PRASAD V POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)

ACADEMIC RULES &REGULATIONS (PVP19)
and
FOUR YEAR B.Tech Course Structure, First Year Syllabus

Applicable for the batch of students admitted from the Academic Year 2019-2020

Mechanical Engineering

PRASAD V. POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY
(Autonomous)
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w.e.f. A.Y 2019 – 2020

PREFACE

PVP Siddhartha Institute of technology, established in 1998, is one of the seventeen educational institutions sponsored and run by Siddhartha Academy of General & Technical Education. The 250 members of the Academy are a group of industrialists, educationists, auditors and philanthropists with vast experience in their respective fields and above all with an ardent desire to spread quality Education. All the academic organizations of Siddhartha Academy stand symbolic of the pragmatic vision of its founders. PVP Siddhartha Institute of Technology has the advantage of inheriting the higher academic standards. The college is approved by AICTE and is permanently affiliated to JNTUK. It is certified by ISO 9001-2015 for its quality standard. It is accredited by the National Board of Accreditation and NAAC with A^+ grade. Moreover, it is an Autonomous College.

The curriculum is revised continuously to address the challenges of industry and academia and to foster the global competencies among the students. The curriculum is revised two times since 2012. The present curriculum(PVP19) is designed incorporating the features such as outcome based approach, Choice Based Credit System, encouraging self-learning through MOOCs platforms i.e., Swayam, Courses Era, EDX, NPTEL, etc., Transformation of creative ideas into a prototype through project phase I & phase II, enhancing depth & breadth by introducing more number of programs, open &interdisciplinary electives in core and multi-disciplinary areas, offering courses by industry experts to improve Industry Institute Interaction in addition to internships at industry and introduction of wide range of value added courses beyond curriculum to choose according to their interest to enhance their skills and employability.

Institute Vision

To provide rich ambience for Academic and Professional Excellence, Research, Employability skills, Entrepreneurship and Social responsibility.

Institute Mission

To empower the students with Technical knowledge, Awareness of up-to-date technical trends, Inclination for research in the areas of human needs, Capacity building for Employment / Entrepreneurship, Application of technology for societal needs.

Quality Policy

At PVPSIT, We commit ourselves to offer Quality professional education in engineering & Management by adhering to applicable statutory and regulatory requirements and through continuous improvement in the Quality of our services by,

- Regular up gradation of knowledge and skills of faculty
- Improving the teaching methods and strategies
- Providing state of art infrastructure
- Recruiting competent faculty and maintaining prescribed Teacher Student ratio
- Improving the employability of students
- Enhanced Collaboration with industry and institutions of National Repute

ME Department Vision

To enhance the capabilities of students and mould them into innovative, employable, entrepreneurial, socially responsible graduates successful in advanced fields of research

ME Department Mission

To impart quality education, ethical values, social responsibility, employability, research and entrepreneurial skills

ME Department Program Educational Objectives

PEO-I: Progress in wide range of mechanical engineering fields with solid foundation in physical and engineering sciences.
PEO-II: Contribute as members of multidisciplinary engineering teams, solve mechanical engineering and allied field problems resulting in significant societal development.
PEO-III: Achieve goals by pursuing higher studies / research, become entrepreneurs.
PEO-IV: Become responsible citizens by undertaking active role in their community.

Program Outcomes

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

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

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

PO - 4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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

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

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

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

PO - 9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

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

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

ME Department Program Specific Outcomes

PSO - 1: Apply Engineering Principles for design, manufacturing and maintenance of mechanical systems

PSO - 2: Execute multidisciplinary projects and exhibit managerial, leadership and entrepreneurial skills

CONTENTS

1. SHORT TITLE AND COMMENCEMENT

a. The regulations listed under this head are common for all degree level undergraduate programmes (B.Tech.), offered by the college with effect from the academic year 2019-20 and they are called as "PVP19" regulations.

b. The regulations here under are subjected to amendments as may be made by the Academic Council of the college from time to time, keeping in view of the recommendations of the Board of Studies. Any or all such amendments will be effective from such date and to such batches of candidates including those already undergoing the programme, as may be decided by the Academic Council.

2. DEFINITIONS

a. "**Commission**" means University Grants Commission(UGC);

b. "**Council**" means All India Council for Technical Education(AICTE);

c. "**University**" means Jawaharlal Nehru Technological University Kakinada(JNTUK);

d. "**College**" means Prasad V Potluri Siddhartha Institute of Technology, Vijayawada;

e. An **Academic Programme** means any combination of courses and/or requirements leading to award of a degree.

f. "**Course**" means a subject either theory or practical identified by its course title and code number and which is normally studied in a semester.

g. "**Degree**" means an academic degree conferred by the university upon those who complete the under graduate curriculum.

h. "**CBCS**" means Choice Based Credit System

i. "**MOOC**" means Massive Open Online Course

j. "**Regular Students**" means students enrolled into the four year programme in the first year.

k. "**Lateral Entry Students**" means students enrolled into the four year programme in the second year.

3. ACADEMIC PROGRAMMES

3.1 Nomenclature of Programmes

3.1.1 The nomenclature and its abbreviation given below, shall continue to be used for the Degree programmes under the University, as required by the Council and the Commission:

Bachelor of Technology (B. Tech)

Besides, the name of specialization shall be indicated in brackets after the abbreviation, for example, engineering degree in Mechanical Engineering programme is abbreviated as B.Tech(Mechanical Engineering).

3.1.2 Bachelor of Technology (B. Tech.) degree programme is offered in:

1. Civil Engineering(CE)
2. Computer Science and Engineering(CSE)
3. Electronics and Communication Engineering(ECE)
4. Electrical and Electronics Engineering(EEE)
5. Information Technology(IT)
6. Mechanical Engineering(ME)

4. DURATION OF THE PROGRAMMES

4.1 Normal Duration

4.1.1. The duration of an academic programme shall be four years consisting of eight semesters.

4.1.2. The duration of the programme for lateral entry students who are admitted in II year shall be three years that consists of six semesters.

4.2 Maximum Duration

4.2.1 The maximum period for which a student can take to complete a full time academic programme shall be double the normal duration of the programme, i.e., for regular students eight years, for lateral entry students six years.

4.3 Minimum Duration of a Semester

Each semester consists of a minimum of 90 instruction days with about minimum 20 and maximum 33 contact hours per week.

5. ADMISSION CRITERIA

The eligibility criteria for admission into UG Engineering programmes are as per the norms approved by Government of Andhra Pradesh from time to time.

The sanctioned seats in each programme in the college are classified into CATEGORY-A, and CATEGORY-B at I year level and only CATEGORY-A at Lateral Entry II year level.

The percentages of Category–A, Category-B and Lateral Entry Seats are decided from time to time by the Government of Andhra Pradesh.

5.1 CATEGORY – A Seats

Category - A seats are filled as per the norms approved by the Government of Andhra Pradesh.

5.2 CATEGORY – B Seats

Category - B seats are filled by the College as per the norms approved by the Government of Andhra Pradesh.

5.3 CATEGORY - Lateral Entry Seats

Lateral entry candidates shall be admitted into the III semester directly as per the norms approved by Government of Andhra Pradesh.

6. CREDIT SYSTEM AND GRADEPOINTS

6.1 Credit Definition

'Credit' means quantified and recognized learning. Credit is measured in terms of contact hours per week in a semester. Typically one credit is given to:

(a) Theory/Tutorial course conducted for one contact period.

(b) Laboratory course conducted for two contact periods.

Each course is assigned a certain number of credits depending upon the number of contact hours (Lectures/Tutorials/Practical) per week.

The curriculum of the eight semesters B.Tech program is designed to have a total of 160 credits for the award of B.Tech degree.

For lateral entry students, the curriculum of six semesters B.Tech program is designed to have a total of 121.5 credits for the award of B.Tech degree.

6.2 Semester Course Load

The average course load shall be fixed at 20 credits per semester with its minimum and maximum limits being set at 13 and 24.5 credits.

6.3 Grade Points and Letter Grade for a Course

The grade points and letter grade will be awarded to each course based on student's performance as per the grading system shown in the Table1.

Table 1: Grading System for B. Tech Programme

Theory/Drawing % of Marks	Laboratory/Project % of Marks	Grade Points	Letter Grade
≥ 90%	≥ 90%	10	S
80 – 89%	80 – 89%	9	A
70 - 79%	70 - 79%	8	B
60 - 69%	60 - 69%	7	C
50 - 59%	55 - 59%	6	D
40 - 49%	50 – 54%	5	E
< 40%	< 50%	0	F (FAIL)
ABSENT	ABSENT	0	AB

6.4 Semester Grade Points Average (SGPA)

The performance of each student at the end of the each semester is indicated in terms of SGPA calculated as shown in equation (1).

$$SGPA = \frac{\sum(CR \times GP)}{\sum CR(for\ all\ coursed\ offered\ in\ the\ semester)} \quad (1)$$

Where CR= Credits of a course

GP = Grade points awarded for a course

6.5 Cumulative Grade Point Average (CGPA)

The Cumulative Performance of each student at the end of each semester is indicated in terms of CGPA which is calculated as shown in equation (2).

$$CGPA = \frac{\sum CR\ X\ GP}{\sum CR(for\ all\ courses\ offered\ upto\ that\ semester/entire\ program)} \quad (2)$$

Where CR = Credits of a course

GP = Grade points awarded for a course

Percentage equivalent of CGPA = (CGPA – 0.5) * 10

7. CURRICULUM FRAMEWORK

7.1 General Issues

7.1.1 Curriculum framework is important in setting the right direction for a degree programme as it takes into account the type and quantum of knowledge necessary to be acquired by a student in order to qualify for the award of degree in his/her chosen branch or specialization.

7.1.2 Besides, this also helps in assigning the credits for each course, sequencing the courses semester-wise and finally arriving at the total number of courses to be studied and the total number of credits to be earned by a student in fulfilling the requirements for conferment of degree.

7.1.3 Each theory course shall consist of five units.

7.2 Curriculum Structure

The curriculum is designed to facilitate CBCS and incorporates courses required to attain the expected knowledge, skills and attitude by the time of graduation as per the needs of the stakeholders. The curriculum structure consists of various course categories (as described in 7.2.1 to7.2.6) to cover the depth and breadth required for the programme and for the attainment of programme outcomes of the corresponding programme.

7.2.1 Institutional Core

Institutional Core consists of the courses required for all UG Engineering Programmes offered in this college. The courses offered under this category cover the required knowledge in the following areas:

(a) Basic Sciences:

Basic Science courses include Engineering Physics, Applied Physics, Engineering Physics Lab, Applied Physics Lab, Engineering Chemistry, Chemistry of Materials, Engineering Chemistry Lab, Chemistry of Materials Lab, Mathematics I(calculus and Algebra), Engineering Mathematics II (ODE, PDE and Multivariable Calculus), Engineering Mathematics III, Engineering Mathematics IV, Life Sciences for Engineers and Life Sciences for Engineers Lab.

(b) Engineering Sciences:

Engineering Science courses include Problem Solving and Programming, AI Tools, Internet of Things, Design Thinking & Product Innovation, Basic Electrical and Electronics Engineering, Engineering Graphics, Problem Solving & Programming Lab, Basic Electrical & Electronics Engineering Lab, AI Tools Lab, Internet of Things Lab, Design Thinking and Product Innovation Lab and Basic Workshop.

(c) Humanities and Social Sciences:

Humanities and Social Science Courses consist of Communicative English I, Communicative English II, HS-I(Engineering Economics & Management), HS-II(Organizational Behavior), Communicative English I Lab and Communicative English II Lab.

7.2.2 Elective Courses

Elective courses are offered across the programmes to enhance the knowledge breadth and professional competency of the students.

Courses	Branch Specific	Compulsory
Elective courses	Program Electives	Supportive to the discipline courses with expanded scope in a chosen track of specialization or cross track courses
	Interdisciplinary Electives	Interdisciplinary exposure & nurture the student interests in other department courses
	Open Electives	Common to all disciplines that helps general interest of a student

Greater flexibility to choose variety of courses is provided through Massive Open Online Courses (MOOCs) during the period of study. Students without any backlog courses upto III semester are permitted to register for MOOCs from IV semester onwards upto a maximum of 15 credits from Program Elective/Interdisciplinary Elective/Open Elective Courses. However, the Departmental Committee (DC) has to approve the courses under MOOCs. The Departmental committee consists of Head of the Department, Program coordinator and Module Coordinator.

Students can register and complete the opted course in approved MOOCs platform on or before the last instruction day of IV/V/VI/VII semester. They have to submit the pass certificate before the last instruction day of that concerned semester.

7.2.3 Programme Core

The Programme core consists of set of courses considered which are necessary for the students of the specific programme. The courses under this category satisfy the Programme Specific Criteria prescribed by the appropriate professional societies.

7.2.4 Project

Project Phase I& ProjectPhase IIwill be initiated in VII semester and completed before the end of VIII semester.

Project Phase Ican be done by a group of students, working under the

guidance of a faculty member and carrying out a detailed feasibility study, literature survey and submit a report regarding work plan for the project phase II.

Project Phase II involves continuation of Project Phase I. The objective is to complete the work as per the prepared work plan and submit a detailed project report.

7.2.5 Industry Interaction

The students may register for either Internship or Industry offered course during the summer break after VI semester to secure 2 credits.

Internship/Industry offered courses are purely meant for internal Assessment which will be evaluated for 75 marks during the VII semester.

a) Internships

The students may undergo Internship for 3 to 6 weeks duration in the industry approved by respective head of the department at the end of VI semester.

b) Industry offered courses

The students can opt for the courses under this category that are offered by the Industry experts whose minimum academic qualification is Bachelor of Engineering or equivalent.

7.2.6 Mandatory Learning Courses

According to the guidelines given by statutory bodies, Courses on Environmental Science, Constitution of India and Engineering Ethics shall be offered.
Induction program shall be offered in I semester for all the branches.

NCC/NSS/NSO/YOGA shall be offered in I& II semesters.

Environmental Science and Constitution of India shall be offered in III & IV semesters.

Engineering Ethics shall be offered in V/VI semesters.

7.3 Course Numbering Scheme

The Course code consists of Eight/Nine characters. The following is the structure of the course Code(Figure 1).

1 9	C S	1	2	0	3	A
Regulation	**Course Category**	**Kind of course**	**Semester**	**Type**	**Course Number**	**[Elective code]**
Last two digits of Regulation offered (i.e. 19 for PVP19 regulations)	HS-Humanities and Social Sciences including Management courses BS-Basic Science courses ES-Engineering Science MC - Mandatory Courses In case of Professional Core/ Professional Elective courses department code is placed: CE-Civil Engineering CS- Computer Science & Engineering EC - Electronics and Communication Engineering EE- Electrical & Electronics Engineering IT - Information Technology ME- Mechanical Engineering	1. Institutional Core (i.e.HS,BS, ES,MC) 2. Inter Disciplinary Elective 3. Program Core 4. Program Elective 5. Open Elective	1- First 2-Second 3-Third 4-Fourth 5- Fifth 6-Sixth 7-Seventh 8-Eight	0-Theory 1-Theory studied in MOOCS Mode 5- Practical 6-Project Work 7- Industrial Training/ Internship	i.e. Course sequence Number in that semester	Incase if the course is Elective then this field will specify the elective code (i.e. A,B, C.)

Figure 1: Course numbering scheme

7.4 Medium of Instruction and Examination

The medium of instruction and examinations shall be English.

7.5 Registration

Every student has to register himself/herself for the courses in each semester individually at the time as specified in academic calendar.

8. CHOICE BASED CREDIT SYSTEM(CBCS)

Choice Based Credit System (CBCS) shall be introduced with effect from 2019-20 academic year, based on guidelines of the statutory bodies in order to promote:

- Activity based learning
- Student centered learning
- Students to choose courses of their choice
- Learning at their own pace
- Interdisciplinary learning

Flexibility is extended to the fast learning students to take the courses of higher semesters in advance as per their convenience to concentrate on their placement activity/ project work, etc., during the VII/VIII semesters.

8.1 CBCS Course Registration Policy

Fast learning students can register for additional courses from higher semesters by satisfying the pre-requisite course(s) to a maximum of 8 credits in each of the semesters from III semester onwards along with the regular semester courses as prescribed. There is no minimum limit to the credits for taking additional courses.

Eligibility for choosing CBCS flexibility:

- **Regular Students (4 Year duration),** entering the n^{th} semester with no backlog courses up to $(n-1)^{th}$semester, are only eligible to opt for this flexibility.
- **Lateral entry students (3 year duration)**with 70% Marks in their Diploma are eligible to opt for this flexibility during III and IV Semesters. Those students entering into V/ VI /VII semester with no backlog courses up to $(n-1)^{th}$semester, are only eligible to opt for this flexibility.

  The list of additional courses offered in the even & odd semesters, registration dates will be notified by the respective departments well in advance.

  A student can withdraw from the respective course within 15 days after the commencement of the course.

  The choice of utilizing this flexibility is purely optional to the students.

A minimum number of students required to register for an additional course shall be twenty (20). In case, the registered strength for the additional course is less than twenty (20), the course may be offered on the recommendation of the Head of the Department and subsequent approval of the Principal.

8.2 Continuous Internal Evaluation (CIE) for CBCS opted Courses

The contact hours, continuous assessment pattern, eligibility criteria to write end semester examinations and revaluation scheme for these additional courses will be as per the current academic regulations [PVP19].

8.3Eligibility to appear CBCS registered courses for Semester End Examinations

The registered additional courses will be dealt separately as individual courses for the calculation of attendance and continuous assessment of marks for assessing the eligibility to write the end semester examinations for these courses.

The performance of the student in the registered additional courses will be separately mentioned in the semester end grade card and it will not be taken into account for the calculation of the SGPA for that semester.

The performance of the student in the registered additional courses will be taken into account in the corresponding semesters.

8.4 CBCS Course Detention

8.4.1 In case, the student is detained for want of minimum specified attendance and continuous assessment marks criterion either in the regular semester or in the additional courses, he/she will forfeit the eligibility for registering additional courses from that semester onwards. However, the additional courses completed by the students in the earlier semesters will be valid and taken into consideration.

8.4.2 In case, the student is detained for want of minimum specified attendance and continuous assessment marks criterion in the regular semester but meets minimum specified attendance and continuous assessment marks criterion in the registered additional courses, he/she shall write the end semester examinations for these additional courses along with the regular students in the corresponding semester only.

8.4.3 In case, the student fails/is absent in the end semester examinations of the registered additional courses or in the regular semester courses in a particular semester, he will forfeit the eligibility for registering additional courses from that semester onwards. However, the additional courses completed by the students in the earlier semesters will be valid and taken into consideration. They can write the end semester examinations for additional courses in which they failed/were absent, along with regular students in the corresponding semesters only.

8.4.4 The criterion for the promotion to higher semesters will be as per PVP19 regulations, taking only the regular semester courses into consideration for the

fast learners.

8.4.5 Additional courses, in which the fast learning student fails, will not be considered as backlogs for them.

8.4.6 The fast learning students shall register for all the courses of a regular semester excluding the courses completed in the previous semesters.

8.4.7 The credits scored by students through CBCS subjects shall not be considered for credit promotion from II year to III year or from III year to IV year B.Tech.

8.4.8 The student opting for the said flexibility will be considered for the award of the division on par with other regular students.

8.4.9 The students who have earlier history of indulging in malpractices in semester end examinations are not eligible for opting CBCS.

8.4.10 If the student fails to register for opted CBCS courses for semester end examination, he/she will forfeit the eligibility for registering additional courses from that semester onwards and marks secured through continuous assessment will not be considered.

8.4.11 The choice of utilizing this flexibility is purely optional to the students.

8.4.12 If a student fails/absent in a CBCS course, he/she is bound to appear in the same course when studied in regular semester.

9. EXAMINATIONS & SCHEME OF EVALUATION

9.1 Description of Evaluation

9.1.1 Continuous Internal Evaluation (CIE): The performance of the student in each course is evaluated by the faculty/course coordinator all through the semester; with mid-term tests (sessional-1and sessional-2), assignments, project reviews, viva-voce, laboratory assessment and other means covering the entire syllabus of the course.

9.1.2 Semester End Examination (SEE): It shall be conducted by chief controller of examinations at the end of each semester, as per the academic calendar and with a written examination for theory courses and practical/project examination with built-in oral part for laboratory/project.

9.2 Continuous Internal Evaluation (CIE)

9.2.1 Theory Courses

Each course is evaluated for 30 marks (a+b+c)

a) Two assignment tests (Assignment Test-1 & Assignment Test-2) for 10 marks each will be conducted with1 hour duration. Assignment-1 shall be conducted from Unit-1 and Assignment-2 shall be conducted from Unit-4. The assignment test marks shall be awarded taking the average of two assignment tests.

The Assignment test shall be held in the zero hour and the class work will be

conducted as usual in those days.

The Question bank with minimum number of 6 comprehensive questions from the concerned UNIT of the syllabus will be given to students at least a week in advance before the commencement of Assignment Test.

The question paper shall contain 2 comprehensive questions, each one is meant for 5 Marks. The student is required to answer all the questions.

b) Home assignment shall be conducted for 5 marks from Unit-3. The question bank with 10 to 15 comprehensive questions from unit-3 shall be given to students. Each student has to answer 3 questions from the question bank which will be assigned by the concerned faculty.

c) Two Mid-term (Sessional - 1 and Sessional - 2) examinations with 15 Marks each shall be conducted with **90 minutes** duration.

The Mid-term examinations shall be held in the zero hour and class work shall be conducted as usual in those days.

The Mid-term marks shall be awarded taking the average of two Mid-term examinations.

The question paper shall be given in the following pattern:

Part A: Contains two questions, one from each unit. The student shall answer all questions. Each question is for 2.5 marks.

Part B: Contains four questions. Two questions shall be given from each unit with internal choice. The student shall answer 1 question from each unit. Each question carries 5 marks.

Syllabus for CIE

Name of the Test	**Syllabus**
Assignment Test – 1	UNIT – I
Sessional – 1	UNIT - I & UNIT – II
Home Assignment	UNIT – III
Assignment Test – 2	UNIT – IV
Sessional – 2	UNIT – IV& UNIT – V

The questions shall be framed in Assignment tests and Sessional examinations in line with the Course Outcomes defined and cognitive levels.

9.2.2 Mandatory Learning Courses

Each course is evaluated for 100 marks (a+b)

a) Two Mid-term (Sessional - 1 and Sessional - 2) examinations each for 40

Marks shall be conducted with **90 minutes** duration.

The Mid-term examinations shall be held in the zero hour and the class work shall be conducted as usual in those days.

The question paper shall be given in the following pattern:

The question paper contains four questions. Two questions shall be given from each unit with internal choice. The student shall answer one question from each unit. Each question carries20 marks.

b) Home assignment for 20 marks shall be conducted from Unit-3. The question bank with 10 to 15 comprehensive questions from unit-3 shall be given to students. Each student has to answer 4 questions from the question bank which will be assigned by the concerned faculty.

The Mid-term marks shall be awarded as sum of two Mid-term examinations and home assignment.

Syllabus for CIE

Name of the Test	**Syllabus**
Sessional – 1	UNIT – I& II
Home Assignment	UNIT – III
Sessional – 2	UNIT – IV& V

9.2.3 Drawing Based Courses:

Each course is evaluated for 30 marks (a+b)

a) Two Mid-term (Sessional - 1 and Sessional - 2) examinations with 15 Marks each shall be conducted with**90 minutes** duration.

The Mid-term examinations shall be held in the zero hour and class work shall be conducted as usual in those days.

The Mid-term marks shall be awarded taking the average of two Mid-term examinations.

The question paper shall be given in the following pattern:

Part A: Contains two questions, one from each unit. The student shall answer all questions. Each question is for 2.5 marks.

