMS, ABACUS, ANSYS, C++, Java, etc.

These software & modules are been selected based on the level of learning for the students and requirements of the industry.

Some of the software modules are mentioned below and may change as per requirement.

Sr.	Code	Course Code	Course
01	PE-2	MET-318.1	1. Creo / CATIA : Sheet Metal
02	PE-2	MET-318.2	2. ADAMS : Mechanism & Analysis (MBD)

		L	T	P	Credits
MET 320	**Internship**	**--**	**--**	**--**	**01**

After the end of Semester V, student has to go for industry internship for the duration of minimum 03 weeks. The evaluation of the internship will be done in the Semester VI.

		L	T	P	Credits
MET 322	**Scholastic Program**	**03**	**--**	**--**	**NC**

Scholastic Program is conducted to enhance the students education as well as to his/her career.