Part B: Contains four questions. Two questions shall be given from each unit with internal choice. The student shall answer 1 question from each unit. Each question carries 5 marks.

b) Home assignment shall be conducted for 5 marks from Unit-3. The question bank with 10 to 15 comprehensive questions from unit-3 shall be given to students. Each student has to answer 3 questions from the question bank which will be assigned by the concerned faculty.

Syllabus for CIE

Name of the Test	Syllabus
Sessional – 1	UNIT – I& II
Home Assignment	UNIT – III
Sessional – 2	UNIT – IV & V

The distribution of marks for continuous internal evaluation is given in the Table 2:

Table 2: Distribution of Marks (CIE)

S. No.	Criterion	Marks
1	Day to Day Evaluation	10
2	Internal Examination	15
3	Home Assignment	5

9.2.4 Laboratory Courses

For Laboratory courses, there shall be continuous evaluation during the semester for 25 marks and semester end evaluation for 50 marks. The distribution of marks for continuous internal evaluation is given in the Table 3:

Table 3: Distribution of Marks (CIE)

S. No.	Criterion	Marks
1	Day to Day Evaluation	10
2	Record	05
3	Internal Examination	10

9.2.5 Project Phase I

For Project Phase I, there shall be continuous internal evaluation during the semester for 100 marks. The continuous internal evaluation for the Project Phase I shall be on the basis of day to day assessment by the project guide and two reviews conducted by the Project Review Committee (PRC).The PRC consists of Head of the Department, Programme Coordinator, Senior Faculty member of the department and Project guide. The distribution of continuous internal evaluation marks is given in the Table 4:

Table 4: Distribution of Marks (CIE)

S. No.	Criterion	Marks
1	Day to Day Evaluation	40
2	Two Reviews	30+30

9.2.6 Project Phase II

For Project Phase II, there shall be continuous internal evaluation during the semester for 100 marks and semester end evaluation for 100 marks. The continuous internal evaluation for the Project Phase II shall be on the basis of day to day assessment by the project guide and two reviews conducted by the Project Review Committee (PRC).The PRC consists of Head of the Department, Programme Coordinator, Senior Faculty member of the department and Project guide. The distribution of marks is given in the Table 5:

Table 5: Distribution of Marks (CIE)

S. No.	Criterion	Marks
1	Day to Day Evaluation	40
2	Two Reviews	30+30

9.2.7 MOOCs Courses

Students who have qualified in the examination conducted by the MOOCs providers as specified in 7.2.2are exempted from appearing in the continuous and semester end evaluations conducted by the institution.

In case, a student fails to complete the MOOCs course offered by MOOC's providers, he/she may be allowed to register again for the same with any of the providers from the list provided by the department or the student may be allowed to register for the course as and when offered by the college as supplementary candidate.

Students Registered and cleared the opted courses in MOOC's are exempted from appearing Semester end examinations conducted by the Institute.

The Scheme of Evaluation for MOOCs courses shall be scaled to continuous internal evaluation as 30 marks and semester end examination as 70 marks.

9.3 Semester End Examination

9.3.1 Theory Courses : 70 Marks

The Semester end examination shall be conducted with 3 hours duration at the end of the semester. The question paper shall be given in the following pattern:

a) **Part A:** Contains 5 questions of 2 marks each to test the knowledge level of the student. One question shall be given from each unit of the prescribed syllabus included in five units. The student shall answer all questions.

b) **Part B:** Contains 10 questions. Two questions from each unit shall be given with internal choice. Each question carries 12 marks. Each course shall consist of five units of syllabus. The student shall answer one question from each unit.
The questions shall be framed in line with the Course Outcomes defined and cognitive levels.

9.3.2 Laboratory Courses: 50 marks

i. The Semester end examination for laboratory courses shall be conducted with three hour duration at the end of semester for 50 marks as given below:

Table 6: Distribution of Marks (SEE)

S.No.	Criterion	Marks
1	Procedure	10
2	Experiment/Programme Execution	20
3	Result	10
4	Viva-Voce	10

ii. Each Semester end Laboratory Examination shall be conducted by an External Examiner along with the Internal Examiner.

9.3.3 Project Phase II: 100 marks

The semester end examination for project phase II shall be held for 100 marks by a committee consisting of an external examiner, Head of the Department, Programme coordinator and Project guide. The evaluation of the project work shall be conducted at the end of the VIII Semester.

The average of the marks awarded by the committee members shall be taken into consideration in case of variation among the members.

The evaluation of 100 marks is distributed as given in Table 7:

Table 7: Distribution of Marks in Project Phase II

S. No.	Criterion	Marks
1	Report	40
2	Presentation	30
3	Viva –Voce	30

9.3.4 Internship/Industry Interaction: 75 Marks

a) Internships :

The candidate shall submit the comprehensive report to the department. The report will be evaluated for 75 marks by the Review Committee consisting of Head of the department, Programme Coordinator and Concerned Industry Representative/ Industry Institute Interaction Coordinator.

b) Industry Offered Courses:

The semester end examination for the courses under this category is evaluated for 75 marks and it shall be conducted and evaluated by the industry expert who has delivered the lecture or by the faculty nominated by the head of the department in consultation with the industry expert. The question paper pattern shall be decided by the industry expert at the beginning of the course and the same is to be approved by the Principal.

There will not be continuous internal evaluation for the courses under this category.

9.4 Conditions for Pass Marks

9.4.1 A candidate shall be declared to have passed in individual theory/drawing course if he/she secures a minimum of 40% aggregate marks (Continuous Internal Evaluation & Semester End Examination marks put together), subject to a minimum of 35% marks in semester end examination.

9.4.2 A candidate shall be declared to have passed in individual laboratory course/project if he/she secures a minimum of 50% aggregate marks (Continuous Internal Evaluation &Semester End Examination marks put together), subject to a minimum of 40% marks in semester end examination.

9.4.3 Mandatory Courses are assessed for PASS or FAIL only. No grade will be assigned to these courses. If a candidate secures more than 40 out of 100 marks, he / she will be declared PASS or else FAIL.

9.4.4 Mandatory courses NCC/NSS/NSO/YOGA are assessed for satisfactory or not satisfactory only. No grade will be assigned. A candidate has to undergo two hours training per week in any one of the above in both I and II semesters.

9.4.5 The student has to get pass marks in the failed course by appearing the supplementary examination as per the requirement for the award of degree.

9.4.6 The student shall earn assigned credits for the course on passing a course of a programme.

9.5 Revaluation

9.5.1 Continuous Internal Evaluation

The Continuous Evaluation scripts shall be shown to the students before finalizing the marks. However, if the student has any concern, not addressed before the finalization of marks, he/she may submit the application for revaluation to the concerned head of the department.

The Head of the Department may constitute a two member committee for re-evaluating the script. The evaluation of the committee is final and binding.

9.5.2 Semester End Examination

1. As per the notification issued by the Controller of Examinations, the students can submit the applications for revaluation, along with the requisite fee receipt for revaluation of his/her answer script(s) of theory course(s), if he/she is not satisfied with the marks obtained.
2. The Controller of Examinations shall arrange for re-evaluation of those answer script(s).
3. A new external examiner, other than the first examiner, shall re-evaluate the answer script(s).
4. Revaluation marks will be taken into consideration only if the difference between the two valuations is more than or equal to 15%. Better marks between the two shall be taken into consideration. However, if the revaluation marks facilitates passing of the candidate, then the revaluation marks will be considered even if the difference of marks is less than 15%.
5. If the difference of marks between the two valuations is more than 20%, the answer script will be referred to third valuation. The average of nearest two marks will be awarded.

9.6 Withholding of Results

If the student has not paid the dues to the college, or if any case of malpractice or indiscipline is pending against him, the result of the student will be kept as withheld and he/she will not be allowed to enter the next semester. His/her degree shall be considered as withheld in such cases.

10 CRITERIA TO ATTEND SEMESTER END EXAMINATIONAND PROMOTION TO HIGHER SEMESTER

10.1 Eligibility for Semester End Examinations

10.1.1 Students shall put in a minimum average attendance of 75% in the courses from category 7.2.1 to 7.2.6 put together, computed by totaling the number of periods of lectures, tutorials, drawing, practical and project work as the case may be, held in every course as the denominator and the total number of periods attended by the student in all the courses put together as the numerator, to be eligible to write semester end examinations.

10.1.2 Condonation of shortage in attendance may be recommended by respective Heads of Departments on genuine medical grounds, provided the student puts in at least 65% attendance as calculated above and provided the Principal is satisfied with the genuineness of the reasons and the conduct of the student.

10.1.3 Students, having more than 65% and less than 75% of attendance, shall have to pay requisite fee towards condonation.

10.2 Conditions for Promotion

10.2.1 A student shall be eligible for promotion to next Semester of B.Tech. programme, if he/she satisfies the conditions as stipulated in Regulations **10.1.**

10.2.2 Further, a student shall be eligible for promotion to V / VII Semester of B.Tech. programme, if he/she completes the academic requirements of 50% of the credits upto IV/ VI semesters.

10.2.3 Promotion to V Semester

For Four Year B.Tech Course candidates

A four year programme student shall be promoted from IV semester to V semester only if he/she earns 50% credits of the designed programme credits from I semester to IV semester.

10.2.4 Promotion to VII Semester

i) For Four Year B.Tech Course candidates

A four year programme student shall be promoted from VI semester to VII semester only if he/she earns 50% credits of the designed programme credits from I semester to VI semester.

ii) For Lateral Entry candidates

A lateral entry student shall be promoted from VI semester to VII semester only if he/she earns 50% credits of the designed programme credits from III semester to VI semester.

10.2.5 For Detained Students

a) Students who are already detained for want of credits shall be promoted to **V Semester** if he/she fulfills the 50 % of the credit requirements from all the regular and supplementary examinations held upto IV Semester till the commencement of next academic year.

b) Students who are already detained for want of credits shall be promoted to **VII Semester** if he/she fulfills the 50% of the credit requirements from all the regular and supplementary examinations held upto VI Semester till the commencement of next academic year.

11. SUPPLEMENTARYEXAMINATIONS

11.1 General

Semester end Supplementary examinations shall be conducted along with regular semester end examinations.

11.2 Advanced Supplementary Exams

Candidate(s), who fails in Theory or Laboratory courses of VIII semester, can appear for advanced supplementary examination conducted within one month after declaration of the revaluation results. However, those candidates who fail in the advanced supplementary examinations of VIII semester shall appear for subsequent examinations along with regular candidates conducted at the end of the respective academic year.

12. READMISSION CRITERIA

13. A candidate, who is detained in a semester due to lack of attendance/credits, has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling all the required norms stipulated by the college in addition to paying an administrative fee of **Rs. 1,000/-**

Rules for calculation of attendance for readmitted students

a) Number of classes conducted shall be counted from the commencement day of the semester concerned, irrespective of the date of payment of tuition fee.

b) They shall submit a written request to the principal of the college, along with a challan paid towards tuition and other fee, for readmission before the commencement of the classwork.

c) They can get the information regarding date of commencement of class work for each semester that will be made available in the college notice boards/website from time to time.

14. BREAK IN STUDY

Student, who discontinues the studies for valid reason permitted by the principal, shall get readmission into appropriate semester of B.Tech. programme after break-in study, with the prior permission of the Principal and following the transitory regulations applicable to such batch in which he/she joins. An administrative fee of **Rs**. 1**000/-**per each year of break in study, in addition to the prescribed tuition and special fee has to be paid by the candidate to condone his/her break in study.

15. TRANSITORY REGULATIONS

A candidate, who is detained or discontinued in a semester, on re-admission, the academic regulations under which he/she has originally admitted will continue to be applicable to him/her on re-admission.

16. ELIGIBILITYFOR AWARD OF B.TECH. DEGREE

16.1 The B.Tech. Degree shall be conferred on a candidate who satisfies the following requirements.

16.1.1 A Regular student (four year programme) shall register and secure himself/herself for **160** Credits from the categories 7.2.1 to 7.2.6

16.1.2 A Lateral Entry student (three year programme) shall register and secure himself/herself for **121.5** credits from the categories 7.2.1 to7.2.6

16.2 Award of Division

The criteria for award of division, after successful completion of programme is as shown in Table8:

Table 8: Criteria for Award of Division

CGPA	DIVISION
≥ 7.5	First Class with distinction*
≥ 6.5 - < 7.5	First Class
≥ 5.5 - < 6.5	Second Class
≥ 5.0 - < 5.5	Pass Class
< 5.0	Fail

* Awarded only if all the courses prescribed are cleared in single attempt within four years for regular candidates and three years for lateral entry candidates

* Detained and break-in study candidates are not eligible for the award of First Class with Distinction

* The cases of students who are absent for semester end examination only once in his/her duration of B.Tech. programme on valid medical grounds/humanitarian grounds shall also be considered for the award of First class with Distinction subject to the recommendations of the committee constituted by the Principal.

For the purpose of awarding First, Second and Pass Class CGPA obtained in the examinations appeared within the maximum period allowed for the completion of the programme shall be considered.

16.3 Consolidated Grade Card

A consolidated grade card containing credits & grades obtained by the students will be issued after successful completion of the four year B.Tech Programme.

17. CONDUCT AND DISCIPLINE

17.1 Students shall conduct themselves within and outside the premises of the Institute in a manner befitting the students of our Institution.

17.2 As per the order of Honorable Supreme Court of India and AICTE guidelines, ragging in any form is considered a criminal offence and is banned. Ragging within or outside any educational institution is prohibited. Ragging means doing an act, that causes or is likely to cause insult or annoyance or fear of apprehension or threat or intimidation or outrage of modesty or injury to a student. Any form of ragging will be severely dealt with as per AP Prohibition of Ragging Act-1997 section-4.

Table – 9: Punishments for Ragging

Nature of ragging	Punishment
Teasing, embarrassing and humiliating	Imprisonment upto 6 months or fine upto Rs.1,000/- or both
Assaulting or using criminal force or criminal intimidation	Imprisonment upto 1 year or fine upto Rs.2,000/- or both
Wrongfully restraining or confining or causing hurt	Imprisonment upto 2 years or fine upto Rs.5,000/- or both
Causing grievous hurt kidnapping or raping or committing unnatural offence	Imprisonment upto 5 years and fine upto Rs.10,000/-
Causing death or abetting suicide	Imprisonment upto 10 years and fine upto Rs.50,000/-

17.3 A student who is convicted of an offence and punished with imprisonment for a term of more than six months shall not be admitted into the institution.

17.4 Whenever any student complains of ragging to the head or manager of an educational institution, such head or manager should inquire into the complaint and if the complaint is prima-facie found true, should suspend the student or students complained against.

17.5 If the head or manager of an educational institution fails or neglects to take action in the manner specified in the Act, the person shall be deemed to have abetted the offence and shall be punished with the punishment provided for the offence.

17.6 If a student commits suicide due to or in consequence of ragging, the person who commits such ragging shall be deemed to have abetted such suicide.

The following acts of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures.

i. Lack of courtesy and decorum; indecent behaviour anywhere within or outside the campus.

ii. Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.

The following activities are not allowed within the campus:

- Mutilation or unauthorized possession of library books.
- Noisy and unseemly behaviour, disturbing studies of fellow students.
- Hacking computer systems (such as entering into other person's areas without prior permission, manipulation and/or damage of computer hardware and software or any other cybercrime etc.)

- Use of mobile phones.
- Plagiarism of any nature.
- Any other act of gross indiscipline as decided by the Institute from time to time.
- Commensurate with the gravity of offense, the punishment may be reprimand, fine, expulsion from the institute/ hostel, debarment from a examination, disallowing the use of certain facilities of the Institute, rustication for a specified period or even outright expulsion from the Institute, or even handing over the case to appropriate law enforcement authorities or the judiciary, as required by the circumstances.
- For an offence committed in (i) a hostel, (ii) a department or in a class room and (iii) elsewhere, the Chief Warden, the Head of the Department and the Principal, respectively, shall have the authority to reprimand or impose fine.
- Cases of adoption of unfair means and/or any malpractice in an examination shall be reported to the Principal for taking appropriate action.
- Unauthorized collection of money in any form is strictly prohibited.
- Detained and break-in-study candidates are allowed into the campus for academic purposes only with the permission from authorities.
- Misconduct committed by a student outside the Institute campus but having the effect of damaging, undermining & tarnishing the image & reputation of the institution will make the student concerned liable for disciplinary action commensurate with the nature and gravity of such misconduct.
- The disciplinary action committee constituted by the Principal, shall be the authority to investigate the details of the offence, and recommend disciplinary action based on the nature and extent of the offence committed.
- Grievance redressal committee, constituted by the Principal, shall deal with all grievances pertaining to the academic/ administrative and disciplinary matters.
- All the students must abide by the code and conduct rules of the Institute.

17 MALPRACTICES

The Principal shall refer the cases of malpractices by students in internal assessment tests and end semester examinations, to a malpractice enquiry committee constituted for the purpose. The committee shall follow the approved scales of punishment.

The committee consists of:

1. Heads of Department (Three)
2. Controller of Examinations
3. Deputy Controller of Examinations

Table – 10: Disciplinary action for malpractices/improper conduct in examinations

	Nature of Malpractices/Improper conduct	Punishment
1 (a)	If the candidate possesses or keeps accessible, any paper, note book, programmable calculators, mobile phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in the examination hall but has not made use of (material shall include any marks on the student's body that can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	If the candidate gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through mobile phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	If the candidate has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work. He shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The hall ticket of the candidate is to be cancelled.
3	If the candidate impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4	If the candidate smuggles in an answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all other examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5	If the candidate uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6	If the candidate refuses to obey the orders of the Chief Superintendent/Assistant - Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which results in damage to or destruction of property in the examination hall or any part of the Institute campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the Institute, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7	If the candidate leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and

	examination hall.	project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all other examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8	If the candidate possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9	If student of the Institute, who is not a candidate for the particular examination or any person not connected with the Institute indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the Institute: Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work. He shall not be permitted for the remaining examinations of the subjects of that semester/ year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the Institute: Will be handed over to police and a police case will be registered against them.
10	If the candidate comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work. He shall not be permitted for the remaining examinations of the subjects of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11, shall be awarded suitable punishment.	

Note: Special squads may be formed to oversee the proper conduct of examinations.

18 OTHERMATTERS

18.1 Scribe facility is extended to B Tech students strictly following the guidelines issued under F. No. 16-110/2003-DD.III Dt. 26-02-2013 by the Ministry of Social Justice and Empowerment, Department of Disability Affairs, Govt. of India.

18.2 Students who are suffering from contagious diseases are not allowed to appear either continuous internal assessment or semester end examinations.

18.3 The students who participate in coaching/tournaments held at State/National/International levels through University/Indian Olympic Association during semester end examination period will be promoted to subsequent semesters till the entire programme is completed as per the guidelines of University Grants Commission Letter No. F.1-5/88 (SPE/PES), dated18-08-1994.

18.4 Based on the recommendations of HOD & Principal, exemption from attending the class work shall be given to those students who secure placement and intend to join as the employer in VIII semester of B.Tech. Special Continuous Internal Evaluation (Assignment Tests, Sessional, etc.,) will be arranged to such candidates separately if necessary.

However, they shall appear for Semester End Examinations as per the Academic Calendar

18.5 The Principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the Heads of the Departments in an appropriate manner, and subsequently such actions shall be placed before the academic council for ratification. Any emergency modification of regulation, approved in the Heads of the Departments Meetings, shall be reported to the academic council for ratification.

19 GENERAL

1 Wherever the words “he”, “him”, “his”, occur in the regulations, they may include “she”, “her”, “hers”.
2 The academic regulations should be read as a whole for the purpose of any interpretation.
3 In case of any doubt or ambiguity in the interpretation of above rules, the decision of the principal is final.

20 INSTITUTE RULES AND REGULATIONS

1 Use of **Mobile phones** is strictly prohibited inside the Institute academic area.

2 Students should come to Institute in **proper dress**.

3 All students should wear **identity cards** in the Institute premises.

4 Students should be present in their respective classrooms **before the commencement of class sharply**.

5 Students should not leave the Institute premises without prior permission of their respective Heads of the departments during Institute working hours.

6 Students should maintain silence in the class rooms during working periods.

7 Sitting / wandering of the students at the stair cases, corridors, cycle stands or the areas within the Institute premises is strictly prohibited.

8 Usage of Vehicle horn inside the Institute premises is prohibited.

21 AMENDMENTS TOREGULATIONS

The Academic Council may, from time to time, revise, amend or change the regulations, schemes of examination and/or syllabi.

Oratory

PRINCIPAL

B.Tech
COURSE STRUCTURE

Prasad V. Potluri Siddhartha Institute of Technology

Course Structure for B. Tech under PVP19 regulations

(Effective from Academic Year 2019-20)

DEPARTMENT OF MECHANICAL ENGINEERING

I B. TECH – I SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19HS1101	Communicative English I	2	0	0	2	30	70	100
19BS1101	Engineering Mathematics I (Calculus and Algebra)	3	0	0	3	30	70	100
19BS1102	Chemistry of Materials	3	0	0	3	30	70	100
19ES1102	Problem Solving and Programming	3	1	0	4	30	70	100
19HS1151	Communicative English I Lab	0	0	3	1.5	25	50	75
19BS1151	Chemistry of Materials Lab	0	0	3	1.5	25	50	75
19ES1152	Problem Solving and Programming Lab	0	0	3	1.5	25	50	75
19ES1153	Basic Workshop	0	0	3	1.5	25	50	75
19MC1151	NCC/NSS/YOGA/Activity Clubs	0	0	2	0	100		100
Total		11	1	14	18	320	480	800

Prasad V. Potluri Siddhartha Institute of Technology

Course Structure for B. Tech under PVP19 regulations

(Effective from Academic Year 2019-20)

DEPARTMENT OF MECHANICAL ENGINEERING

I B.TECH - II SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19HS1201	Communicative English II	2	0	0	2	30	70	100
19BS1201	Engineering Mathematics II (ODE,PDE and Multivariable Calculus)	3	0	0	3	30	70	100
19BS1204	Applied Physics	3	0	0	3	30	70	100
19ES1201	Basic Electrical and Electronics Engineering	3	1	0	4	30	70	100
19ES1203	Engineering Graphics	1	0	3	2.5	30	70	100
19HS1251	Communicative English II Lab	0	0	3	1.5	25	50	75
19BS1252	Applied Physics Lab	0	0	3	1.5	25	50	75
19ES1251	Basic Electrical and Electronics Engineering Lab	0	0	3	1.5	25	50	75
19ME3251	Mechanical Engineering Workshop	0	0	3	1.5	25	50	75
19MC1251	NCC/NSS/YOGA/Activity Clubs	0	0	2	0	100		100
Total		12	1	17	20.5	350	550	900

Prasad V. Potluri Siddhartha Institute of Technology

Course Structure for B. Tech under PVP19 regulations

(Effective from Academic Year 2019-20)

DEPARTMENT OF MECHANICAL ENGINEERING

II B. TECH – I SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19BS1301	Engineering Mathematics III (PDE, Complex Variables and Transform Techniques)	3	0	0	3	30	70	100
19BS1303	Life Sciences for Engineers	2	0	0	2	30	70	100
19ES1302	Design Thinking & Product Innovation	2	0	0	2	30	70	100
19ME3301	Engineering Mechanics	2	1	0	3	30	70	100
19ME3302	Engineering Thermodynamics	2	1	0	3	30	70	100
19ME3303	Material Science and Engineering	3	0	0	3	30	70	100
19MC1301	Environmental Sciences	3	0	0	0	100		100
19BS1351	Life Sciences for Engineers Lab	0	0	2	1	25	50	75
19ES1352	Design Thinking & Product Innovation Lab	0	0	2	1	25	50	75
19ME3351	Computer Aided Machine Drawing	1	0	3	2.5	25	50	75
Total		18	2	7	20.5	355	570	925

Prasad V. Potluri Siddhartha Institute of Technology

Course Structure for B. Tech under PVP19 regulations

(Effective from Academic Year 2019-20)

DEPARTMENT OF MECHANICAL ENGINEERING

II B.TECH - II SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19BS1401	Engineering Mathematics-IV (Numerical Methods, Probability and Statistics)	3	0	0	3	30	70	100
19ES1401	AI Tools	2	0	0	2	30	70	100
19ME3401	Strength of Materials	3	1	0	4	30	70	100
19ME3402	Applied Thermodynamics	2	1	0	3	30	70	100
19ME3403	Fluid Mechanics	3	1	0	4	30	70	100
19ME3404	Manufacturing Processes	3	0	0	3	30	70	100
19MC1402	Constitution of India	3	0	0	0	100		100
19ES1451	AI Tools Lab	0	0	2	1	25	50	75
19ME3451	Applied Thermodynamics Lab	0	0	3	1.5	25	50	75
19ME3452	Fluid Mechanics Lab	0	0	3	1.5	25	50	75
Total		19	3	8	23	355	570	925

Prasad V. Potluri Siddhartha Institute of Technology

Course Structure for B. Tech under PVP19 regulations

(Effective from Academic Year 2019-20)

DEPARTMENT OF MECHANICAL ENGINEERING

III B. TECH – I SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19ES1501	Internet of Things	2	0	0	2	30	70	100
19ME3501	Metal Cutting and Machine Tools	3	0	0	3	30	70	100
19ME4501	Program Elective-I	3	0	0	3	30	70	100
19ME3502	Mechanics of Machinery	3	1	0	4	30	70	100
	Interdisciplinary Elective I	3	0	0	3	30	70	100
	Open Elective I	3	0	0	3	30	70	100
19ES1552	Internet of Things Lab	0	0	2	1	25	50	75
19ME3551	Material testing and characterization Lab	0	0	3	1.5	25	50	75
19ME3552	Manufacturing Technology Lab	0	0	3	1.5	25	50	75
Total		17	1	8	22	255	570	825

III B.TECH - II SEMESTER

Final Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19HS1601	Engineering Economics and Management	3	0	0	3	30	70	100
19ME3601	Heat and Mass Transfer:	3	1	0	4	30	70	100
19ME4601	Program Elective-II	3	0	0	3	30	70	100
19ME3602	Design of Machine Elements	3	1	0	4	30	70	100
19ME4602	Program Elective-III	3	0	0	3	30	70	100
19MC1601	Engineering Ethics	3	0	0	0	100		100
	Open Elective II	3	0	0	3	30	70	100
19ME3651	CAD/ CAM Lab	0	0	3	1.5	25	50	75
19ME3652	Heat and Mass Transfer Lab	0	0	3	1.5	25	50	75
Total		21	2	6	23	330	520	850

Prasad V. Potluri Siddhartha Institute of Technology

Course Structure for B. Tech under PVP19 regulations

(Effective from Academic Year 2019-20)

DEPARTMENT OF MECHANICAL ENGINEERING

IV B. TECH – I SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19HS1702	Operations Research	3	0	0	3	30	70	100
19ME3701	Measurements and Metrology	3	0	0	3	30	70	100
19ME4701	Program Elective-IV	3	0	0	3	30	70	100
19ME4702	Program Elective-V	3	0	0	3	30	70	100
	Interdisciplinary Elective II	3	0	0	3	30	70	100
19ME3751	Measurements and Metrology Lab	0	0	2	1	25	50	75
19ME3761	Project Phase-I	0	0	4	2	100		100
19ME3771	Industrial Training/Internship/Research Projects in National Laboratories/Academic Institutions				2	75		75
Total		15	0	6	20	350	400	750

IV B.TECH - II SEMESTER

Course Code	Title	L	T	P	Credits	Internals	Externals	Total
19ME4801	Program Elective-VI	3	0	0	3	30	70	100
	Inter Disciplinary Elective III	3	0	0	3	30	70	100
19ME3861	Project Phase-II	0	0	14	7	100	100	200
Total		6	0	14	13	160	240	400

Prasad V. Potluri Siddhartha Institute of Technology

Course Structure for B. Tech under PVP19 regulations

(Effective from Academic Year 2019-20)

Inter Disciplinary Electives

Offered By	Subject	Course Code	Title	L	T	P	Credits	Internals	Externals	Total
CSE	Inter Disciplinary Elective-I	19CS2501C	Data Base Management Systems	3	0	0	3	30	70	100
MBA	Inter Disciplinary Elective-I	19HS2501C	Quantitative Techniques for Management	3	0	0	3	30	70	100
IT	Inter Disciplinary Elective-I	19IT2501C	OOP with C++	3	0	0	3	30	70	100
ME	Inter Disciplinary Elective-I	19ME2501A	Computational methods	3	0	0	3	30	70	100
EEE	Inter Disciplinary Elective-II	19EE2701C	Renewable Energy Resources	3	0	0	3	30	70	100
IT	Inter Disciplinary Elective-II	19IT2701C	Web Technologies	3	0	0	3	30	70	100
ME	Inter Disciplinary Elective-II	19ME2701B	Optimization Techniques	3	0	0	3	30	70	100
ME	Inter Disciplinary Elective-II	19ME2701C	Project Management & Optimization	3	0	0	3	30	70	100
CSE	Inter Disciplinary Elective-III	19CS2801D	Introduction to Python Programming	3	0	0	3	30	70	100
ECE	Inter Disciplinary Elective-III	19EC2801B	Instrumentation and Sensor Technologies of Civil Engineering Applications	3	0	0	3	30	70	100
MBA	Inter Disciplinary Elective-III	19HS2801A	Logistics and Supply Chain Management	3	0	0	3	30	70	100
ME	Inter Disciplinary Elective-III	19ME2801B	Total Quality Management	3	0	0	3	30	70	100

Prasad V. Potluri Siddhartha Institute of Technology

Course Structure for B. Tech under PVP19 regulations

(Effective from Academic Year 2019-20)

Open Electives

Subject	Course Code	Title	L	T	P	Credits	Internals	Externals	Total
Open Elective I	19ES5501A	Biotechnology and Society	3	0	0	3	30	70	100
Open Elective I	19ES5501B	Electrical Safety	3	0	0	3	30	70	100
Open Elective I	19ES5501C	Fundamentals of Cyber Law	3	0	0	3	30	70	100
Open Elective I	19ES5501D	Environment and Ecology	3	0	0	3	30	70	100
Open Elective I	19HS5501A	Contemporary Relevance of Indian Epics	3	0	0	3	30	70	100
Open Elective I	19HS5501B	Indian National Movement	3	0	0	3	30	70	100
Open Elective I	19HS5501C	Engineering for Community Service	3	0	0	3	30	70	100
Open Elective I	19HS5501D	Personality Development	3	0	0	3	30	70	100
Open Elective I	19HS5501E	Introduction to International Business	3	0	0	3	30	70	100
Open Elective I	19HS5501F	Gandhian Philosophy	3	0	0	3	30	70	100
Open Elective I	19HS5501G	Indian History	3	0	0	3	30	70	100
Open Elective II	19ES5601A	Environmental Management	3	0	0	3	30	70	100
Open Elective II	19ES5601B	Telecommunication for Society	3	0	0	3	30	70	100
Open Elective II	19HS5601A	German for Beginners	3	0	0	3	30	70	100
Open Elective II	19HS5601B	Chinese for Beginners	3	0	0	3	30	70	100
Open Elective II	19HS5601C	Analytical Essay Writing	3	0	0	3	30	70	100
Open Elective II	19HS5601D	Indian Economy	3	0	0	3	30	70	100
Open Elective II	19HS5601E	Public Administration	3	0	0	3	30	70	100
Open Elective II	19HS5601F	National Service Scheme	3	0	0	3	30	70	100
Open Elective II	19HS5601G	Professional Communication	3	0	0	3	30	70	100
Open Elective II	19HS5601H	Basics of Finance	3	0	0	3	30	70	100
Open Elective II	19HS5601I	Basics of Marketing	3	0	0	3	30	70	100

First Year Syllabus

Communicative English - 1

Course Code	19HS1101	Year	I	Semester	I
Course Category	Humanities	Branch	ME	Course Type	Theory
Credits	2	L-T-P	2-0-0	Prerequisites	Nil
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Comprehend how to apply parts of speech in a sentence and construct a paragraph.
CO2	Apply grammar to formulate text using punctuation.
CO3	Evaluate reading texts and use correct tense forms for effective communication.
CO4	Analyze reading texts and to write summaries based on comprehension of the texts.
CO5	Create awareness on how to write correct sentences in English and comprehend the text.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1										3		3		1
CO2										3		3		1
CO3										3		3		1
CO4										3		3		1
CO5										3		3		1

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	**Reading:** Skimming to get the main idea of a text; Scanning to look for specific pieces of information. **Reading for Writing:** Beginnings and endings of paragraphs - Introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph. **Grammar and Vocabulary:** Content words and function words; Word forms: Verbs, Nouns, Adjectives and Adverbs; Nouns: countables and uncountables; singular and plural; Basic sentence structures; Simple question form - wh-questions; Word order in sentences.	CO1
II	**Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together. **Writing:** Paragraph writing (specific topics) using suitable cohesive devices; Mechanics of writing - punctuation, capital letters. **Grammar and Vocabulary:** Cohesive devices - linkers, sign posts and transition signals; Use of articles and zero article; prepositions	CO2
III	**Reading:** Readinga text in detail by making basic inferences - recognizing and interpreting specific context clues;strategies to use text clues for	CO3

	comprehension. **Writing:** Summarizing - identifying main idea/s andrephrasing what is read; avoiding redundancies and repetitions. **Grammar and Vocabulary:** Verbs - Tenses; Subject-verb agreement; Direct and indirect speech, Reporting verbs for academic purposes.	
IV	**Reading:** Studying the use ofgraphic elements in texts to convey information, reveal trends/patterns/relationships, communicateprocesses or display complicated data. **Writing:** Information transfer; describe, compare, contrast,identify significance/trends based on information provided in figures/charts/graphs/tables. **Grammar andVocabulary:** Quantifying expressions - adjectives and adverbs; comparing and contrasting; Degrees ofcomparison; Use of antonyms	CO4
V	**Reading:** Reading for comprehension. **Writing:** Writing structured essays on specific topics using suitable claims and evidences **Grammar and Vocabulary:** Editing short texts – Identifying and correcting common errors in grammar and usage (Articles, prepositions, Tenses, Subject-verb agreement)	CO5

Learning Resources
Text Books
Prabhavathy Y, M.LalithaSridevi, Ruth Z. Hauzel, "English all round communication skills for undergraduate students", Orient Black Swan, 2019
Reference Books
1.Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014. 2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational. 3. Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012
e- Resources & other digital material
Grammar/Listening/Writing 1-language.com; http://www.5minuteenglish.com/ https://www.englishpractice.com/ Grammar/Vocabulary English Language Learning Online; http://www.bbc.co.uk/learningenglish/ http://www.better-english.com/; http://www.nonstopenglish.com/ https://www.vocabulary.com/; BBC Vocabulary Games Free Rice Vocabulary Game Reading https://www.usingenglish.com/comprehension/; https://www.englishclub.com/reading/short-stories.htm; https://www.english-online.at/ All Skills https://www.englishclub.com/; http://www.world-english.org/ http://learnenglish.britishcouncil.org/ Online Dictionaries Cambridge dictionary online; MacMillan dictionary; Oxford learner's dictionaries

Engineering Mathematics – 1 (Calculus and Algebra)

Course Code	19BS1101	Year	I	Semester	I
Course Category	Basic Sciences	Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	utilize the techniques of matrix algebra that is needed by engineers for practical applications
CO2	apply mean value theorems to engineering problems
CO3	utilize functions of several variables in optimization
CO4	employ the tools of calculus for calculating the areas
CO5	calculate volumes using multiple integrals

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											1	
CO2	3	2											1	
CO3	3	2											1	
CO4	3	2											1	
CO5	3	2											1	

Syllabus

Unit No.	Contents	Mapped CO
I	Matrices: Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous linear equations. Eigen values, Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.	CO1
II	Mean Value Theorems:Rolle‘s Theorem, Lagrange‘s mean value theorem, Cauchy‘s mean value theorem, Taylor‘s and Maclaurin‘s theorems with remainders (without proof).	CO2
III	Multivariable Calculus :Partial derivatives, total derivatives, chain rule, change of variables, Jacobian, maxima and minima of functions of two variables, method of Lagrange multipliers.	CO3
IV	Multiple Integrals-I :Double integrals, change of order of integration, double integration in polar coordinates, areas enclosed by plane curves.	CO4
V	Multiple Integrals-II: Evaluation of triple integrals, change of variables between Cartesian, cylindrical and spherical polar co-ordinates, volume as	CO5

	triple integral.	

Learning Resources

Text Books

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018

Reference Books

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.

e- Resources & other digital material

1. www.nptelvideos.com/mathematics/
2. https://nptel.ac.in/courses/111104025/
3. https://nptel.ac.in/courses/122101003/

Chemistry of Materials

Course Code	19BS1102	Year	I	Semester	I
Course Category	Basic Sciences	Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	List the difference between temporary and permanent hardness of water.
CO2	Know the principles and applications of solar and wind energy.
CO3	Identify different organic coatings.
CO4	Analyze the importance of nano and smart materials.
CO5	Distinguish the principles of BET and TEM.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													1
CO2	3		2											1
CO3	3													1
CO4	3	2												1
CO5	3													1

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	WATER TECHNOLOGY: Introduction –Hard and Soft water, Estimation of hardness by EDTA Method - Boiler troubles- scale and sludge-priming and foaming, specifications for drinking water, Bureau of Indian Standards (BIS) and World health organization (WHO) standards, Industrial water treatment – zeolite and ion- exchangeprocesses- desalination of brackish water, reverse osmosis (RO) and electrodialysis.	CO1
II	ENERGY SOURCES AND APPLICATIONS: Electrode potential, determination of single electrode potential –Nernst's equation, reference electrodes, Weston Cd Cell, hydrogen and calomel electrodes – electrochemical series and its applications – primary cell, dry or Leclanche cell – secondary cell, lead acid storage cell, nickel- cadmium cell – lithium batteries (Lithium-MnO2) – fuel cell, hydrogen-oxygen fuel cell, Solar energy, photovoltaic cell andapplications	CO2
III	CORROSION ENGINEERING: Corrosion: Definition – theories of corrosion, dry corrosion and electrochemical corrosion – factors affecting corrosion, nature of the metal and nature of the environment. Corrosion controlling methods: Sacrificial and Impressed current cathodic protection, Metallic coatings, anodic coatings, cathodic coating, galvanizing and tinning, anodic inhibitors and cathodic inhibitors –organic	CO3

	coatings, paints and varnishes (constituents and their functions).	
IV	ENGINEERING MATERIALS AND POLYMERS Steel – Types of Steel, chemical composition – applications of alloy steels Cement: Portland cement, constituents, Manufacture of Portland Cement, chemistry of setting and hardening of cement (hydration, hydrolysis, equations). Polymers: Introduction, differences between thermoplastic and thermo setting resins, Preparation, properties and uses of polystyrene and polyphosphazines.	CO4
V	NANO AND SMART MATERIALS: Introduction to Nano materials, chemical synthesis of nanomaterials: Sol-gel method, Reverse micellar method, Characterization of nanoparticles by BET method, characterization of nanomateirals by TEM (includes basic principle of TEM), Applications of nanomaterials in waste water treatment, lubricants and engines. **Smart Materials:** Introduction Typesof smart materials self healing materials Shape memory alloys and Uses of smart materials	CO5

Learning Resources
Text Books
1.P.C. Jain and M. Jain, Engineering Chemistry, 15/e,DhanapatRai& Sons,(2014). 2.B.K. Sharma, Engineering Chemistry, Krishna Prakasham,(2014).
Reference Books
1.SashiChawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons,(2003) 2.B.S Murthy and P. Shankar, A Text Book of Nano Science and Nano Technology, University Press(2013). 3.S.S. Dara, A Textbook of Engineering Chemistry, S. Chand& Co,(2010) 4.V.Raghavan, A Material Science and Engineering, Prentice-Hall India Ltd,(2004). 5.N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications(2014). 6.K. SeshaMaheshwaramma and MridulaChugh, Engineering Chemistry, Pearson India Edn services,(2016).
e- Resources & other digital material
https://nptel.ac.in/courses/105105178/ http://202.53.81.118/course/view.php?id=82

Problem Solving and Programming

Course Code	19ES1102	Year	I	Semester	I
Course Category	Engineering Sciences	Branch	ME	Course Type	Theory
Credits	4	L-T-P	3-1-0	Prerequisites	Nil
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Develop algorithm and flowchart for simple problems.
CO2	Understand the structure, fundamentals and decision making statements in C.
CO3	Choose suitable iterative statements and arrays to solve the problems.
CO4	Solve problems using functions and pointers.
CO5	Apply the structures, unions and file operations in a specific need.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	M										1	1	2
CO2	1	1											1	2
CO3	2	2	2									1	1	2
CO4	2	2	2									1		1
CO5	2	2	2									1		1

Syllabus

Unit No.	Contents	Mapped CO
I	Introduction to Computer Problem-Solving – Introduction, The Problem-Solving Aspect, Top-Down Design, Fundamental Algorithms – Exchanging the values of two variables, Counting, Summation of a Set of Numbers, Factorial Computation, Sine Function Computation, Generation of the Fibonacci Series. Basics of Flow charts.	CO1
II	**Introduction to C:** Introduction, Structure of C Program, A Simple C Program, C-Tokens, Basic Data types, Variables, Constants, Input / Output statements, Operators, Type conversion and Type casting. **Conditional Branching Statements:** if, if-else, if-else-if Statements and Switch case.	CO2
III	**Iterative Statements:** while, for and do - while loops, Nested loops, break and continue statements. **Arrays:** Declaration, Accessing array elements, Storing values, Operations on arrays, Multi-dimensional arrays. **Strings:** Introduction, String manipulation functions.	CO3
IV	**Functions:** Introduction, Using Functions, Function declaration, Function	CO4

	definition and Function call, Parameter passing, Passing arrays to functions, Recursion, Storage classes. **Pointers:** Declaration and Initialization of pointer variables, Pointer arithmetic, Pointers and arrays, Pointer to pointer, Array of pointers, Pointers and functions, Dynamic memory allocation.	
V	**Structures:** Introduction, Nested structures, Array of structures, Structures and functions, Unions. **Files in C:** Using Files in C, Read data from files, Writing data to files, Random access to files of records.	CO5

Learning Resources
Text Books
1.R.G. Dromey, How to Solve it by Computer, 1/e, Pearson Education, 2006. (for Unit I). 2.ReemaThareja , Programming in C, Oxford University Press, AICTE Edition, 2018.
Reference Books
1.B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning, 2007. 2. PradipDey, Manas Ghosh, Programming in C, Oxford University Press, AICTE Edition, 3.B. Gottfried, Programming with C, 3/e, Schaum's outlines, McGraw Hill (India), 2017. 4.Jeri R. Hanly, Ellot B. Koffman, Problem Solving and Program Design in C, 5/e, Pearson.
e- Resources & other digital material
1. http://cprogramminglanguage.net/ 2. https://www.geeksforgeeks.org/c-programming-language/ 3. https://nptel.ac.in/courses/106105085/4

Communicative English – 1 Lab

Course Code	19HS1151	Year	I	Semester	I
Course Category	Humanities	Branch	ME	Course Type	Lab
Credits	1.5	L-T-P	0-0-3	Prerequisites	Nil
Continuous Internal Evaluation:	25	Semester End Evaluation:	50	Total Marks:	75

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Remember and understand the different aspects of the English language proficiency with emphasis on LSRW skills
CO2	Apply communication skills through various language learning activities
CO3	Analyze the comprehensive ability and logical thinking for better listening and speaking.
CO4	Evaluate and exhibit acceptable etiquette essential in social and professional situations.
CO5	Create awareness on how to improve presentation skills in English.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									2	3		3	1	
CO2									2	3		3	1	
CO3									2	3		3	1	
CO4									2	3		3	1	
CO5									2	3		3	1	

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
I	Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.	CO1
II	Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.	
III	Answering a series of questions about main idea and supporting ideas after listening to audio texts.	CO2
IV	Discussion in pairs/ small groups on specific topics followed by short structured talks.	
V	Listening for global comprehension and summarizing what is listened to.	CO3
VI	Discussing specific topics in pairs or small groups and reporting what is discussed	
VII	Making predictions while listening to conversations/transactional dialogues without video;listening with video.	CO4

VIII	Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.	
IX	Identifying key terms, understanding concepts and answering a series of relevant questionsthat test comprehension.	CO5
X	Formal oral presentations on topics from academic contexts -without the use of PPT slides.	

Learning Resources
Reference Books
1. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2ndEdition, 2018. 2. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational. 3. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012
e- Resources & other digital material
Grammar/Listening/Writing 1-language.com http://www.5minuteenglish.com/ https://www.englishpractice.com/ Listening https://learningenglish.voanews.com/z/3613; http://www.englishmedialab.com/listening.html Speaking https://www.talkenglish.com/BBC; Learning English – Pronunciation tips Merriam-Webster – Perfect pronunciation Exercises All Skills https://www.englishclub.com/; http://www.world-english.org/ http://learnenglish.britishcouncil.org/ Online Dictionaries Cambridge dictionary online; MacMillan dictionary; Oxford learner's dictionaries

Chemistry of Materials Lab

Course Code	19BS1151	Year	I	Semester	I
Course Category	Basic Sciences	Branch	ME	Course Type	Lab
Credits	1.5	L-T-P	0-0-3	Prerequisites	Nil
Continuous Internal Evaluation:	25	Semester End Evaluation:	50	Total Marks:	75

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Illustrate different ores (Fe, Cr & Cu) and their usage.
CO2	Compare the viscosities of oils.
CO3	Experiment with the physical parameters of organic compounds.
CO4	Apply the TLC technique for the identification of organic compounds.
CO5	Analyze the quality of ground water sample.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		2											1
CO2	3		2											1
CO3	3		2											1
CO4	3		2											1
CO5	3		2											1

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
I	Estimation of calcium in Portland cement	CO1
II	Determination of chromium (VI) in potassium dichromate	
III	Determination of viscosity of a liquid	CO2
IV	Determination of surface tension of a liquid	CO3
V	Determination of sulphuric acid in lead-acid storage cell	
VI	Determination of strength of an acid by pH metric method	
VII	Determination of Hardness of a ground water sample	CO5
VIII	Estimation of active chlorine content in Bleaching powder	CO3
IX	Thin layer chromatography	CO4
X	Preparation of Phenol-formaldehyde resin	CO3

Learning Resources
Text Books
1.Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers(2000).
Reference Books
1.N.KBhasin and Sudha Rani Laboratory Manual on Engineering Chemistry 3/e, DhanpatRai Publishing Company(2007).

e- Resources & other digital material
https://nptel.ac.in/courses/105105178/ http://202.53.81.118/course/view.php?id=82

Problem Solving and Programming Lab

Course Code	19ES1152	Year	I	Semester	I
Course Category	Engineering Sciences	Branch	ME	Course Type	Lab
Credits	1.5	L-T-P	0-0-3	Prerequisites	Nil
Continuous Internal Evaluation:	25	Semester End Evaluation:	50	Total Marks:	75

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Build algorithm and flowchart for simple problems.
CO2	Use suitable control structures to solve problems.
CO3	Use suitable iterative statements and arrays to solve the problems.
CO4	Implement Programs using functions and pointers.
CO5	Develop code for complex applications using structures, unions and file handling features.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2										1	1	2
CO2	2	2	2		2							1	1	1
CO3	2	2	2		2							1	1	1
CO4	2	2	2		2							1		2
CO5	2	2	2		1							1		2

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
I	Draw flowcharts for fundamental algorithms.	CO1
II	C Programs to demonstrate C-tokens.	CO2
III	C Programs on usage of operators.	
IV	C Programs to demonstrate Decision making and branching (Selection)	
V	C programs to demonstrate different loops.	CO3
VI	C programs to demonstrate 1-D arrays.	
VII	C programs to demonstrate multi-dimensional arrays.	
VIII	C programs to perform operations on strings with String handling functions and without String handling functions.	
IX	C programs to demonstrate functions.	CO4
X	C programs on pointers.	
XI	C programs on structures and unions.	CO5
XII	C programs to demonstrate files.	

Learning Resources
Text Books
1.R.G. Dromey, How to Solve it by Computer, 1/e, Pearson Education, 2006. 2.ReemaThareja , Programming in C, Oxford University Press, AICTE Edition, 2018.
Reference Books
1.B. A. Forouzan and R. F. Gilberg, Computer Science: A Structured Programming Approach Using C, 3/e, Cengage Learning, 2007. 2. PradipDey, Manas Ghosh, Programming in C, Oxford University Press, AICTE Edition, 3.B. Gottfried, Programming with C, 3/e, Schaum's outlines, McGraw Hill (India), 2017. 4.Jeri R. Hanly, Ellot B. Koffman, Problem Solving and Program Design in C, 5/e, Pearson.
e- Resources & other digital material
1. http://cprogramminglanguage.net/ 2. https://www.geeksforgeeks.org/c-programming-language/ 3. https://nptel.ac.in/courses/106105085/4

Basic Workshop

Course Code	19ES1153	Year	I	Semester	I
Course Category	Engineering Sciences	Branch	ME	Course Type	Lab
Credits	1.5	L-T-P	0-0-3	Prerequisites	Nil
Continuous Internal Evaluation:	25	Semester End Evaluation:	50	Total Marks:	75

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Apply wood working skills in real world applications
CO2	Build different parts with metal sheets in real world applications.
CO3	Apply fitting operations in various applications.
CO4	Apply different types of basic electric circuit connections and demonstrate soldering.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3					1			3		1		3	
CO2	3					1			3		1		3	
CO3	3					1			3		1		3	
CO4	3					1			3		1		3	

Syllabus

Job Type	Contents	Mapped CO
Wood Working	Familiarity with different types of woods and tools used in wood working and make following joints i) Half – Lap joint. ii) Mortise and Tenon joint. iii) Corner Dovetail joint or Bridle joint.	CO1
Sheet Metal Working	Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets i) Tapered tray ii) Conical funnel ii) Elbow pipe	CO2
Fitting	Familiarity with different types of tools used in fitting and do the following fitting exercises i) V-fit ii) Semi-circular fit iii) Bicycle tire puncture and change of two wheeler tire	CO3
Electrical	Familiarities with different types of basic electrical circuits and	CO4

Wiring	make the following connections i) Preparation of a circuit for Parallel and series connection. ii) Preparation of a circuit Go down lighting using Two way switch and tube light. iii) Soldering of wires	

Learning Resources
Text Books
1. Work shop Manual - P.Kannaiah/ K.L.Narayana/ Scitech Publishers. 2. Workshop Manual / Venkat Reddy/ BS Publications/Sixth Edition

Engineering Mathematics – II (ODE, PDE and Multivariable Calculus)

Course Code	19BS1201	Year	I	Semester	II
Course Category	Basic Sciences	Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Calculus&Algebra
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	solve the differential equations related to various engineering fields .
CO2	Solve the linear differential equation with constant coefficients.
CO3	identify solution methods for partial differential equations that model physical processes .
CO4	interpret the physical meaning of gradient, curl and divergence .
CO5	determine the work done against a force field, circulation and flux using vector calculus .

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2											1	
CO2	3	2											1	
CO3	3	2											1	
CO4	3	2											1	
CO5	3	2											1	

Syllabus

Unit No.	Contents	Mapped CO
I	**Linear Differential Equations of Higher Order:** Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral, method of variation of parameters.	CO1
II	**Equations Reducible to Linear Differential Equations and Applications:** Cauchy‘s and Legendre‘s linear equations, simultaneous linear equations with constant coefficients, Applications: Mass spring system and L-C-R Circuit problems.	CO2
III	**Partial Differential Equations:** First order partial differential equations, solutions of first order linear PDEs, Charpit‘s method, solutions to homogenous and non-homogenous linear partial differential	CO3

	equations.	
IV	**Multivariable Calculus (Vector Differentiation):**Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities	CO4
V	**Multivariable Calculus (Vector Integration):** Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof).	CO5

Learning Resources
Text Books
1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018 2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.
Reference Books
1 R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002. 2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013. 3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011.
e- Resources & other digital material
www.nptelvideos.com/mathematics/ https://nptel.ac.in/courses/111104025/ https://nptel.ac.in/courses/122101003/

Applied Physics

Course Code	19BS1204	Year	I	Semester	II
Course Category	Basic Sciences	Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Nil
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Estimate** forces and moments in mechanical systems using scalar and vector techniques.
CO2	**Apply** the concepts of strain, internal force, stress and equilibrium to deformation of solids.
CO3	**Explain** the fundamental theory for the analysis of heat transfer processes in solids and liquids and to apply basic principles of heat transfer in design of refrigerators and heaters.
CO4	**Describe** the fundamental principles of acoustics with emphasis on physical mechanisms, law and relationships.
CO5	**Outline**the basic principle and operation of different types of *sensors.*

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3											3	
CO2	3	3											3	
CO3	3	3											3	
CO4	3	3											3	
CO5	3	3											3	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	Mechanics Basic laws of vectors and scalars; Rotational frames; Conservative and non-conservative forces; F = - grad V; Central forces; Elliptical, parabolic and hyperbolic orbits; Noninertial frames of reference; Centripetal acceleration; Harmonic oscillator; Damped harmonic motion; Forced oscillations and resonance. Degrees of freedom.	CO1
II	Elasticity Concepts of elasticity and plasticity, stress and strain, Hooke's law, different moduli of elasticity, Poisson's ratio, strain energy, stress-strain diagram, elastic behavior of a material, factors affecting elasticity, relation between different moduli of elasticity, determination of elastic moduli	CO2

III	Thermal Properties Transfer of heat energy; Thermal expansion of solids and liquids; Expansion joints - bimetallic strips;Thermal conduction, convection and radiation and their fundamental laws; Heat conductions in solids; Thermal conductivity - Forbe's and Lee's disc method: theory and experiment; Applications (qualitative only): heat exchangers, refrigerators, ovens and solar water heaters.	CO3
IV	Acoustics Characteristics of sound waves; Weber-Fechner Law; Absorption coefficient, determination of absorption coefficient; Reverberation time; Sabine's formula, derivation of Sabine's formula using growth and decay method; Intensity of sound; Acoustics of Buildings, Acoustic requirements of a good auditorium.	CO4
V	Sensors Sensors (qualitative description only); Different types of sensors and applications; Strain and pressure sensors - Piezoelectric, magnetostrictive sensors; Fibre optic methods of pressure sensing; Temperature sensor - bimetallic strip, pyroelectric detectors; Hall-effect sensor; Smoke and fire detectors.	CO5

Learning Resources
Text Books
1. D. Kleppner and Robert Kolenkow "An Introduction to Mechanics– II" Cambridge University Press, 2015. 2. A Textbook of Engineering Physics, Volume-I By M.N. Avadhanulu& T.V.S. Arun Murthy S Chand. 3. Ian R Sinclair, Sensor and Transducers 3/e, 2001, Elsevier (Newnes)
Reference Books
1. M K Varma "Introduction to Mechanics"-Universities Press,2015. 2.PrithwirajPurkait, BudhadityaBiswas and ChiranjibKoley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1/e., 2013 McGraw Hill Education (India) Private Limited, 2013.
e- Resources & other digital material
http://nptel.ac.in/courses.phphttp://jntuk-coeer http://freevideolectures.com/Course/3048/Physics-of-Materials/36

Basic Electrical & Electronics Engineering

Course Code	19ES1201	Year	I	Semester	II
Course Category	Engineering Sciences	Branch	ME	Course Type	Theory
Credits	4	L-T-P	3-1-0	Prerequisites	Nil
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	To familiarize the basic DC and AC networks used in electrical and electronic circuits.
CO2	To explain the concepts of electrical machines and their characteristics.
CO3	To identify the importance of transformers in transmission and distribution of electric power.
CO4	To impart the knowledge about the characteristics, working principles and applications of semiconductor diodes, metal Oxide semiconductor field effect transistors (MOSFETs).
CO5	To expose basic concepts and applications of Operational Amplifier and configurations.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2					1		1		2	1	1	1
CO2	3	2				1	1		1		2	1	2	2
CO3	3	2				1	1		1		2	1	2	2
CO4	3	2					1		1		2	1	1	2
CO5	3	2					1		1		2	1	1	2

Syllabus

Unit No.	Contents	Mapped CO
I	Basic laws and Theorems: Ohms law, Kirchoff's Laws, series and parallel circuits, source transformations, delta-wye conversion. Mesh analysis, nodal analysis. Linearity and superposition theorem, Thevenin's and Norton's theorem with simple examples, maximum power transfer theorem with simple examples.	CO1
II	DC Machines: Constructional features, induced EMF and torque expressions, different types of excitation, performance characteristics of different types of dc machines, Starters: 2-point, 3-point starters, losses and efficiency, efficiency by direct loading.	CO2
III	Transformers: Constructional details, EMF equation, voltage regulation, losses and efficiency, open/short- circuit tests and determination of efficiency. Three Phase Induction Motors: Construction, working principle	CO3

	of three phase induction motor, Torque and Torque-Slip characteristics.	
IV	Semiconductor Devices: p-n Junction diode - Basic operating principle, current-voltage characteristics, rectifier circuits (half-wave, full-wave, rectifier with filter capacitor), Zener diode as Voltage Regulator; Metal oxide semiconductor field effect transistor (MOSFET): Operation of NMOS and PMOS FETs, MOSFET as an amplifier and switch.	CO4
V	Operational Amplifiers: The Ideal Op Amp, The Inverting Configuration, The closed loop gain, Effect of Finite open-loop gain, The Noninverting Configuration, The closed loop gain, Characteristics of Non Inverting Configuration, Effect of finite open loop gain, the voltage follower, Difference amplifiers, A Single Op-amp difference amplifier.	CO5

Learning Resources
Text Books
1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1stedition, McGraw Hill Education (India) Private Limited, 2017. 2 B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1stedition,S.Chand Publishing, New Delhi, 2006. 3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6th edition, Oxford University Press, 2014.
Reference Books
1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education,2011. 2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008. 3. R.K.Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi,2012.
e- Resources & other digital material
http://202.53.81.118/course/view.php?id=122 https://nptel.ac.in/courses/108105112/

Engineering Graphics

Course Code	19ES1203	Year	I	Semester	II
Course Category	Engineering Sciences	Branch	ME	Course Type	Theory
Credits	2.5	L-T-P	1-0-3	Prerequisites	Nil
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Conic sections and curves used in engineeringpractice.
CO2	Orthographic projections of points, lines, planes and solids.
CO3	Isometric and orthographic views.
CO4	Development of lateral surfaces of solids.
CO5	Features of CAD packages.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3									3	1		3	1
CO2	3									3	1		3	1
CO3	3									3	1		3	1
CO4	3									3	1		3	1
CO5	3				3					3	1		3	1

Syllabus

Unit No.	Contents	Mapped CO
I	Introduction to Engineering Graphics: Principles of Engineering Graphics and their significance- Conventions in drawing, lettering, dimensioning, BIS conventions. a)**Conicsections**:Construction of ellipse, parabola and hyperbola (generalmethodonly) b) **Cycloidal curves**: Cycloid, Epicycloidand Hypocycloid c) **Involutes**: Involute of regular polygons and Circle.	CO1
II	**Projection of points, lines and planes:** Projection of points in different quadrants, lines inclined to one and both the reference planes, finding true length and inclination made by the line. Projections of regular plane surfaces.	CO2
III	**Projections of solids:** Projections of regular solids such as cube, prism, pyramid, cylinder and cone (Treatment limited to solids inclined to one of the reference planes). **Sectionsofsolids:**Sectionplanesandsectionalviewofrightregularsolids - cube, prism,cylinder,pyramid andcone.Trueshapeofthesection.	CO3

	(Treatment limited to the solids perpendicular to one of the principal planes)	
IV	**Orthographic Views:** Systems of projections, conversion of isometric view to orthographic view. **Isometric Projections:** Principles of isometric projection- isometric scale; isometric views: lines, planesandsolids.(Treatment is limited to simple objects only)	CO4
V	**Developmentofsurfaces:**Developmentof lateral surfacesofrightregularsolids-prism,cylinder,pyramid, cone and theirsectionalparts. (Treatment limited to solids perpendicular to one of the principal planes)	CO5
	IntroductiontoCAD: Basicdrawing,editing and dimensioning commands:line,circle,rectangle,erase,view, undo, redo, snap, edit, move, copy, rotate, scale, mirror, layer, template, polyline, trim, extend, stretch, fillet, array, dimension.	

Learning Resources

Text Books

1. N.D. Bhatt, Engineering Drawing, 53/e, Charotar Publishers,2016.
2. K.L.Narayana&P.Kannaiah,EngineeringDrawing,3/e,ScitechPublishers,2012.

Reference Books

1. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill,2009.
2. Shah and Rana, Engineering Drawing, 2/e, Pearson Education,2009.
3. K. Venugopal,EngineeringDrawingandGraphics,6/e,NewAgePublishers,2011.
4. K.C. John, Engineering Graphics, 2/e, PHI,2013.
5. BasantAgarwalandC.M.Agarwal,EngineeringDrawing,TataMcGrawHill,2008.

e- Resources & other digital material

1. http://www.youtube.com/watch?v=XCWJ XrkWco, Accessed On 01-06-2017.
2. http://www.me.umn.edu/courses/me2011/handouts/drawing/blanco-tutorial.html# isodrawing, Accessed On 01-06-2017.
3. http://www.slideshare.net, Accessed On 01-06-2017.
4. http://edpstuff.blogspot.in, Accessed On 01-06-2017.

Applied Physics Lab

Course Code	19BS1252	Year	I	Semester	II
Course Category	Basic Sciences	Branch	ME	Course Type	Lab
Credits	1.5	L-T-P	0-0-3	Prerequisites	Nil
Continuous Internal Evaluation:	25	Semester End Evaluation:	50	Total Marks:	75

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Determine** the rigidity modulus, Poisson's ratio of a material and coefficient of damping, quality factor for an oscillator.
CO2	**Demonstrate** elastic limit and stress-strain relationship using Hooke's law
CO3	**Calculate** thermal conductivity of bad and good conductors.
CO4	**Apply** resonancetoestimatethe frequency of a tuning fork and **examine** the relation between frequency and volume of a cavity.
CO5	**Identify** the type of semiconductor and**evaluate** the acceptance angle, numerical aperture an optical fiber.

Contribution of Course Outcomes towards achievement of Program Outcomes &Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		3										3	
CO2	3		3										3	
CO3	3		3										3	
CO4	3		3										3	
CO5	3		3										3	

Syllabus		
Unit No.	**Contents**	**Mapped CO**
I	To Determine The Rigidity Modulus Of Material Of A Wire-Dynamic Method(Torsional Pendulum).	CO1
II	To Determine The Poisson's Ratio Of Rubber Experiment	
III	To Investigate Hooke's Law	CO2
IV	To Determine The Thermal Conductivity Of A Bad Conductor By Lee's Disc Method	CO3
V	To Study Of Resonance In A LCR Circuit.	CO4
VI	To Verify The Relation Between Volume Of The Air In The Resonator And Frequency Of Note.	
VII	To Determine The Resonance Frequency Using Sonameter	
VIII	To Determine The Frequency Of Electrically Maintained Tuning Fork By Melde's Method.	
IX	To Determine The Hall Coefficient Using Hall Effect Experiment.	CO5
X	To Determine The Numerical Aperture Of A Given Optical Fibre And Hence To Find Its Acceptance Angle.	

Learning Resources
Text Books
RamaraoSri,ChoudaryNityanand and Prasad Daruka, "Lab Manual of Engineering Physics"., Vth ed., Excell Books, 2010
Reference Books
PrithwirajPurkait, BudhadityaBiswas and ChiranjibKoley, Chapter 11 Sensors and Transducers, Electrical and Electronics Measurements and Instrumentation, 1/e., 2013 McGraw Hill Education (India) Private Limited, 2013.
e- Resources & other digital material
http://www.physicsclassroom.com/The-Laboratory

Basic Electrical & Electronics Engineering Lab

Course Code	19ES1251	Year	I	Semester	II
Course Category	Engineering Sciences	Branch	ME	Course Type	Lab
Credits	1.5	L-T-P	0-0-3	Prerequisites	Nil
Continuous Internal Evaluation:	25	Semester End Evaluation:	50	Total Marks:	75

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	To familiarize the basic DC and AC networks used in electrical and electronic circuits.
CO2	To explain the concepts of electrical machines and their characteristics.
CO3	To identify the importance of transformers in transmission and distribution of electric power.
CO4	To impart the knowledge about the characteristics, working principles and applications of semiconductor diodes, metal Oxide semiconductor field effect transistors (MOSFETs).
CO5	To expose basic concepts and applications of Operational Amplifier and configurations

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1					1		1	1	2	2
CO2	3	2	2	1			1		1		1	1	2	2
CO3	3	2	2	1			1		1		1	1	2	2
CO4	3	2	2	1			1		1		1	1	1	1
CO5	3	2	2	1			1		1		1	1	1	1

Syllabus

Expt. No.	Contents	Mapped CO
I	Verification of Kirchhoff`s Laws KVL and KCL.	CO1
II	Verification of DC Superposition Theorem.	
III	Verification of Thevenin's Theorem and Norton's Theorem	
IV	Swinburne's tests on a DC shunt motor.	CO2
V	OC and SC Tests on single phase transformer.	CO3
VI	Brake Test on DC shunt motor.	CO2
VII	Current Voltage Characteristics of a p-n Junction Diode/LED	CO4
VIII	Diode Rectifier Circuits.	
IX	Voltage Regulation with Zener Diodes.	
X	Inverting and Non-inverting Amplifier Design with Op-amps	CO5

Learning Resources
Text Books
1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1stedition, McGraw Hill Education (India) Private Limited, 2017. 2 B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1stedition,S.Chand Publishing, New Delhi, 2006. 3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6th edition, Oxford University Press, 2014.
Reference Books
1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education,2011. 2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008. 3. R.K.Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi,2012.

Mechanical Engineering Workshop

Course Code	19ME3251	Year	I	Semester	II
Course Category	Program Core	Branch	ME	Course Type	Lab
Credits	1.5	L-T-P	0-0-3	Prerequisites	Nil
Continuous Internal Evaluation:	25	Semester End Evaluation:	50	Total Marks:	75

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Demonstrate steps involved in preparing patterns, moulds and sand properties.
CO2	Make various joints using different welding techniques.
CO3	Exhibit press working operations using Hydraulic press.
CO4	Produce various components using plastic molding techniques.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		1			1			2		2		3	2
CO2	3		1			1			2		2		3	2
CO3	3		1			1			2		2		3	2
CO4	3		1			1			2		2		3	2

Syllabus

Unit No.	Contents	Mapped CO
I	1) Preparation of single piece pattern 2) Preparation of split pattern 3) Sand Molding 4) Testing Sand Properties	CO 1
II	1) Arc welding – Two exercises 2) Spot Welding 3) TIG welding 4) Gas Welding	CO 2
III	Piercing and Blanking	CO 3
IV	1) Injection Molding – Two exercises. 2) Blow Molding.	CO 4

Learning Resources
Text Books
1) Manufacturing Technology: Foundry, Forming, Welding, Volume-1, By P.N.Rao, Mc Graw Hill Education(India Pvt Limited), 5th Edition
2) Manufacturing Processes for Engineering Materials by SeropeKalpakjain, Steven R.Schmid, Pearson Education India 4e

PVP SIDDHARTHA INSTITUTE OF TECHNOLOGY, KANURU
MECHANICAL ENGINEERING DEPARTMENT
Course Structure and Syllabus (Effect from Academic Year 2019-20)

II B. Tech – I Semester

Course Code	Name of the Course	L	T	P	Credits	Internals	Externals	Total
19BS1301	Engineering Mathematics –III (PDE, Complex Variables and Transform Techniques)	3	0	0	3	30	70	100
19BS1303	Life Sciences for Engineers	2	0	0	2	30	70	100
19ES1302	Design Thinking	2	0	0	2	30	70	100
19ME3301	Engineering Mechanics	2	1	0	3	30	70	100
19ME3302	Engineering Thermodynamics	2	1	0	3	30	70	100
19ME3303	Material Science and Engineering	3	0	0	3	30	70	100
19MC1301	Environmental Sciences	3	0	0	0	100	--	100
19BS1351	Life Sciences for Engineers Lab	0	0	2	1	25	50	75
19ES1352	Design Thinking Lab	0	0	2	1	25	50	75
19ME3351	Computer Aided Machine Drawing	1	0	3	2.5	25	50	75
TOTAL		18	2	7	20.5	355	570	925

II B. Tech – II Semester

Course Code	Name of the Course	L	T	P	Credits	Internals	Externals	Total
19BS1401	Engineering Mathematics-IV (Numerical Methods, Probability and Statistics)	3	0	0	3	30	70	100
19ES1401	AI tools	2	0	0	2	30	70	100
19ME3401	Strength of Materials	3	1	0	4	30	70	100
19ME3402	Applied Thermodynamics	2	1	0	3	30	70	100
19ME3403	Fluid Mechanics	3	1	0	4	30	70	100
19ME3404	Manufacturing Processes	3	0	0	3	30	70	100
19MC1402	Constitution of India	3	0	0	0	100	--	100
19ES1451	AI tools Lab	0	0	2	1	25	50	75
19ME3451	Applied Thermodynamics Lab	0	0	3	1.5	25	50	75
19ME3452	Fluid Mechanics Lab	0	0	3	1.5	25	50	75
TOTAL		19	3	8	23	355	570	925

PVP SIDDHARTHA INSTITUTE OF TECHNOLOGY, KANURU
MECHANICAL ENGINEERING DEPARTMENT
Course Structure and Syllabus (Effect from Academic Year 2019-20)
III B. Tech – I Semester

Course Code	Name of the Course	L	T	P	Credits	Internals	Externals	Total
19ES1501	Internet of Things	2	0	0	2	30	70	100
19ME3501	Metal Cutting and Machine Tools	3	0	0	3	30	70	100
19ME4501	Program Elective-I	3	0	0	3	30	70	100
19ME3502	Mechanics of Machinery	3	1	0	4	30	70	100
	Inter disciplinary Elective-I	3	0	0	3	30	70	100
	Open Elective – I	3	0	0	3	30	70	100
19ES1552	Internet of Things Lab	0	0	2	1	25	50	75
19ME3551	Material testing and characterization Lab	0	0	3	1.5	25	50	75
19ME3552	Manufacturing Technology Lab	0	0	3	1.5	25	50	75
TOTAL		17	1	8	22	255	570	825

Course Code	**Program Elective 1**
19ME4501A	Turbo Machinery
19ME4501B	Advanced Strength of Materials
19ME4501C	CAD/CAM
19ME4501D	Industrial Engineering & Management
Course Code	**Inter disciplinary Elective-I**
19CS2501A	Data Base Management Systems
19HS2501A	Quantitative Techniques for Management
19IT2501A	OOP with C++
19IME2501A	Computational Methods

Course Code	**Open Elective – I**	**Course**	**Open Elective – I**
19ES5501A	Biotechnology and Society	19HS5501C	Engineering for Community Service
19ES5501B	Electrical Safety	19HS5501D	Personality Development
19ES5501C	Fundamentals of Cyber Law	19HS5501E	Introduction to International Business
19ES5501D	Environment and Ecology	19HS5501F	Gandhian Philosophy
19HS5501A	Contemporary Relevance of Indian Epics	19HS5501G	Indian History
19HS5501B	Indian National Movement		

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MECHANICAL ENGINEERING DEPARTMENT
Course Structure and Syllabus (Effect from Academic Year 2019-20)
III B. Tech – II Semester

Course Code	Name of the Course	L	T	P	Credits	Internals	Externals	Total
19HS1601	Engineering Economics and Management	3	0	0	3	30	70	100
19ME3601	Heat and Mass Transfer	3	1	0	4	30	70	100
19ME4601	Program Elective-II	3	0	0	3	30	70	100
19ME3602	Design of Machine Elements	3	1	0	4	30	70	100
19ME4602	Program Elective-III	3	0	0	3	30	70	100
19MC1601	Engineering Ethics	3	0	0	0	100	-	100
	Open Elective-II	3	0	0	3	30	70	100
19ME3651	CAD/CAM Lab	0	0	3	1.5	25	50	75
19ME3652	Heat and Mass Transfer Lab	0	0	3	1.5	25	50	75
TOTAL		21	2	6	23	330	520	850

Course Code	Program Elective II
19ME4601A	Refrigeration and Air Conditioning
19ME4601B	Mechanical Vibrations
19ME4601C	Additive Manufacturing
19ME4601D	Statistical Quality Control
Course Code	**Program Elective III**
19ME4602A	Renewable Energy Technology
19ME4602B	Design of Transmission Elements
19ME4602C	Modern Machining Methods
19ME4602D	Plant Layout and Facilities Planning

Course Code	Open Elective – II	Course Code	Open Elective – II
19ES5601A	Environmental Management	19HS5601F	National Service Scheme
19ES5606H	Telecommunication for Society	19HS5601G	Professional Communication
19HS5601C	Analytical Essay Writing	19HS5601H	Basics of Finance
19HS5601D	Indian Economy	19HS5601I	Basics of Marketing
19HS5601E	Public Administration		

PVP SIDDHARTHA INSTITUTE OF TECHNOLOGY, KANURU
MECHANICAL ENGINEERING DEPARTMENT
Course Structure and Syllabus (Effect from Academic Year 2019-20)
IV B. Tech – I Semester

Course Code	Name of the Course	L	T	P	Credits	Internals	Externals	Total
19HS1702	Operations Research	3	0	0	3	30	70	100
19ME3701	Measurements and Metrology	3	0	0	3	30	70	100
19ME4701	Program Elective-IV	3	0	0	3	30	70	100
19ME4702	Program Elective-V	3	0	0	3	30	70	100
	Inter Disciplinary Elective-II	3	0	0	3	30	70	100
19ME3751	Measurements and Metrology Lab	0	0	2	1	25	50	75
19ME3761	Project Phase –I	0	0	4	2	100	-	100
19ME3771	Internship *				2	75	-	75
TOTAL		15	0	6	20	350	400	750

* Industrial Training / Research Projects in National Laboratories / Academic Institutions

Course Code	Program Elective IV
19ME4701A	Computational Fluid Dynamics
19ME4701B	Finite Element Methods
19ME4701C	Robotics and it's Applications
19ME4701D	Production Planning and Control
Course Code	**Program Elective V**
19ME4702A	Power Plant Engineering
19ME4702B	Product Design
19ME4702C	Manufacturing Methods in Precision Engineering
19ME4702D	Management Information Systems
Course Code	**Inter disciplinary Elective-II**
19EE2701C	Renewable Energy Resources
19ITS2701C	Web Technologies
19ME2701B	Optimization Techniques
19ME2701C	Project Management and Optimization

PVP SIDDHARTHA INSTITUTE OF TECHNOLOGY, KANURU
MECHANICAL ENGINEERING DEPARTMENT
Course Structure and Syllabus (Effect from Academic Year 2019-20)
IV B. Tech – II Semester

Course Code	Name of the Course	L	T	P	Credits	Internals	Externals	Total
19ME4801	Program Elective-VI (MOOCs-Optional)	3	0	0	3	30	70	100
	Inter Disciplinary Elective-III (MOOCs-Optional)	3	0	0	3	30	70	100
19ME3861	Project Phase –II	0	0	14	7	100	100	200
TOTAL		6	0	14	13	160	240	400

Course Code	Program Elective VI
19ME4801A	Automobile Engineering
19ME4801B	Geometric Dimensioning and Tolerancing
19ME4801C	Automation in Manufacturing
19ME4801D	Optimization Techniques
Course Code	**Inter disciplinary Elective-III**
19CS2801D	Intro. Python Programming
19EC2801B	Instrumentation and Sensor Technologies of Civil Engineering Applications
19HS2801A	Logistics and Supply chain Management
19ME2801B	Total Quality Management

ENGINEERING MATHEMATICS-III
(PDE, COMPLEX VARIABLES &TRANSFORM ECHNIQUES)

Course Code	19BS1301	**Year**	II	**Semester**	I
Course Category	Basic Sciences course	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Determine Laplace transform and inverse Laplace transforms of given function(s).	L2
CO2	Develop a Fourier series in terms of sine and cosine of a given function.	L3
CO3	Find out Fourier sine and cosine transforms.	L3
CO4	Determine complex potential function, evaluate integrals by applying Cauchy's integral formula and construct series expansions of complex functions.	L2
CO5	Apply method of separation of variables to find the solution of wave, heat, Laplace equations with given boundary conditions.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2										2	2	
CO2	3	2										2	2	
CO3	3	2										2	2	
CO4	3	2										2	2	
CO5	3	2										2	2	

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**LAPLACE TRANSFORMS & INVERSE LAPLACE TRANSFORMS** Definition of Laplace transform, properties of Laplace transforms, transforms of derivatives, transforms of integrals, multiplication by t^n, division by t, unit step function, unit impulse function. Inverse Laplace transforms by partial fractions, convolution theorem (All theorems/properties without proofs)	CO1
II	**FOURIER SERIES** Fourier series, Dirichlet's conditions, functions of any period, odd and even functions - half range series. (All theorems/properties without proofs)	CO2
III	**FOURIER TRANSFORMS** Fourier integrals, Fourier cosine and sine integrals, Fourier transform, sine and cosine transform. (All theorems/properties without proofs)	CO3

IV	**COMPLEX VARIABLES** Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate. Cauchy theorem, Cauchy integral formula, Taylor's series, Laurent's series. (All theorems/properties without proofs)	CO4
V	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS** Classification of second order partial differential equations, method of separation of variables, solutions of one-dimensional wave equation, one dimensional heat equation and two-dimensional Laplace's equation in cartesian coordinates. (All theorems/properties without proofs)	CO5

Learning Recourse(s)
Text Book(s)
1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44/e, 2019. 2. Erwin Kreyszig, Advanced Engineering Mathematics, 9/e, John Wiley & Sons, 2006.
Reference Book(s)
1. N.P. Bali and Manish Goyal, A Text book of Engineering Mathematics, Laxmi Publications, 2008.
e- Resources & other digital material
1. https://www.nptel.ac.in/courses/111/105/111105123/ 2. https://www.nptel.ac.in/courses/111/105/111105134/ 3. https://www.nptel.ac.in/courses/111/105/111105093/

LIFE SCIENCES FOR ENGINEERS

Course Code	19BS1303	**Year**	II	**Semester**	I
Course Category	Basic Sciences course	**Branch**	ME	**Course Type**	Theory
Credits	2	**L – T – P**	2 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Apply the principles of biology to create tangible and economically viable engineering goods.	L3
CO2	Know and illustrate bio-engineering field.	L2
CO3	Analyze the importance of bioenergetics and apply the knowledge to improve the living standards of societies.	L4
CO4	Gain the knowledge in genetic engineering.	L1
CO5	Design and develop new technologies in genetic industrial field.	L5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3						2							
CO2	3						2							
CO3	3						2							
CO4	3						2							
CO5	3						2							

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO BIOLOGY** Comparison of Biological organisms with manmade systems- eye and camera, flying bird and aircraft. Classification of living organisms- Cellular basis of life, differences between prokaryotes and eukaryotes, classification on the basis of carbon and energy sources	CO1 CO3 CO5
II	**BIO-MOLECULES** Structure and functions of proteins and nucleic acids, hemoglobin, antibodies. Enzymes-Industrial applications, Fermentation and its industrial applications.	CO1 CO2
III	**BIOENERGETICS AND RESPIRATION** Glycolysis and TCA cycle, Electron transport chain and oxidative phosphorylation, Mechanism of photosynthesis. Human physiology.	CO2 CO3
IV	**GENETIC ENGINEERING** Mendel's laws, gene mapping, Mitosis and Meiosis, Epistasis, single gene disorders in humans. Genetic code.	CO2 CO4 CO5
V	**RECOMBINANT DNA TECHNOLOGY** Recombinant vaccines, transgenic microbes, plants and animals. Animal cloning, biosensors, biochips.	CO1 CO4 CO5

Learning Recourse(s)
Text Book(s)
1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2018. 2. Arthur T Johnson, Biology for Engineers, CRC press, 2011.
Reference Book(s)
1. Alberts et al., The molecular biology of the cell, 6/e, Garland Science, 2014. 2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wileyand Sons, 2009. 3. John Enderle and Joseph Bronzino, "Introduction to Biomedical Engineering", 3/e, 2012.

DESIGN THINKING

Course Code	19ES1302	**Year**	II	**Semester**	I
Course Category	Engineering Sciences course	**Branch**	ME	**Course Type**	Theory
Credits	2	**L – T – P**	2 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Explain the principles of design thinking and its approaches	L2
CO2	Identify the empathy, define phases in human centered design problems.	L2
CO3	Develop an idea, build a prototype and test in design thinking context.	L3
CO4	Implement design thinking techniques for product innovation	L3
CO5	Use design thinking in business process models.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1			3			1						1		2
CO2			3	2		1			2	2		1		2
CO3			3	2		1			3	2		1		2
CO4			3	2		1			2	2		1	2	2
CO5			3	2		1			2	2	1	1		2

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO DESIGN THINKING** An insight into Design, origin of Design thinking, Design thinking Vs Engineering thinking, importance of Design thinking, Design Vs Design thinking, understanding Design thinking and its process models, application of Design thinking	CO1
II	**EMPATHIZE IN DESIGN THINKING:** Human-Centered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate. Role of Empathy in design thinking, methods and tools of empathy, understanding empathy tools. Explore define phase state users' needs and problems using empathy methods	CO2
III	**IDEATION, PROTOTYPING AND TESTING:** Ideation methods, brain storming, advantages of brain storming, methods and tools of ideations, prototyping and methods of prototyping, user testing methods, Advantages and disadvantages of user Testing/ Validation	CO3

IV	**PRODUCT INNOVATION:** Design thinking for strategic innovation, Definition of innovation, art of innovation, teams for innovation, materials and innovation in materials, definition of product and its classification. Innovation towards product design Case studies	CO4
V	**DESIGN THINKING IN BUSINESS PROCESSES:** Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs.	CO5

Learning Recourse(s)
Text Book(s)
1. Change by design, Tim Brown, 2009, Harper Collins 2. Engineering design, George E Dieter,4th Revised edition, 2009 McGraw Hill
Reference Book(s)
1. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons 2. Design Thinking-The Guidebook – Facilitated by the Royal Civil service Commission, Bhutan 3. Design Methods: A Structured Approach for Driving Innovation in Your Organization, Vijay Kumar, First Edition, 2012, Wiley 4. Human-Centered Design Toolkit: An Open-Source Toolkit to Inspire New Solutions in the Developing World, IDEO, Second Edition, 2011, IDEO
e-Resources & other digital material
1. https://www.interaction- design.ora/literature/topics/design-thinking 2. https://www.interaction- design.prq/literature/article/how-tq-<eve'op-an- empath\capproach-in-design-thinking

ENGINEERING MECHANICS

Course Code	19ME3301	**Year**	II	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	2 – 1 – 0	**Prerequisites**	Engineering Mathematics
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Determine the resultant force, moment and static equilibrium of a rigid body subjected to a force system.	L3
CO2	Analyze planar force systems to determine the forces in the members of trusses and solve friction related problems.	L4
CO3	Determine centroids and moment of inertia for simple and composite areas	L3
CO4	Apply kinematic principles to the rigid bodies under translation and rotation motion.	L3
CO5	Determine the motion parameters for a body subjected to a given force system.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2							1		2	3	1
CO2	3	3	2							1		2	3	1
CO3	3	3	2							1		2	3	1
CO4	3	3	2							1		2	3	1
CO5	3	3	2							1		2	3	1

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION**: Significance of Engineering Mechanics, Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and non-concurrent, coplanar forces, resultant of coplanar force systems, couple, moment of a force, Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.	CO1
II	**FRICTION:** Laws of friction, types of friction, equilibrium of force systems involving frictional forces, ladder and wedge friction **ANALYSIS OF STRUCTURES:** Introduction to plane trusses, Types of trusses, Assumptions in analysis of truss, analysis of plane trusses by method of joints.	CO2
III	**CENTROID:** Centroid and centre of gravity, derivation of centroids of rectangle, triangle, circle, semi-circle from first principles, centroid of composite areas.	CO3

	MOMENT OF INERTIA: Area moment of inertia of plane and composite figures, parallel axis theorem, perpendicular axis theorem, polar moment of inertia.	
IV	**KINEMATICS:** Equations of motion for rigid bodies under constant and variable acceleration, rectilinear and curvilinear motion, Rotation of a rigid body about a fixed axis- Rotation under the action of constant moment.	CO4
V	**KINETICS:** Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy. **IDEAL SYSTEMS:** Principle of conservation of energy, conservation of linear momentum, principle of momentum and impulse, impact – Direct central impact	CO5

Learning Recourse(s)
Text Book(s)
1. S. Timoshenko, D.H. Young, J.V. Rao, Sukumar Pati, Engineering Mechanics (in SI units), 5/e, McGraw Hill, 2013. 2. Engineering Mechanics Statics and dynamics, by A.K.Tayal, Umesh Publication, Delhi, 14e, 2010.
Reference Book(s)
1. Irving Shames, G.K.M. Rao, Engineering Mechanics: Statics and Dynam-ics, 4/e, Pearson, 2009. 2. K.L. Kumar, Veenu Kumar, Engineering Mechanics, 4/e, Tata McGraw Hill, 2010. 3. N.H. Dubey, Engineering Mechanics: Statics and Dynamics,TataMcGrawHill,2014
e-Resources & other digital material
1. https://nptel.ac.in/courses/112/103/112103108/ 2. https://www.coursera.org/learn/engineering-mechanics- statics

ENGINEERING THERMODYNAMICS

Course Code	19ME3302	**Year**	II	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	2 – 1 – 0	**Prerequisites**	NIL
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Learn the terminology and basic concepts of thermodynamics and capable of analyzing zeroth and first law of thermodynamics	L1
CO2	Analyze Second law of thermodynamics and working of various devices with heat and work transactions.	L4
CO3	Assess quality and quantity of energy and analyze Exergy	L5
CO4	Recognize and understand different phases of pure substances and familiarize with saturated and superheated steam property tables and charts	L2
CO5	Learn power producing thermodynamic cycles capable of making their analysis and evaluate the relative performance	L1

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
	2	2				2	2	2				2	2	2
CO2	3	3				3	3	2				2	2	2
CO3	3	3				3	3	2				2	2	2
CO4	2	2				3	3	2				2	2	2
CO5	3	3				3	3	2				2	2	2

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION:** Macroscopic and microscopic viewpoints, definitions of thermodynamic terms, quasi – static process, point and path function, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics. **FIRST LAW OF THERMODYNAMICS:** Joule's experiment - first law of thermodynamics, corollaries- perpetual motion machines of first kind, first law applied to non-flow and flow process- limitations of first law of thermodynamics**.**	CO1
II	**SECOND LAW OF THERMODYNAMICS**: Kelvin - Planck statement and Clausius statement and their equivalence, corollaries - perpetual motion machines of second kind - reversibility and irreversibility, cause of irreversibility - Carnot cycle, heat engine, heat pump and refrigerator, Carnot theorem, Carnot efficiency.	CO2

III	**ENTROPY:** Clausius inequality - Concept of Entropy- entropy equation for different processes and systems, Maxwell relations, TDS equations **AVAILABILITY AND IRREVERSIBILITY**: Definition of exergy and energy, expressions for availability and irreversibility. Availability in steady flow, non-flow processes, irreversibility.	CO3
IV	**PROPERTIES OF STEAM AND USE OF STEAM TABLES**: Pure Substances, P-V-T surfaces, dryness fraction, property tables, T-s and h-s diagram (Mollier chart), analysis of steam undergoing various thermodynamic processes using Mollier chart– steam calorimetry.	CO4
V	**THERMODYNAMIC CYCLES**: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle, Brayton Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.	CO5

Learning Recourse(s)

Text Book(s)

1. P.K.Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Van Wylen, Fundamentals of Classical Thermodynamics, G.J.John Wylie./ S chand Publications

Reference Book(s)

1. Yunus A. Cengel, Michaela A. Boles, Thermodynamics, 7/e, Tata McGraw Hill, 2011.
2. P.L.Dhar, Engineering Thermodynamics a generalized approach, Elsevier
3. J.B.Jones and G.A.Hawkins, Introduction to Thermodynamics, 2/e, John Wiley & Sons,2012.
4. Moran, Michael J. and Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 3/e, Wiley, 2015
5. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 7/e, Wiley,2009
6. R.K. Rajput, S.Chand& Co., Thermal Engineering, 6/e, Laxmi publications, 2010.

e-Resources & other digital material

1. https://nptel.ac.in/courses/112/105/112105266/
2. https://nptel.ac.in/courses/112/105/112105220/
3. https://nptel.ac.in/courses/101/104/101104067/
4. https://nptel.ac.in/courses/101/104/101104063/
5. https://nptel.ac.in/courses/103/104/103104151/

MATERIAL SCIENCE AND ENGINEERING

Course Code	19ME3303	**Year**	II	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Applied Physics, Chemistry of Materials
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Identify the properties of metals with respect to crystal structure and grain size	L2
CO2	Interpret the phase diagrams of materials and describe the concept of Strengthening Mechanisms	L2
CO3	Describe the concept of heat treatment and Case hardening of steels	L2
CO4	Distinguish different types of steels, Tool and cast irons	L4
CO5	Explain Properties and Applications of Nonferrous alloys and composite materials	L1

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	1		2					2			3	1
CO2	2	3	1		2					2			3	1
CO3	2	2	2	1	2					2			3	1
CO4	2	2	2	1	2		1			2			3	1
CO5	2	2	2	1	2		1			2			3	1

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**MATERIALS SCIENCE AND ENGINEERING**: Introduction, Classification of Materials, Mechanical Properties of Materials, Case Study: Delhi Iron Pillar and Wootz Steel. **CRYSTALLOGRAPHY:** Unit cell, Classification, Bravais Lattices, Packing factor and coordination number in cubic systems, Miller Indices for Cubic systems, imperfections in solids: Point, Line and Volume, Slip and Twinning. Determination of grain size.	CO1
II	**MECHANISM OF CRYSTALLIZATION:** Nuclei Formation, crystal growth **CONSTITUTION OF ALLOYS:** Types of solid solution-substitutional and interstitial solid solutions, Hume Rothery rules for solid solution. **PHASE DIAGRAMS:** Phase, Phase equilibrium, Gibbs Phase rule –	CO2

	one component system, two component system, Construction of binary phase diagram, Isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, Fe-Fe_3C equilibrium diagram, Lever rule: Isomorphous. **STRENGTHENING MECHANISMS:** Grain Refinement, Strain hardening, solid solution strengthening, Dispersion strengthening	
III	**HEAT TREATMENT PROCESSES:** stages of heat treatment, TTT and CCT diagram of eutectoid steel, Annealing: Full Annealing, Spherodizing, Stress Relief Annealing, Process Annealing, Normalizing, Hardening, Tempering, Austempering, Martempering. **CASE HARDENING:** Flame hardening, Induction hardening, Carburizing, Cyaniding, Nitriding.	CO3
IV	**STEELS: STAINLESS STEELS**: Ferritic, Martensitic, Austenitic, **Tool steels:** Water Hardened, Shock Resistance, Cold-Work, Hot-Work Tool Steels, Applications and Properties. **CAST IRONS:** Structure, Properties and Applications of White Cast iron, Malleable Cast iron, Grey cast iron, Spheroidal graphite cast iron.	CO4
V	**NON-FERROUS METALS AND ALLOYS:** Properties and Applications of Copper and its alloys: Cartridge Brass, Cupronickel, Gun Metal, Naval Brass, Bell Metal, Speculum metal, Phosphor Bronze, **ALUMINIUM AND ITS ALLOYS:** Duralumin, Hindalium, Magnalium, Aluminium–Scandium, **TITANIUM AND ITS ALLOYS:** α and Nearα, β Alloys, α-β Alloys. **COMPOSITE MATERIALS:** Classification of composites, particle reinforced materials, fiber reinforced composite materials and metal matrix composites.	CO5

Learning Recourse(s)

Text Book(s)

1. R. Balasubramaniam, Callister's, Material Science and Engineering, 2/e, Wiley India,2014.
2. S.H. Avner, Introduction to Physical Metallurgy, 2/e, Tata McGrawHill,1997.

Reference Book(s)

1. Donald R. Askeland, "Essential of Materials Science and Engineering", Thomson Learning, 5th Edition – 2006
2. V.D. Kodgire, "Material Science and Metallurgy", Everest Publishing House - 25th Edition – 2009.
3. B.K.Agarwal, "Introduction to Engineering Materials", Tata McGraw Hill-1stEdition.
4. V. Raghavan, "Material Science and Engineering",-PHI Learning - 5th Edition.

e-Resources & other digital material

1. http://materials.iisc.ernet.in/~wootz/heritage/WOOTZ.htm
2. http://met.iisc.ernet.in/~rangu/text.pdf
3. https://nptel.ac.in/courses/113106032/
4. https://nptel.ac.in/courses/113107078/
5. http://vvm.org.in/study_material/ENG%20-%20Indian%20Contributions%20to%20Science.pdf

ENVIRONMENTAL SCIENCES

Course Code	19MC1301	**Year**	II	**Semester**	I
Course Category	Mandatory course	**Branch**	ME	**Course Type**	Theory
Credits	0	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	100	**Semester End Evaluation**	0	**Total Marks**	100

Course Outcomes	
After successful completion of the course, the student will be able to	
CO1	Develop an awareness and knowledge on natural resource protection.
CO2	Compile for the better future of environment in India which is based on many positive factors like Biodiversity and ecosystems.
CO3	Apply knowledge how to manage the harmful pollutants
CO4	Identify solutions for global environmental problems for sustainable environment.
CO5	Create awareness among the youth on environmental acts; take part in Environment impact assessment and management plans.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3						2							
CO2	3						2							
CO3	3						2							
CO4	3						2							
CO5	3						2							

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO ENVIRONMENT AND NATURAL RESOURCES** Introduction to environment: Definition scope importance need for public awareness. Natural resources: Renewable and non-renewable resources, natural resources and associated problems. Forest resources: Uses, Reasons for over-exploitation, deforestation effects case studies. Water resources: Use and over – utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems. Mineral resources: Uses, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, Impacts of overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, use of renewable and non-renewable energy sources, case studies.	CO1
II	**ECOSYSTEMS AND BIODIVERSITY** Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs,	

	Ecological pyramids, Energy flow in the ecosystem, Ecological succession. Biogeochemical cycle: Nitrogen, carbon, Phosphorus cycle. Biodiversity: Definition, Levels of biodiversity: genetic, species and ecosystem diversity. Bio-geographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega – diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: In– situ and Ex-situ conservation of biodiversity.	CO2
III	**ENVIRONMENTAL POLLUTION AND CONTROL** Environmental Pollution: Definition, causes, effects and control measures: Air Pollution, Water pollution, Soil pollution, Marine pollution, Thermal pollution, nuclear hazards, Solid waste Management, e-waste, Pollution case studies.	CO3
IV	**SOCIAL ISSUES AND GLOBAL ENVIRONMENT PROBLEMS AND EFFORTS** From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management, Remote sensing and GIS methods. Environmental ethics: Issues and possible solutions. Green building concept, Environmental Impact Assessment Environmental Management Plan, Climate change: global warming, acid rain, ozone layer depletion.	CO4
V	**HUMAN POPULATION AND ENVIRONMENT LEGISLATION** Population growth, Environment and human health. HIV/AIDS, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Environmental Protection Act.	CO5

Learning Recourse(s)

Text Book(s)

1. Anubha Kaushik and C.P. Kaushik, Text book of environmental studies New Age International Publisher (2014).
2. Erach Barucha, Text book of environmental studies for undergraduate's courses, published by – University Grants Commission, University Press (2005)
3. Anindita Basak, Environmental Studies. Pearson (2009)

Reference Books

1. D.K. Asthana and Meera Asthana, A Text book of Environmental Studies, S. Chand (2010).
2. P.M Cherry Solid and Hazardous waste Management, CBS Publisher (2016).
3. Charles H. Ecclestion, Environmental Impact Assessment, CRC Press (2011).

LIFE SCIENCES FOR ENGINEERS LAB

Course Code	19BS1351	**Year**	II	**Semester**	I
Course Category	Basic Sciences	**Branch**	ME	**Course Type**	Practical
Credits	1	**L – T – P**	0 – 0 – 2	**Prerequisites**	NIL
Continuous Internal Evaluation	25	**Semester End Evaluation**	50	**Total Marks**	75

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Understand basic facts and concepts in life sciences.	L2
CO2	Evaluate and explain different processes in industrial applications	L5
CO3	Summarize the applications of various spheres in life sciences in relevance to future studies.	L2
CO4	Develop the ability to apply the principles of Mendalian laws and acquire problem solving skills.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3						2							
CO2	3						2							
CO3	3						2							
CO4	3						2							

Syllabus		
Expt. No	**Contents**	**Mapped COs**
1.	Microscopy	CO1, CO3
2.	Dissect & mount different parts of plants using Microscope	CO1, CO3
3.	Estimation of Proteins by using Biuret method	CO1, CO2
4.	Estimation of enzyme activity.	CO1, CO2
5.	Estimation of chlorophyll content in some selected plants.	CO1, CO3
6.	Nitrogen Cycle: Estimation of Nitrates /Nitrites in soil by using Spectrophotometer	CO2, CO3
7.	Mendal's laws	CO1, CO4
8.	Solve Problems based on Mapping.	CO2, CO4

DESIGN THINKING LAB

Course Code	19ES1352	**Year**	II	**Semester**	I
Course Category	Engineering Sciences	**Branch**	ME	**Course Type**	Practical
Credits	1	**L – T – P**	0 – 0 – 2	**Prerequisites**	NIL
Continuous Internal Evaluation	25	**Semester End Evaluation**	50	**Total Marks**	75

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Develop a mind map for design thinking process	L3
CO2	Prepare empathy maps and journey maps for problems.	L3
CO3	Construct mock-up models through ideation and innovation techniques	L5
CO4	Use software for design thinking problems	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1			2	2					3				1	2
CO2			2	2					3				1	2
CO3			2	2					3				1	2
CO4			2	2					3				1	2

Note: Any TWELVE From Below

Syllabus		
Expt.No	**Contents**	**Mapped COs**
1.	Design a mind map of design thinking	CO1
2.	Thirty circle Exercise ---ideation	CO3
3.	Prepare a toothpick bridge (mock-up model)	CO1, CO3
4.	Prepare a marble maze (mock up model)	CO1, CO3
5.	Build a wind power car (mock up model)	CO1, CO3
6.	Make a hydraulic elevator (mock up models)	CO1, CO3
7.	Construct empathy maps for a given case study-1	CO2
8.	Develop customer journey map for a given case-1	CO2
9.	Construct empathy maps for a given case study-2	CO2
10.	Develop customer journey map for a given case -2	CO2
11.	Make a paper prototype for user testing (mock-up model)	CO2
12.	Design and development of cell phone wallet (mock-up model)	CO1, CO2, CO3
13.	Design thinking-1 using sprint base software	CO4
14.	Design thinking-1 using sprint base software	CO4

Learning Recourse(s)
Text Book(s)
1. Change by design, Tim Brown, 2009, Harper Collins 2. Engineering design, George E Dieter,4th Revised edition, 2009 McGraw Hill.
Reference Book(s)
1. Design Thinking for Strategic Innovation, Idris Mootee, 2013, John Wiley & Sons 2. Design Thinking-The Guidebook – Facilitated by the Royal Civil service Commission, Bhutan 3. Design Methods: A Structured Approach for Driving Innovation in Your Organization, Vijay Kumar, First Edition, 2012, Wiley 4. Human-Centered Design Toolkit: An Open-Source 5. Toolkit to Inspire New Solutions in the Developing World, IDEO, Second Edition, 2011, IDEO
e-Resources & other digital material
1. https://www.interaction- design.ora/literature/topics/design-thinkinq 2. https://www.interaction- design.prq/literature/article/how-tq-<eve'op-an-empath\capproach-in-design-thinking

COMPUTER AIDED MACHINE DRAWING

Course Code	19ME3351	**Year**	II	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Practical
Credits	2.5	**L – T – P**	1 – 0 – 3	**Prerequisites**	NIL
Continuous Internal Evaluation	25	**Semester End Evaluation**	50	**Total Marks**	75

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Develop engineering drawings for the machine components as per Indian Standard Code of practice using drafting software.	L5
CO2	Prepare assembly drawings from part drawings.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1		1		3					3			3	1
CO2	1		1		3					3			3	1

Expt.No	**Contents**	**Mapped COs**
A	**The following contents are to be done by any 2D software package** **Conventional representation of materials and machine components:** **DETACHABLE JOINTS**: Geometric dimensioning, Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint with washer and locknut. **RIVETED JOINTS**: Types of rivet heads, single riveted and double riveted lap joints, butt joint with single riveted, double riveted, single strap and double strap joints. **KEYS:** Sunk key, round key, saddle key, feather key, woodruff key. **COTTER JOINTS:** Cotter joint with Socket and spigot joint ends, Knuckle Joint. **SHAFT COUPLING**: bushed pin-type flanged coupling, Oldham's coupling.	CO1
B	**The following contents to be done by any 3D software package** Creating solid models of complex machine parts, assembly of the parts and create sectional views. **ASSEMBLY DRAWINGS: (ANY FOUR OF THE FOLLOWING USING SOLID MODEL SOFTWARE)** Screw jack, Stuffing box, Single tool post, Plummer block, Universal coupling, Piston of a Petrol Engine.	CO2

Learning Recourse(s)
Text Book(s)
1. Machine Drawing by K.L.Narayan, P.Kannaiah and K.Venkata Reddy, 3rd edition, New Age Publications 2006. 2. Machine Drawing with Auto CAD, (1st edition) by GowthamPohit and Goutam Ghosh, Pearson Education, Delhi, 2004.
Reference Books
1. Machine Drawing, by R.K.Dhawan, S.Chand Publications, New Delhi, 1996. 2. Machine Drawing by K.C.John, PHI Learning Pvt.Ltd.,New Delhi, 2009.

ENGINEERING MATHEMATICS -IV
(Numerical Methods, Probability and Statistics)

Course Code	19BS1401	**Year**	II	**Semester**	II
Course Category	Basic Sciences course	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	NIL
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Determine approximate root of an equation and apply different methods to calculate the value of interpolating polynomial at given point	L1
CO2	Evaluate integrals making use of quadrature formulae and solve ordinary differential equations by Euler's, R.K. methods.	L4
CO3	Use discrete and continuous distribution models to calculate probabilities for appropriate random variables.	L5
CO4	Understand and apply the basic concepts of inferences concerning means and proportions to the decision making process.	L2
CO5	Interpret hypotheses test for small samples.	L1

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2										2	2	
CO2	3	2										2	2	
CO3	3	2										2	2	
CO4	3	2										2	2	
CO5	3	2										2	2	

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**SOLUTION TO ALGEBRAIC AND TRANSCENDENTAL EQUATIONS** Solution of algebraic and transcendental equations: Bisection method and Newton-Raphson's method. Finite differences, relation between operators, interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Lagrange's formula.	CO1
II	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Numerical Differentiation- Newton's forward and backward difference formulae, numerical integration- trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules. Ordinary differential equations: Euler's, modified Euler's, Runge-Kutta method of fourth order for solving first order equations.	CO2
III	**PROBABILITY** Random variables (discrete and continuous), probability density functions,	

	probability distribution: Binomial - Poisson - normal distribution and their properties (mathematical expectation and variance).	CO3
IV	**TESTING OF HYPOTHESIS** Formulation of null hypothesis, critical regions, level of significance. Large sample tests: Test for single proportion, difference of proportions, test for single mean and difference of means.	CO4
V	**SMALL SAMPLE TESTS** Student's t-distribution (single mean, two means and paired t-test), Testing of equality of variances (F-test)	CO5

Learning Recourse(s)
Text Book(s)
1. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44/e, 2019. 2. T.K.V.Iyenger, Krishna Gandhi and others, *Probability & Statistics*, S.Chand.
Reference Book(s)
1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 9/e, John Wiley & Sons, 2006. 2. Miller and Freund's, *Probability and Statistics for Engineers*,Pearson.
e-Resources & other digital material
1. https://www.nptel.ac.in/courses/111/107/111107105/ 2. https://www.nptel.ac.in/courses/111/105/111105041/ 3. https://www.nptel.ac.in/courses/111/106/111106112/ 4. https://www.nptel.ac.in/courses/111/105/111105090/

AI TOOLS

Course Code	19ES1401	**Year**	II	**Semester**	II
Course Category	Engineering Sciences	**Branch**	ME	**Course Type**	Theory
Credits	2	**L – T – P**	2 – 0 – 0	**Pre-requisites**	**Mathematics –** Calculus, Statistics, Probability, Graph Theory **Programming Languages –** C, C++, Java or Python
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Understand the Fundamentals of Artificial Intelligence and its Applications.	L2
CO2	Summarize various machine learning methods.	L2
CO3	Identify different machine learning applications.	L3
CO4	Compare Machine Learning & Deep Learning and Outline basic Deep Learning Algorithm.	L2
CO5	Make use of Deep Learning Concepts for various Applications.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3												2	
CO2	3						2						2	1
CO3	3					2	2						2	1
CO4	3	3				2	1		2	2			2	1
CO5	3					1	2						2	

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE:** What is AI, Foundations of AI, Goals of AI, and Applications of AI.	CO1
II	**MACHINE LEARNING:** Definition, Learning Methods: Supervised Learning, Unsupervised Learning, Semi-Supervised Learning, Reinforcement Learning.	CO1, CO2
III	**MACHINE LEARNING APPLICATIONS:** Computer vision, Speech Recognition, Natural Language Processing, Decision Making process.	CO1, CO2, CO4
IV	**DEEP LEARNING:** Basics of Deep Learning, Machine Learning vs Deep Learning, Fundamental Deep Learning Algorithm-Convolution Neural Network (CNN).	CO1, CO3

V	**DEEP LEARNING APPLICATIONS:** Computer vision, Speech Recognition, Natural Language Processing, Decision Making process.	CO1, CO3

Learning Recourse(s)
Text Book(s)
1. Artificial Intelligence: A Modern Approach, Stuart Russell and Norvig, Third Edition, 2015, Pearson Education. **(Unit-1)** 2. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, 2012, MIT Press **(Unit-2&3)** 3. Deep Learning (Adaptive Computation and Machine Learning series), Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach, 2017, MIT Press. **(Unit-4&5)**
e-Resources & other digital material
1. https://swayam.gov.in/nd1_noc19_cs52/preview **2.** https://swayam.gov.in/nd1_noc19_cs85/preview **3.** https://emerj.com/ai-sector-overviews/machine-learning-healthcare-applications/

STRENGTH OF MATERIALS

Course Code	19ME3401	**Year**	II	**Semester**	II
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	4	**L – T – P**	3 – 1 – 0	**Prerequisites**	Engineering Mechanics
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Calculate stresses, strains and deflections in structural members subjected to various types of loadings.	L3
CO2	Draws shear force and bending moment diagrams of simple beams subject to combination of loads	L2
CO3	Determine the principal stresses & evaluate the stresses in thin cylinders and torsion.	L3
CO4	Plot the stress distribution in section of the beam subjected to bending and shear loads	L3
CO5	Calculate deflections of statically determinate beams & analyze the critical buckling loads of columns	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2							1		2	3	1
CO2	3	3	2							1		2	3	1
CO3	3	3	2							1		2	3	1
CO4	3	3	2							1		2	3	1
CO5	3	3	2							1		2	3	1

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**SIMPLE STRESSES AND STRAINS:** Types of stresses and strains, Hooke's law, stress- strain diagrams, Axially loaded bars of uniform and varying cross section, Compound bars, Relation between elastic moduli, Thermal stresses.	CO1
II	**SHEAR FORCE AND BENDING MOMENT DIAGRAMS:** Types of beams and loads, Shear force and bending moment diagram for cantilever, simply supported and overhanging beams subjected to Point load, Moments and UDL, Point of contra flexure, Relation between load, shearing force and bending moment.	CO2
III	**TORSION OF CIRCULAR SHAFTS:** Torsion - Torsion equation - solid and hollow circular shaft - Torsional rigidity - power transmitted by the shafts **COMPLEX STRESSES**: Biaxial state of stress with and without shear- principal stresses - Mohr's circle **THIN CYLINDERS**: thin cylinders and spheres subjected to internal	CO3

	pressure	
IV	**BENDING AND SHEAR STRESSES IN BEAMS:** Flexural formula, distribution of bending and shear stresses across various cross sections of beams.	CO4
V	**DEFLECTION OF BEAMS:** Differential equations of the deflection curve, Slope and deflection using double integration method, Macaulay's method. **COLUMNS:** buckling and stability of column, crippling load of columns with pinned ends, fixed- free, fixed –fixed and fixed-pinned effective length of column, limitations of Euler's formula	CO5

Learning Recourse(s)

Text Book(s)

1. Stephen P. Timoshenko, James M. Gere "Mechanics of Materials", 2nd edition, C B S Publishers, 2011.
2. SS Rattan, Strength of materials, 3/e, Tata McGraw-Hill, 2016.

Reference Book(s)

1. Timoshenko, Strength of Materials, Part-I&II,3/e,CBSPublishers,2004.
2. Popov, Mechanics of Solids, 2/e, New Pearson Education, 2015.
3. F.P. Beer, E.R. Johnston, Jr & John. T. DeWolf, Mechanics of Materials, 7/e, Tata McGraw- Hill, 2016.
4. Adarsh Swaroop, "Mechanics of Materials" 1st edition, New Age International Pvt. Ltd, 2012.

APPLIED THERMODYNAMICS

Course Code	19ME3402	**Year**	II	**Semester**	II
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	2– 1 – 0	**Prerequisites**	19ME3302 - Engineering Thermodynamics
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Learn the terminology, basic concepts and working principles of IC engines.	L1
CO2	Understand the various stages of combustion process in SI and CI engines.	L2
CO3	Analyze thermodynamic analysis of Rankine cycle.	L3
CO4	Assess thermodynamic analysis of gas power cycles.	L4
CO5	Evaluate the COP of refrigeration systems and understand various Psychometric processes.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1											3	
CO2	3	2											2	
CO3	3	2		2		2	2						3	2
CO4	3	1		2		2	2						3	2
CO5	3	1		2		2	2						2	

Syllabus		
UNIT No.	**Contents**	**Mapped COs**
I	**IC Engines:** Working and classification of IC engines, comparison of two stroke and four stroke engines, comparison of SI and CI Engines. **Testing and Performance of IC Engines:** Methods of testing IC Engines, performance analysis of IC Engines.	CO1
II	**Combustion in IC Engines: SI Engine**: stages of combustion, normal combustion, abnormal combustion, variables affecting delay period and knocking, pre-ignition. S**tages of Combustion in CI Engine**: normal combustion, abnormal combustion, variables affecting delay period and knocking. Fuel requirements and fuel rating of SI and CI engines.	CO2
III	**Vapour Power Cycles:** Vapour power cycle, simple Rankine cycle, mean temp of heat addition thermodynamic variables affecting efficiency and output of Rankine cycle. **Methods to Improve Thermal Efficiency of Rankine Cycle:** Reheating, Regeneration, Factors affecting Rankine cycle, Adiabatic flame temperature.	CO3

IV	**Gas Power Cycle:** Brayton cycle, Simple gas turbine plant, closed cycle and open cycle for gas turbines, condition for maximum pressure ratio and optimum pressure ratio, actual cycle.	CO4
V	**Refrigeration:** Bell-Coleman cycle-vapour compression cycle, effect of vapour condition on COP of VCR, vapour absorption cycle, properties of common refrigerants. **Principles of Psychrometry and Air-Conditioning:** Psychometric terms, Psychometric processes and air conditioning systems.	CO5

Learning Recourse(s)

Text Book(s)

1. Ganesan V/ Internal Combustion Engines / Tata McGraw Hill,2017.
2. CP Arora / Refrigeration and Air Conditioning / TMH.
3. V.P.Vasandani and D.S.Kumar / Treatise on Heat Engineering / Metropolitan book Co. Pvt. Ltd.

Reference Book(s)

1. Mahesh M Rathore, Thermal Engineering, McGraw Hill Publications - 2012.
2. CengalY.A and Boles M.A, Thermodynamics: An Engineering Approach,5/e, McGraw-Hill, 2006.
3. Yahya,S.M.,Turbines,CompressorsandFans,4/e,TataMcGrawHill,201 0.
4. Nag P.K, Engineering Thermodynamics, 4/e, Tata McGraw- Hill,2008.
5. Onkar Singh, Thermal Turbomachines, 3/e, Wiley India,2014.
6. P.L.Ballaney, Thermal Engineering, 2/e, Khanna,2005.

FLUID MECHANICS

Course Code	19ME3403	**Year**	II	**Semester**	II
Course Category	Basic Sciences course	**Branch**	ME	**Course Type**	Theory
Credits	4	**L – T – P**	3 – 1 – 0	**Prerequisites**	19ME3301 - Engineering Mechanics
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Describe the concepts of fluid properties, pressure measurement by manometers.	L1
CO2	Estimate the forces acting on submerged body in a static fluid.	L2
CO3	Apply conservation laws to solve fluid flow problems in engineering applications.	L3
CO4	Analyze the various flow measuring devices and estimate the force exerted by the jet on vanes.	L3
CO5	Apply Rayleigh's method, and Buckingham Pi theorem to arrange given variables into dimensionless groups.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1						1			1	3	2
CO2	3	3	1						1			1	3	3
CO3	3	3	1						1			1	3	3
CO4	3	3	1						1			1	3	3
CO5	3	3	1						1			1	3	3

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**PROPERTIES OF FLUIDS** Properties of fluids- Density, specific weight, specific volume, specific gravity, Viscosity-Dynamic viscosity, Kinematic Viscosity-Cohesion, Adhesion, surface tension, capillarity and vapor pressure, compressibility and elasticity. **MEASUREMENT OF PRESSURE:** Pascal's law, Manometers–Simple Manometers-Piezometer, U- tube manometer, Single column manometers, Differential manometers-U-Tube differential manometers and inverted U-Tube differential manometers.	CO1
II	**HYDROSTATIC FORCES ON SURFACES:** Total pressure and center of pressure on horizontal plane surface, Vertical plane surface, inclined plane surface, Practical applications of	CO2

	total pressure and center of pressure-Dams, Gates and Tanks. **BUOYANCY AND FLOATING:** Buoyancy-Archimedes principle- center of buoyancy-metacenter and metacentric height-stability of submerged and floating bodies-determination of metacentric height. **FLUID KINEMATICS**: Classification of flows-steady and unsteady, uniform and non- uniform, laminar and turbulent, rotational and irrational, viscous and inviscid, continuity equation, Description of fluid flow, Stream line, path line, streak lines and stream tube	
III	**FLUID DYNAMICS**: Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend. **CLOSED CONDUIT FLOW**: Reynolds's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line- hydraulic gradient line.	CO3
IV	**MEASUREMENT OF FLOW**: Pitot tube, Venturi meter and orifice meter –flow over rectangular, triangular, trapezoidal and stepped notches. **IMPACT OF JETS**: Hydrodynamic force of jets on stationary and moving flat, inclined and curved vanes, jet striking centrally and at tip – velocity triangles at inlet and outlet – expressions for work done and efficiency - angular momentum principle	CO4
V	**DIMENSIONAL ANALYSIS:** Fundamental and derived dimensions, Rayleigh method, Buckingham theorem, dimensionless groups, application of dimensional groups, model testing and similitude, types of similarity - geometric, kinematic and dynamic, model testing methods.	CO5

Learning Recourse(s)

Text Book(s)

1. Hydraulics and Fluid Mechanics including hydraulic machines, by P.N.Modi and S.M.Seth, Standarard book house, 2000, New Delhi.
2. K.L. Kumar / Engineering Fluid Mechanics / S chand Publications.

Reference Book(s)

1. Fluid Mechanics and Hydraulic Machines, by R.K.Bansal,Laxmi publications (P) Ltd. 2011, New Delhi.
2. Hydraulics and Fluid Mechanics and fluid machines, by S Ramamrutham, Dhanapat rai publishing company, New Delhi
3. Fluid Mechanics and Hydraulic Machines, by R.K.Rajput, S.Chand limited publications, 2008, New Delhi.
4. Fluid Mechanics and Hydraulic Machines, by Sukumar Pati, Mc Graw Hill Education Private Limited, 2014, New Delhi.
5. Fluid Flow Machines by N.S.Govinda Rao, Tata Mc Graw Hill publishing company Ltd.
6. Fluid Mechanics and Hydraulic Machines by K.R. Arora, Standard Publishers Distributors

e-Resources & other digital material
1. https://nptel.ac.in/courses/112/105/112105171/ 2. https://nptel.ac.in/courses/112/105/112105183/ 3. https://nptel.ac.in/courses/105/101/105101082/ 4. https://nptel.ac.in/courses/105/103/105103095/

MANUFACTURING PROCESSES

Course Code	19ME3404	**Year**	II	**Semester**	II
Course Category	Basic Sciences course	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	19ME3303-Material Science and Engineering
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Illustrate the casting processes with their features and applications.	L1
CO2	Explain various metal forming techniques.	L2
CO3	Appraise suitable welding process for the given application.	L3
CO4	Apply suitable Non-Destructive Testing method.	L3
CO5	Discuss the various techniques for processing of plastics, ceramics and powders.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1	1	1			1		1	1	3	1
CO2	3	2	1	1	1	1			1		1	1	3	1
CO3	3	2	1	1	1	1			1	1	1	1	3	1
CO4	3	2	1	1	2	1			1	1	1	1	3	1
CO5	3	2	1	1	1	1			1		1	1	3	1

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION:** Importance and selection of manufacturing processes. **CASTING PROCESSES:** Introduction to casting, steps in casting process. **Pattern**: Types, materials and allowance. **SAND MOLDING**: Basic steps in mold preparation, materials used for mould, types of molds, cores. Principles and design of gating system. **METHODS OF MELTING:** Crucible melting and cupola operation. **SPECIAL CASTING PROCESSES**: Shell casting, Investment casting, Die casting, Centrifugal casting, CO_2 Molding. Casting defects and remedies. Advantages and applications of casting.	CO1
II	**METAL FORMING**: Introduction, hot and cold working of metals; **Rolling**: Principle, types of rolling mill and products, roll passes, forces in rolling and power requirements. **EXTRUSION**: Basic extrusion processes and its characteristics, wire drawing, tube drawing. **FORGING**: Principle of forging. Tools and dies used in forging. **TYPES**: Smith forging, drop forging and rotary forging, forging defects.	CO2

	SHEET METAL FORMING: Introduction, Blanking, Piercing, Bending, Stamping, Coining, Spinning and Stretch Forming. Clearance and shear as applied to Punching/Blanking operations.	
III	**METAL JOINING PROCESSES:** Classification of welding processes, types of welds and welded joints, V-I characteristics, Arc Welding, Submerged Arc Welding, Gas Tungsten Arc Welding, Gas Metal Arc Welding, Electron Beam Welding, Laser Welding, Forge welding, Resistance welding, Friction welding, Explosive welding, Thermit welding and Plasma Arc welding. Heat affected zone in welding. Welding defects: causes and remedies. Soldering and brazing	CO3
IV	**NON-DESTRUCTIVE TESTING:** Introduction to Non-Destructive Testing, Industrial applications of Non-Destructive evaluation, Visual Optical testing, Dye penetrant testing, Magnetic particle testing, Eddy current testing, Ultrasonic testing, Acoustic emission testing, Radiography, Comparison and selection of NDT methods.	CO4
V	**PLASTIC PROCESSING, CERAMICS AND POWDER METALLURGY**: **Plastics**: Introduction to polymers, Processing of plastics, extrusion of plastics, transfer molding, compression molding, injection molding, thermoforming, rotational molding and blow molding. **Ceramics**: Ceramic powder preparation; Processing of ceramic parts: Pressing, casting, sintering; secondary processing of ceramics: Coatings and finishing. **Powder Metallurgy**: Manufacture of powders, steps involved in making a component using powder metallurgy.	CO5

Learning Recourse(s)

Text Books

1. P.N.Rao, Manufacturing Technology – Volume I, 5/e, McGraw-Hill Education, 2018.
2. S.Kalpakjain and S.R.Schmid, Manufacturing Engineering and Technology, 7/e, Pearson, 2018.
3. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010

Reference Books

1. Mikell. P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems, 4/e, John Wiley and Sons Inc, 2013.
2. P.C.Sharma, A Text book of Production Technology, 8/e, S Chand Publishing, 2014.

e- Resources & other digital material

1. https://nptel.ac.in/courses/112107145/
2. https://www.nde-ed.org
3. https://nptel.ac.in/courses/113/106/113106070/

CONSTITUTION OF INDIA

Course Code	19MC1402	**Year**	II	**Semester**	II
Course Category	Mandatory course	**Branch**	Common to all	**Course Type**	Theory
Credits	-	**L – T – P**	3 – 0 – 0	**Prerequisites**	NIL
Continuous Internal Evaluation	100	**Semester End Evaluation**	-	**Total Marks**	100

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO INDIAN CONSTITUTION** Constitutional history, constituent assembly, Salient features of the Constitution, Significance of Preamble	CO1
II	**RIGHTS AND DUTIES** Fundamental Rights, Directive principles, Fundamental duties.	CO2
III	**FEDERAL STRUCTURE OF THE INDIAN GOVERNMENT** Union government (President, Parliament and PM cum Council of ministers) State government (Governor, State Assembly and council and CM cum Council of ministers) Local government (Rural and urban local governments with special reference to 73rd and 74th Constitutional amendment Acts)	CO3
IV	**CONSTITUTIONAL COURTS** Difference between constitutional courts and Statutory courts, Supreme Court and High Courts (Custodian of the Constitution), Writ Jurisdiction.	CO4
V	**EMERGENCY PROVISIONS** National emergency, Constitutional emergency and financial emergency	CO5

Learning Recourse(s)

Text Books

1. J. C. Johari, Indian Government and Politics, Vishal Publications, Delhi, 2009.
2. M. V. Pylee, Introduction to the Constitution of India, 5/e, Vikas Publishing House, Mumbai, 2007

Reference Books

1. D.D. Basu, Introduction to the Indian Constitution, 21/e, Lexis Nexis, Gurgaon, India, 2011.
2. Subhas C. Kashyap, Our Constitution, 2/e, National Book Trust India, New Delhi, 2013

AI TOOLS LAB

Course Code	19ES1451	**Year**	II	**Semester**	I
Course Category	Engineering Sciences	**Branch**	ME	**Course Type**	Practical
Credits	1	**L – T – P**	0 – 0 – 2	**Prerequisites**	**Programming Languages** – Basics of Python
Continuous Internal Evaluation	25	**Semester End Evaluation**	50	**Total Marks**	75

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Apply various preprocessing techniques and Machine Learning/ Deep Learning methods on different datasets for a given problem.	L3
CO2	Implement various experiments in Jupyter Notebook Environment.	L3
CO3	Develop an effective report based on various learning methods implemented.	L3
CO4	Apply technical knowledge for a given scenario and express with an effective oral communication.	L3
CO5	Analyze the outputs and visualizations generated for different datasets.	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3											2	1	
CO2					2				2			1	1	
CO3										2			2	
CO4	3									1			1	
CO5		3											2	

Syllabus		
Expt. No	**Contents**	**Mapped CO**
1.	Apply Data pre-processing techniques.	**CO1, CO2, CO3, CO4, CO5**
2.	Construct a Machine Learning model using supervised learning method.	**CO1, CO2, CO3, CO4, CO5**
3.	Construct a Machine Learning model using Unsupervised learning method.	**CO1, CO2, CO3, CO4, CO5**
4.	Construct a Machine Learning model using Semi supervised learning method.	**CO1, CO2, CO3, CO4, CO5**
5.	Develop a Deep Learning model using supervised learning method.	**CO1, CO2, CO3, CO4, CO5**

6.	Develop a Deep Learning model using Unsupervised learning method.	**CO1, CO2, CO3, CO4, CO5**
7.	Apply a Convolutional Neural Network for Image Classification.	**CO1, CO2, CO3, CO4, CO5**
8.	Build an AI application.	**CO1, CO2, CO3, CO4, CO5**

Learning Recourse(s)
Text Books
1. Artificial Intelligence: A Modern Approach, Stuart Russell and Norvig, Third Edition, 2015, Pearson Education. 2. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, 2012, MIT Press 3. Deep Learning (Adaptive Computation and Machine Learning series), Ian Good fellow , Yoshua Bengio, Aaron Courville, Francis Bach, 2017, MIT Press
e- Resources & other digital material
1. https://github.com/atinesh-s/Coursera-Machine-Learning-Stanford 2. https://github.com/Kulbear/deep-learning-coursera

APPLIED THERMODYNAMICS LAB

Course Code	1 9ME3451	**Year**	II	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Practical
Credits	1.5	**L – T – P**	0 – 0 – 3	**Prerequisites**	Engineering Thermodynamics, Applied Thermodynamics
Continuous Internal Evaluation	25	**Semester End Evaluation**	50	**Total Marks**	75

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Test the performance of different types of petrol engine and diesel engine.	L1
CO2	Disassembly and assembly of engine.	L2
CO3	Assess the performance of reciprocating air compressor.	L3
CO4	Calculate calorific values among different types of solid, liquid and gaseous fuels.	L4
CO5	Estimate the residue percentage of given fuel and properties of Refrigeration & Air Conditioning.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3		3									3	2
CO2	3	3		3									3	2
CO3	3	3		3									3	2
CO4	3	3		3									3	2
CO5	3	3		3									3	2

Syllabus

Expt.No	**Contents**	**Mapped CO**
1.	Valve timing diagram of 4-stroke diesel engine	CO1
2.	Port timing diagram of 2-stroke petrol engine.	
3.	Performance of 4-stroke single cylinder diesel engine.	
4.	I.C. Engines Air/Fuel Ratio and Volumetric Efficiency.	
5.	I.C. Engines Heat Balance.	
6.	Morse test on multi cylinder petrol engine.	
7.	Retardation test	
8.	Assembly and disassembly of diesel and petrol engines	CO2
9.	Performance of two stage reciprocating air compressor	CO3
10.	Junker's gas calorimeter.	CO4
11.	Bomb calorimeter.	
12.	Canradson's carbon residue tester.	CO5
13.	Performance of Refrigeration Test Rig.	
14.	Study the properties of Air Conditioning Tutor.	

FLUID MECHANICS LAB

Course Code	1 9ME3452	**Year**	II	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Practical
Credits	1.5	**L – T – P**	0 – 0 – 3	**Prerequisites**	Engineering Thermodynamics, Applied Thermodynamics
Continuous Internal Evaluation	25	**Semester End Evaluation**	50	**Total Marks**	75

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Estimate major and minor losses in pipes.	L2
CO2	Evaluate coefficient discharge of various flow measuring devices.	L2
CO3	Determine the coefficient of the impact of jet on vanes.	L3
CO4	Verify Bernoulli's theorem.	L3
CO5	Test the performance of pumps and turbines.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1		1									2	3
CO2	3	1		2									2	3
CO3	3	1		2									2	3
CO4	3	1		2									2	3
CO5	3	1		1									2	3

Syllabus

Expt.No	**Contents**	**Mapped COs**
1.	Determination of loss of head due to the sudden contraction in a pipeline.	CO1
2.	Determination of friction factor for a given pipeline.	CO1
3.	Determination of coefficient of discharge of Triangular Notch	CO2
4.	Determination of coefficient of discharge of Venturimeter.	CO2
5.	Determination of coefficient of discharge of Orifice meter.	CO2
6.	Determination of coefficient of Impact of jets on Stationary Vanes.	CO3
7.	Verification of Bernoulli"s equitation.	CO4
8.	Performance Test on Single Stage Centrifugal Pump.	CO5
9.	Performance Test on Multi Stage Centrifugal Pump.	CO5
10.	Performance Test on Pelton Wheel.	CO5
11.	Performance Test on Kaplan Turbine.	CO5
12.	Performance Test on Francis Turbine.	CO5

Learning Resources
Text books:
1.K.L.Kumar."Engineering Fluid Mechanics" Experiments, Eurasia Publishing House, 1997 2.Jagdish Lal, Hydraulic Machines, Metropolitan Book Co, Delhi, 1995
Reference books
1.Hydraulics and Fluid Mechanics, by P.N.Modi and S.M.Seth, Standarard book house, 2000, New Delhi. 2.Fluid Mechanics and Hydraulic Machines, by Sukumar Pati, Mc Graw Hill Education Private Limited, 2014, New Delhi. 3.Hydraulics and Fluid Mechanics and fluid machines, by S Ramamrutham, Dhanapat rai publishing company, New Delhi

INTERNET OF THINGS

Course Code	19ES1501	**Year**	III	**Semester**	I
Course Category	Engineering Sciences	**Branch**	ME	**Course Type**	Theory
Credits	2	**L – T – P**	2 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Summarize the genesis and impact of IoT applications, architectures in real world.	L2
CO2	Illustrate diverse methods of deploying smart objects and connect them to network.	L3
CO3	Construct simple applications using Arduino.	L3
CO4	Interpret different protocols and select which protocol can be used for a specific application.	L2
CO5	Identify and develop a solution for a given application using APIs.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	3	2	2	2	2	2	3	3
CO2	3	3	3	3	3	3	3	2	2	2	2	2	3	3
CO3	3	3	3	3	3	3	3	2	2	2	2	2	3	3
CO4	3	3	3	3	3	3	3	2	2	2	2	2	3	3
CO5	3	3	3	3	3	3	3	2	2	2	2	2	3	3

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.	CO1
II	Smart Objects: The Things in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.	CO2
III	Embedded Computing Basics, Microcontrollers, System-on-Chips, Choosing Your Platform, Arduino, Developing on the Arduino, Some Notes on the Hardware, Openness	CO3
IV	Communication in the IoT: Internet Principles, Internet Communications: An Overview, IP, TCP, The IP Protocol Suite (TCP/IP), UDP, IP Addresses, DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses, TCP and UDP Ports, An Example: HTTP Ports, Other Common Ports, Application Layer Protocols HTTP, HTTPS: Encrypted HTTP, Other Application Layer Protocols.	CO4

V	Prototyping Online Components: Getting Started with an API, Mashing Up APIs, Scraping, Legalities, writing a New API, Clockodillo, Security, Implementing the API, Using Curl to Test, Going Further, Real-Time Reactions, Polling, Comet, Other Protocols, MQ Telemetry Transport, Extensible Messaging and Presence Protocol, Constrained Application Protocol.	CO5

Learning Recourse(s)

Text Books

1. Adrian McEwen, Hakim Cassimally - Designing the Internet of Thing Wiley Publications, 2012.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, 1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)

Reference Books

1. Arshdeep Bahga, Vijay Madisetti - Internet of Things: A Hands-On Approach, Universities Press, 2014
2. Srinivasa K G, Internet of Things, CENGAGE Leaning India, 2017

METAL CUTTING AND MACHINE TOOLS

Course Code	19ME3501	**Year**	III	**Semester**	I
Course Category	Engineering Sciences	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Illustrate Geometry of single point single point cutting tool and Mechanics of machining.	L3
CO2	Describe Tool reliability, materials and identify suitable cutting fluid for a machining operation.	L3
CO3	Comprehend working principle, mechanism and various operations performed on lathe, shaper and planner	L2
CO4	Discuss Drilling machines, milling machines, and various operations performed.	L2
CO5	Specify suitable finishing process for a component and learn basics of CNC machines.	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2				1	1			1		2	3	1
CO2	3	2	1			1	1			1		2	3	1
CO3	3	2	1			1				1		2	3	1
CO4	3	2	1			1				1		2	3	1
CO5	3	2	1			1				1		2	3	1

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**GEOMETRY OF CUTTING TOOLS:** Geometry of single-point cutting tool: Tool-in hand system, ASA system, Significance of various angles of single point cutting tools, Orthogonal Rake System (ORS). **MECHANICS OF MACHINING PROCESSES:** Orthogonal and Oblique cutting, Mechanics of Chip formation: Types of chips, chip-breakers, Chip reduction coefficient, shear angle, shear strain, Built-Up-Edge and its effect in metal cutting, Merchant's analysis of metal cutting process - Various forces, power and specific energy in cutting, Problems on Tool Geometry and Mechanics of Machining, Theories of Metal Cutting: Ernst & Merchant, theory, Modified Merchant's theory, Lee & Shaffer Theory, Stress distribution at Chip-Tool Interface.	CO1
II	**TOOL WEAR, TOOL LIFE, MACHINABILITY AND MACHINING ECONOMICS:** Wear Mechanisms, Types of tool wear, Tool Life and Machinability, Problems on Economics of Machining.	CO2

	CUTTING TOOL MATERIALS: Desirable Properties of tool materials, Characteristics of Cutting Tool Materials, indexable inserts, coated tools. **CUTTING FLUIDS:** Functions, characteristics and types, selection of cutting fluids.	
III	**LATHE:** Types, Parts, Feed Mechanisms, Specifications of lathe, Lathe Operations, Accessories and Attachments, Machining time estimation, Capsten and Turret Lathes. **SHAPER AND PLANER:** Types, Specifications, Crank and slotted link mechanism, Stroke length and position adjustments, Automatic feed mechanisms, Shaper Vs Planer, Machining time estimation	CO3
IV	**DRILLING:** Types, Operations, Nomenclature of a Twist drill, Machining time estimation. **MILLING:** Types, Up Milling Vs Down Milling, Types of milling cutters, Operations, Dividing head, Types of Indexing and problems on indexing.	CO4
V	**FINISHING PROCESSES**: Theory of grinding – classification of grinding machines, cylindrical and surface grinding machines, tool and cutter grinding machines, different types of abrasives, bonds, specification and selection of a grinding wheel. Lapping, Honing & Broaching operations, comparison to grinding. **CNC MACHINE TOOLS:** CNC Machines, working principle, classification, constructional features of CNC machines, CNC controller, types of motion controls in CNC machines, applications of CNC machines.	CO5

Learning Recourse(s)
Text Books
1. Production Technology by R.K. Jain and S.C. Gupta. Khanna Publications, New Delhi 2. Workshop Technology Vol II, (10th edition), by B.S.Raghu Vamshi, Dhanpat Rai & co (p) Ltd., 2009
Reference Books
1. Mikell Metal cutting Principles, by M.C. Shaw, 3rd ed., Oxford, 1957. 2. Production Technology, by HMT, (Hindustan Machine Tools), TMH publications 2001. 3. Manufacturing Science, by Amitabha Ghosh and Asok Kumar Mallik, East West Press, 2nd Edition, 2010.
e- Resources & other digital material
https://nptel.ac.in/courses/112/105/112105233/

TURBO MACHINERY

Course Code	19ME4501A	**Year**	III	**Semester**	I
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	State precise definition of turbomachinery	L1
CO2	Apply the laws of thermodynamics on turbomachinery	L2
CO3	Understand the principle of operation of Radial flow pumps	L1
CO4	Perform the preliminary design of hydraulic turbines	L3
CO5	Analyze the stage performance of compressors	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3									2	2	1
CO2	3	3	3									2	2	1
CO3	3	3	3									2	2	1
CO4	2	2	3									2	2	1
CO5	3	3	3									2	2	1

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION:** Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynolds number, Unit and specific quantities, model studies.	CO1
II	**THERMODYNAMICS OF FLUID FLOW:** Application of first and second law of thermodynamics to turbo machines, Efficiencies of turbo machines, Static and Stagnation states, Incompressible fluids and perfect gases, overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process	CO2
III	**GENERAL ANALYSIS OF TURBO MACHINES:** Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, Theoretical head – capacity relationship, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Problems.	CO3

IV	**HYDRAULIC TURBINES:** Classification, various efficiencies. **Pelton turbine –** velocity triangles, design parameters, Maximum efficiency. **Francis turbine -**velocity triangles, design parameters, runner shapes for different blade speeds. Draft tubes- Types and functions. **Kaplan and Propeller turbines -** velocity triangles, design parameters. Problems.	CO4
V	**PUMPS AND COMPRESSORS:** Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Cavitation, Need for priming, Pumps in series and parallel. Problems. Stage velocity triangles, Stage work, Pressure developed, stage efficiency and surging and problems. Axial flow Compressors: Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling. Problems.	CO5

Learning Recourse(s)

Text Books

1. An Introduction to Energy Conversion, Volume III, Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers, reprint 2008.
2. Turbo Machines ,B.U.Pai , 1st Editions, Wiley India Pvt, Ltd.
3. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw Hill Co. Ltd., 2nd edition, 2002

Reference Books

1. Principals of Turbo machines, D. G. Shepherd, The Macmillan Company (1964).
2. Fluid Mechanics & Thermodynamics of Turbo machines, S. L. Dixon, Elsevier (2005).
3. Text Book of Turbo machines, M. S. Govindegouda and A. M. Nagaraj, M. M. Publications, 4Th Ed, 2008.
4. Gopalakrishnan G, Prithvi Raj D, "A treatise on Turbomachines", Scitec Publications, Chennai, 2002.
5. Sheppard, Principles of Turbomachinery.
6. R.K.Turton, Principles of Turbomachinery, E & F N Spon Publishers, London & New York.

e- Resources & other digital material

1. https://nptel.ac.in/courses/112/106/112106200/
2. https://nptel.ac.in/courses/101/101/101101058/
3. https://nptel.ac.in/courses/112/104/112104117/

ADVANCED STRENGTH OF MATERIALS

Course Code	19ME4501B	**Year**	III	**Semester**	I
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Calculate deflections in fixed and continuous beams.	L3
CO2	Determine the stresses in thick cylinders.	L3
CO3	Analyse the curved beams for stresses with different cross sections.	L4
CO4	Calculate the stresses in rotating disks.	L3
CO5	Determine the Strain Energy under various loading conditions.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	1								2	3	1
CO2	3	3	3	1								2	3	1
CO3	3	3	3	1								2	3	1
CO4	3	3	3	1								2	3	1
CO5	3	3	3	1								2	3	1

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**FIXED BEAMS AND CONTINUOUS BEAMS:** Introduction, analysis of fixed beams by Macaulay's method, Clapeyron's theorem of three moments, Beams with constant moments of inertia.	CO1
II	**THICK CYLINDERS:** Introduction, Stresses in thick cylindrical shell (Lame's theory), Radial Deflection, Stresses in Compound Cylinders.	CO2
III	**CURVED BEAMS:** Stresses in Beams of small and large initial curvature, The Winkler-Bach theory, Assumptions for stresses in the bending of curved bars, Stresses in Crane Hook and C-Clamp with Rectangular, circular and trapezoidal cross sections.	CO3
IV	**CENTRIFUGAL STRESSES**: Introduction, Rotating Ring, Rotating Disc, Rotating Disc of uniform strength.	CO4
V	**STRAIN ENERGY:** Resilience, Proof Resilience, Strain energy stored in a body when the load is applied gradually, Load is applied suddenly, Load is applied with impact, Strain energy stored in a body due to shear stress.	CO5

Learning Recourse(s)
Text Books
1. James M. Gere, "Mechanics of Materials", 7th edition, Cengage learning India, 2010. 2. S.S. Rattan, "Strength of Materials", 2nd edition, Tata Mc-Graw Hill Private Limited, New Delhi, 2012. 3. S. B. Junarkar, Mechanics of Structures, Charotar Publishers, 2010
Reference Books
1. Adarsh Swaroop, "Mechanics of Materials" 1st edition, New Age International Pvt. Ltd, 2012. 2. Popov, Mechanics of Solids, 2/e, New Pearson Education, 2015.
e- Resources & other digital material
1. https://nptel.ac.in/courses/112/101/112101095/

CAD/CAM

Course Code	19ME4501C	**Year**	III	**Semester**	I
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Describe basic structure of CAD workstation and Graphic systems	L2
CO2	Apply the knowledge of geometric modeling	L3
CO3	Explain the features of CNC machines and part programming	L2
CO4	Discuss the concepts of Group Technology, CAQC, FMS and CIM.	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3		3	2		1	1			2	3	
CO2	1	2	3		3	2		1	1			2	3	3
CO3	1		3		3	2		1	1			2	3	
CO4	2				3	2		1	1			2	3	

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION:** Product cycle and CAD/CAM, applications and Benefits of CAD, Hardware in CAD: Design Workstation-Graphics Terminal-Input devices- output devices-Display devices- Flat panel Display-LCD, LED, Hard Copy Devices-Printers and Plotters, CPU, Secondary Storage, Image Generation Techniques. **RASTER SCAN GRAPHICS** -Line generation Algorithms-DDA, Bresenham's algorithm, Coordinate systems, 2D transformation of geometry, Homogeneous representation,3D transformations, Cohen Sutherland Line clipping Algorithm, Hidden surface removal- Back face detection algorithm, Depth buffer algorithms.	CO1
II	**GEOMETRIC MODELING**: Curve representation- Cubic, Bezier and B-spline curves parametric forms, Geometric Modeling of Surfaces: Basic surfaces entities, sweep surfaces, surface of revolution, Surface blending, Geometric Modeling of Solids: Solid entities, Boolean operations, B-rep, CSG **DRAFTING AND MODELING SYSTEMS:** Basic geometric commands, layers, display control commands, editing, dimensioning	CO2
III	**COMPUTER AIDED MANUFACTURING (CAM):** Basic Components of NC System, NC Procedure, NC motion control systems, problems with conventional NC, Direct Numerical control (DNC), Computer Numerical Control (CNC), Functions of CNC and DNC	CO3

	systems. **CNC PART PROGRAMMING:** fundamentals, manual part programming and Computer Assisted Part Programming-APT	
IV	**GROUP TECHNOLOGY (GT):** Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning- Retrieval type and Generative type. **COMPUTER AIDED QUALITY CONTROL (CAQC):** Coordinate Measuring Machine, Non-Contact Inspection and Machine Vision	CO4
V	**FLEXIBLE MANUFACTURING SYSTEM (FMS):** Components of FMS, FMS equipment and control **COMPUTER INTEGRATED MANUFACTURING SYSTEM (CIMS):** CIM Wheel, Elements of CIMS, CIMS benefits.	CO4

Learning Recourse(s)

Text books:

1. CAD / CAM A Zimmers & M.P.Groover/PE/PHI
2. CAD / CAM Theory and Practice / Ibrahim Zeid / TMH

Reference books

1. CAD/CAM by P.N. Rao/TMH.
2. Automation, Production systems & Computer integrated Manufacturing/ Groover /P.E
3. CAD / CAM / CIM / Radhakrishnan and Subramanian / New Age
4. Principles of Computer Aided Design and Manufacturing / Farid Amirouche / Pearson
5. CAD/CAM: Concepts and Applications/Alavala/ PHI
6. Computer Numerical Control Concepts and programming / Warren S Seames / Thomson.

e- Resources & other digital material

1. https://nptel.ac.in/courses/112/102/112102101/
2. https://nptel.ac.in/courses/112/104/112104289/
3. https://nptel.ac.in/courses/112/104/112104188/

INDUSTRIAL ENGINEERING & MANAGEMENT

Course Code	19ME4501D	**Year**	III	**Semester**	I
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Describe the role and responsibilities of management and the organizational Structures	L2
CO2	Explain the leadership qualities and concept of plant layout.	L2
CO3	Elucidate different quality control techniques.	L2
CO4	Explain various operations management Techniques	L2
CO5	Solve operations management and project management problems	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1					3		2			3		2	3
CO2	1					3		2			3		2	3
CO3	1					3		2			3		2	3
CO4	1					3		2			3		2	3
CO5	1					3		2			3		2	3

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION**: Definition of Industrial Engineering, Applications, Role of Industrial Engineer, Quantitative tools of IE, Functions of Management, Taylor's Scientific Management, Fayol's Principles of Management, Douglas Mc-Gregor's Theory X and Theory Y, Hertzberg's Two Factor Theory of Motivation, Maslow's Hierarchy of Human Needs.	CO1
II	**ORGANISATIONAL STRUCTURES**: Basic concepts related to Organization – Depart mentation and Decentralization, Flat and Tall organizations, Organizational chart, Line organization, Line and staff organization, functional organization **LEADERSHIP**: Introduction, Definition, Types of leadership based on authority- their area of applicability and suitability, advantages and limitations, Traits approach to leadership **PLANT LOCATION**: Definition, factors affecting the plant location, comparison of rural and urban sites. Plant Layout – definition, objectives, types of production, types of plant layout – various data analyzing forms-travel chart	CO2
	INSPECTION AND QUALITY CONTROL: Types of inspections -	

III	Statistical Quality Control-techniques-variables and attributes-assignable and non-assignable causes- variable control charts, and R charts, attributes control charts, p charts and c charts. Acceptance sampling-Single Sampling-OC curves. Introduction to TQM-Quality Circles, ISO 9000 series procedures.	CO3
IV	**WORK STUDY**: Definition, objectives, method study - definition, objectives, steps involved- various types of associated charts-out line process charts, flow process charts, two handed process charts and SIMO charts. **TIME STUDY**: definition, time study, steps involved-equipment, different methods of performance rating- allowances, standard time calculation.	CO4
V	**PROJECT MANAGEMENT**: Network modeling, Probabilistic model-various types of activity times estimation, programme evaluation review techniques (PERT), probability of completing the project, deterministic model- critical path method (CPM), critical path calculation, crashing of simple of networks.	CO5

Learning Recourse(s)

Text Books

1. S.Bhaskar, "Management Science", Anuradha Publications
2. O.P. Khanna, "Industrial Engineering and Management", DhanpatRai
3. T. R. Banga, S. C. Sharma, N. K. Agarwal, "Industrial Engineering and Management Science" Khanna Publishers

Reference Books

1. Panner Selvam, Production and Operations Management, PHI, 2004.
2. Ralph M Barnes, Motion and Time Studies, John Wiley and Sons, 2004.
3. Chase, Jacobs, Aquilano, Operations Management, TMH 10th Edition, 2003.
4. L.S.Srinath, PERT / CPM, affiliate East-West Press, New Delhi, 2000.
5. Phillip Kotler, Marketing Management, Pearson, 2004. 6. S. Bhaskar, "Management Science" Anuradha Publications.

MECHANICS OF MACHINERY

Course Code	19ME3502	**Year**	III	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	4	**L – T – P**	3 – 1 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Illustrate the elementary mechanisms and kinematic inversions of simple mechanisms	L2
CO2	Calculate the velocity and accelerations of various links and points in the mechanisms	L3
CO3	Construct the cam profile for a given motion and perform kinematics of gears and gear trains	L3
CO4	Perform balancing for rotating and reciprocating parts and estimate the effect of gyroscopic couple on aeroplanes and ships	L3
CO5	Demonstrate the operation of flywheel and governors.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes &														
Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3									2	3	1
CO2	3	3	3							2		2	3	1
CO3	3	3	3							2		2	3	1
CO4	3	3	3									2	3	1
CO5	3	3	3									2	3	1

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**SIMPLE MECHANISMS**: Classification of mechanisms – Basic kinematic concepts and definitions – Degrees of freedom, mobility – Grashof's law, kinematic inversions of four bar chain, single slider and double slider crank chains	CO1
II	**VELOCITY AND ACCELERATION IN MECHANISMS**: Velocity analysis of simple mechanisms by Instantaneous centre method, relative velocity method (graphical method), Kennedy's theorem**.** Acceleration analysis of simple mechanisms - Slider crank mechanism, Coriolis component of acceleration, crank and slotted lever mechanism.	CO2
III	**GEARS AND GEAR TRAINS**: Classification of Gears, gear terminology, fundamental law of gearing, Involute and cycloidal gear profiles, spur gear contact ratio and interference/undercutting, Gear trains - Simple, compound, reverted and epicyclic gear train	CO3

	CAMS: Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, simple harmonic and uniform acceleration and retardation, Design of cam profiles (knife edge and roller followers).	
IV	**BALANCING OF ROTATING AND RECIPROCATING MASSES**: Need for balancing, static and dynamic balancing, balancing of single mass and several masses in different planes. Balancing of reciprocating masses and inline multicylinder engines. **GYROSCOPE**: Principle of gyroscope, gyroscopic effect in an aeroplane and ship.	CO4
V	**FLYWHEELS**: Introduction, Turning moment diagram for Multi cylinder Engine, Fluctuation of energy. Coefficient of fluctuation of Speed, Energy Stored in a Flywheel, Flywheel in Punching Press **GOVERNORS**: Introduction, Watt, Porter, Proell Governors, Hartnell, Hartung Governors, Sensitiveness of a Governor, Hunting, Isochronisms, Stability, Controlling Force Diagrams	CO5

Learning Recourse(s)

Text Books

1. S.S.Rattan, Theory of Machines, 4/e, Tata Mc-Graw Hill, 2014

Reference Books

1. F. Haidery, Dynamics of Machines, 5/e, Nirali Prakashan, Pune, 2003
2. J.E.Shigley, Theory of Machines and Mechanisms, 4/e, Oxford, 2014
3. P.L.Ballaney, Theory of Machines & Mechanisms, 25/e, Khanna Publishers, Delhi, 2003.
4. Norton, R.L., Design of Machinery - An introduction to Synthesis and Analysis of Mechanisms and Machines,2/e, McGraw Hill, New York, 2000.

e- Resources & other digital material

1. https://nptel.ac.in/courses/112/104/112104121/
2. https://nptel.ac.in/courses/112/104/112104114/

DATABASE MANAGEMENT SYSTEMS

Course Code	19CS2501A	**Year**	III	**Semester**	I
Course Category	Inter Disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of database management systems	L2
CO2	Understand normalization techniques with simple examples.	L2
CO3	Apply SQL commands to create tables for a given database application	L3
CO4	Apply ER Model concepts to draw ER Diagrams for a given database application and make an effective report.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2	3													
CO3	3													
CO4	3								3	3				

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO DATABASES:** Characteristics of the Database Approach, Advantages of using the DBMS Approach, A Brief History of Database Applications. **OVERVIEW OF DATABASE LANGUAGES AND ARCHITECTURES:** Data Models, Schemas and Instances, Three-Schema Architecture and Data Independence, Database Languages and Interfaces, Database System environment, Centralized and Client-Server Architecture for DBMS.	CO1
II	**RELATIONAL MODEL:** The Relational Model Concepts, Relational Model Constraints and Relational Database Schemas. **SQL:** Data Definition, Constraints, Basic Queries and Updates, Views(Virtual Tables) in SQL	CO`3
III	**CONCEPTUAL DATA MODELING:** High-Level Conceptual Data Models for Database Design, A Sample Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types. **ER-Diagrams:** Refining the ER Design, ER Diagrams, Naming Conventions and Design Issues	CO4

IV	**DATABASE DESIGN THEORY**: Functional Dependencies, Normal forms based on Primary Keys, Second and Third Normal Forms, Boyce-Codd Normal Form.	CO2
V	**TRANSACTION PROCESSING**: Introduction, Transaction and System Concepts, Desirable Properties of Transactions. **INTRODUCTION TO PROTOCOLS FOR CONCURRENCY CONTROL IN DATABASES:** Two-Phase Locking Techniques for Concurrency Control - Types of Locks and System Lock Tables.	CO1

Learning Recourse(s)
Text Books
1. Database Systems Models, Languages, Design and Application Programming, Ramez Elmasri, Shamkant B.Navathe, 6th Edition, Pearson.
References
1. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, 3rd Edition, TMH. 2. Data base System Concepts, Abraham Silberschatz, Henry F Korth, S.Sudarshan, 5th Edition, Mc Graw Hill.

QUANTITATIVE TECHNIQUES FOR MANAGEMENT

Course Code	19HS2501A	**Year**	III	**Semester**	I
Course Category	Inter Disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Understand the basic concepts for solutions to business problems.	L2
CO2	Apply the analytical techniques in business transactions that would help in making effective business decisions.	L3
CO3	Analyze problems in business transactions that would help in making effective business.	L4
CO4	Apply the least square technique to find the equation of the curve.	L3
CO5	Determine the equation of the curve from the given data.	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1													2	
CO2	3												2	
CO3		3											2	
CO4	3												2	
CO5		3							2	2			2	

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO STATISTICS:** Meaning, Definition, Functions, Importance, Limitations of Statistics, Collection of Primary and Secondary Data.	CO1, CO2, CO3
II	**MEASURES OF CENTRAL TENDENCY:** Definition, Objectives, Characteristics and Techniques: Mean Median, Mode, Geometric Mean and Harmonic Mean.	
III	**MEASURES OF DISPERSION**: Definition, Objectives, Characteristics and Techniques: Range, Quartile Deviation, Mean Deviation, Standard Deviation and Coefficient of Variation.	
IV	**MEASURES OF SKEWNESS & KURTOSIS**: Definition, types of skewness, types of kurtosis, Karl-Pearson's Co-efficient, Bowley's Co-efficient, Kelly Co-efficient, Calculation of Raw Moments and Central Moments	
V	**CURVE FITTING:** Method of least squares, straight line, parabola, exponential curve, power curve	CO1, CO4, CO5

Learning Recourse(s)
Text Books
1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Publications, 2012. 2. Dr.T.K.V. Iyengar, Dr.B.Krishna Gandhi, S. Ranganatham, Dr. M.V.S.S.N. Prasad, "Probability & Statistics", Publications: S.Chand, 4th Revised Edition, 2012.
Reference Books:
1. S. Ross, a First Course in Probability, Pearson Education India, 2002. 2. Miller and Freunds, Probability and Statistics for Engineers,7/e, Pearson, 2008.
e- Resources & other digital material:
1. www.nptelvideos.com/mathematics/ (Math Lectures from Mit,Stanford,IIT'S) 2. nptel.ac.in/courses/111/106/111106150/ 3. nptel.ac.in/courses/111105035

OOP with C++

Course Code	19IT2501A	**Year**	III	**Semester**	I
Course Category	Inter Disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Illustrate the fundamental programming concepts in C++	L2
CO2	Demonstrate the concepts of Object-Oriented Programming	L2
CO3	Outline the concepts of polymorphism and Exception handling in C++	L2
CO4	Make use of OOP concepts to develop C++ programs.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2					1	1				2	2
CO2	2	2	2					1	1				2	2
CO3	2	2	2					1	1				2	2
CO4	2	2	2					1	1				2	2

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO C++:** Difference between C and C++, Evaluation of C++, Programming Paradigms, Key concepts of OOP, Advantages of OOP. **DECLARATIONS:** Tokens, Variable declaration and initialization, Data types in C++, Operators in C++, Scope access operator, Name Space, Memory management operators, Comments. **DECISION STATEMENTS:** Introduction, The if statement, Multiple ifs, Nested if-else, else-if ladder, unconditional control transfer statements, the switch statement	CO1, CO2
II	**CONTROL LOOP STRUCTURES:** Introduction, what is loop, The for loop, the while loop, The do-while loop **FUNCTIONS IN C++:** Introduction, Parts of a function, Passing arguments, Inline functions, Function overloading **INPUT AND OUTPUT IN C++:** Streams in C++ and Stream Classes, Pre-defined streams.	CO1, CO2
III	**CLASSES AND OBJECTS**: Introduction, Structure in C, Classes in C++, declaring Objects, Access specifiers and their scope, Defining member functions, Characteristics of member functions, Outside member function as inline, Rules for inline functions, Static member variable,	CO2, CO4

	static member functions, friend functions. **CONSTRUCTORS AND DESTRUCTORS**: Introduction, Constructors and destructors, Constructors with default arguments, Parameterized constructor, Overloading constructors, Array of objects using constructors, Constructors with default arguments **OPERATOR OVERLOADING:** Introduction, The keyword operator, Overloading unary operators, Overloading binary operator.	
IV	**INHERITANCE**: Introduction, Reusability, Access Specifies and Simple inheritance, Types of inheritance, Single, Multiple, Hierarchical, Hybrid, Multipath inheritances, Virtual base classes, program on simple inheritance **POINTERS**: Introduction, Features of pointers, Pointer Declaration, void pointer, wild pointer, The this pointer, Pointers to derived class and base class	CO2, CO4
V	**BINDING AND POLYMORPHISM AND VIRTUAL FUNCTIONS**: Introduction, Binding in C++, Pointer to base class and derived class objects, Virtual functions, pure virtual functions, Abstract classes. **EXCEPTION HANDLING**: Introduction, Principles of exception handling, the keywords try, throw and catch, Multiple catch statements, Re-throwing an exception.	CO3

Learning Recourse(s)
Text Books
1. Programming in C++, Second Edition, by Ashok N Kamthane, Pearson Education.
References
1. C++ How To Program, Dietel and Dietel, Prentice Hal . 2. C++ The Complete Reference, 5th Edition, by Herbert Schildt, TMH.
E-Recourses and other Digital Material
1. http://www.cplusplus.com 2. https://www.w3schools.com/cpp/

COMPUTATIONAL METHODS

Course Code	19ME2501A	**Year**	III	**Semester**	I
Course Category	Inter disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Solve System of equations using direct and iterative methods	L2
CO2	Solve Boundary and characteristic Value Problems	L3
CO3	Approximate linear and nonlinear curve using regression analysis	L3
CO4	Find a numerical solution to partial differential equations	L3
CO5	Apply finite difference scheme to solve parabolic and hyperbolic partial differential equations	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2										2	2	
CO2	3	2										2	2	
CO3	3	2										2	2	
CO4	3	2										2	2	
CO5	3	2										2	2	

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO NUMERICAL METHODS APPLIED TO ENGINEERING PROBLEMS:** Examples, solving Sets of equations– Matrix notation–Determinants and inversion– Iterative methods– Relaxation methods–Systems of non-linear equations.	CO1
II	**BOUNDARY VALUE PROBLEMS AND CHARACTERISTIC VALUE PROBLEMS:** Shooting method– Solution through a set of equations –Derivative boundary conditions–Characteristic value problems.	CO2
III	**CURVE FITTING AND APPROXIMATION OF FUNCTIONS:** Least square approximation fitting of non- linear curves by least squares –regression analysis- multiple linear regression, non-linear regression.	CO3
IV	**NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS:** Laplace's equations – Representations as a difference equation – Iterative methods for Laplace's equations – Poisson equation – Examples – Derivative boundary conditions – Irregular and non – rectangular grid.	CO4

V	**PARABOLIC PARTIAL DIFFERENTIAL EQUATIONS:** Explicit method– Crank-Nicolson method– Derivative boundary condition– Stability and convergence criteria. **HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS:** Solving wave equation by finite differences- stability of numerical method– method of characteristics-wave equation in two space dimensions.	CO5

Learning Recourse(s)
Text Books
1. Steven C.Chapra, Raymond P.Canale"NumericalMethodsforEngineers"TataMc-Grawhill,,Fifth edition. 2. Curtis F.Gerald, partick.O.Wheatley, "Applied numerical analysis" Pearson Education –Sixth Edition.2002
Reference Book(s)
1. Ward cheney&David Kincaid "Numerical mathematics and computing" Brooks /colepublishingcompany1999,fourthedition. 2. RileyK.F. M.P. Hobson & BenceS.J, "mathematical methods for physics and engineering" Cambridgeuniversitypress,1999.
e- Resources & other digital material
1. https://www.nptel.ac.in/courses/111/107/111107105/ 2. https://www.nptel.ac.in/courses/111/105/111105041/ 3. https://www.nptel.ac.in/courses/111/106/111106112/ 4. https://www.nptel.ac.in/courses/111/105/111105090/

BIOTECHNOLOGY AND SOCIETY

Course Code	19ES15501A	**Year**	III	**Semester**	I
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Understanding the basic concepts of advanced and emerging issues in biotechnology (L2)	L2
CO2	Analyze, and evaluate social and ethical issues in the conduct of biological research and application of biological knowledge (L4)	L4
CO3	Apply knowledge and analytical approaches in several major domains of the biological sciences that reflects a breadth and depth of understanding (L3)	L3
CO4	Analyze the scientific method by formulating hypotheses, proposing testable predictions and then testing to reach supportable conclusions about biological processes and systems, and articulate the relevance of modern biology to society (L4)	L4
CO5	Apply responsibilities to promote societal health and safety, upholding the trust given to the profession by the society (L3)	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2	3					3		3						
CO3	3					3								
CO4						3								
CO5						3	3							

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	History of Biotechnology, Genes (basic concepts), Genetic engineering, Tools for manipulation of genes (introduction to recombinant DNA technology), Vectors and expression systems (introduction)	CO1
II	Intellectual property rights (concepts related to drugs, genes and genomes) Recombinant DNA Debates, Biotechnology and Business, Patenting Life, Genetically Modified Foods: Risk, Regulation, and Our Food	CO2
III	Freezing, Banking, Crossing, Eugenics, The Human Genome Project, Genetic Testing, Disability, and Discrimination, Bioethics and Medicine, From the Pill to IVF, Cloning, Stem Cells.	CO3

IV	Drugs and Designer Bodies, Biotechnology and Race, Bioprospecting and Bio colonialism	CO4
V	Vaccines, Gene therapy, Clinical trials, Synthetic Biology and Bioterrorism, Use of biofertilizers and biopesticides for organic farming	CO5

Learning Recourse(s)

Text Books

1. Biotechnology and Society: An introduction. Hallam Stevens. University of Chicago Press. 2016. ISBN 022604615X, 978022604615

Reference Books

1. W. Godbey, An Introduction to Biotechnology, The Science, Technology and Medical
2. Applications, 1/e, Woodhead Publishing, 2014.
3. J.M. Walker and R. Rapley, Molecular Biology and Biotechnology, 5/e, Royal society of chemistry, 2009.
4. B.R.Glick, J.J.Pasternak, C.L.Patten. Molecular Biotechnology.ASM Press. 2009. ISBN-10:
5. 1555814980, ISBN-13: 978-1555814984s

ELECTRICAL SAFETY

Course Code	19ES5501B	**Year**	III	**Semester**	I
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	**Understand** the Indian power sector organization and Electricity rules, electrical safety in residential, commercial, agriculture, hazardous areas and use of fire extinguishers. (L2)	L2
CO2	**Outline** the electrical safety during installation, testing and commissioning procedure. (L2)	L2
CO3	**Make use of** specification of electrical plants and classification of safety equipment forvarious hazardous locations. (L3)	L3
CO4	**Distinguish** various fire extinguishers and their classification. (L4)	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3		2		1	2		2			1		2	1
CO2	3		2		1	2		2			1		2	1
CO3	3		2		1	2		2			1		2	1
CO4	3		2		1	2		2			1		2	1

Syllabus		
UNIT No.	**Contents**	**Mapped COs**
I	**INDIAN ELECTRICITY RULES & REGULATIONS**: Power sector organization and their roles; significance of IE rules & IE acts; general safety requirements: Span, conductor configuration, spacing and clearing, sag, erection, hazards ofelectricity.	CO1
II	**ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS**: Wiring and fitting – Domestic appliances –water tap giving shock –shock from wet wall –fan firing shock –multi-storied building – Temporary installations – Agricultural pump installation –Do's and Don'ts for safety in the use of domestic electrical appliances.	CO1
III	**ELECTRICAL SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE**: Preliminary preparations –safe sequence –risk of plant and equipment – safety documentation –field quality and safety - personal protective equipment –safety clearance notice –safety precautions – safeguards for operators –safety.	CO2

IV	**ELECTRICAL SAFETY IN HAZARDOUS AREAS**: Hazardous zones –class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipment for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours –classification of equipment/enclosure for hazardous locations.	CO1 CO3
V	**FIRE EXTINGUISHERS**: Fundamentals of fire - initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system; CO_2 and Halogen gas schemes; foam schemes.	CO1 CO4

Learning Recourse(s)

Text Books

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.

Reference Books

1. Cooper. W.F, "Electrical safety Engineering", Newnes-Butterworth Company, 1978.
2. John Codick, "Electrical safety hand book", McGraw Hill Inc., New Delhi, 2000.
3. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
4. Wadhwa, C.L., "Electric Power Systems", New Age International, 2004.

FUNDAMENTALS OF CYBER LAW

Course Code	19ES5501C	**Year**	III	**Semester**	I
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of Section 80 of IT Act 2000, Cyber Crime, Computer Crime, Internet Theft/Fraud, Goods and Services.	**L2**
CO2	Demonstrate the basic concepts of Cognizable and Non-Cognizable Offences, Hacking, Teenage Web Vandals, Prevalence and Victimology, Consumer Protection Act.	**L3**
CO3	Analyze the concepts of Arrest for "About to Commit" an Offence Under the IT Act, A tribute to Draco, Cyber Fraud, Computer as Commodities, Consumer Complaint.	**L4**
CO4	Explain the concepts of Arrest, But No Punishment, Cyber Cheating, Theft of Intellectual Property, Restrictive and Unfair Trade practices	**L4**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						2	2	3					2	
CO2						2	2	3					2	
CO3						2	2	3					2	
CO4						2	2	3					2	2

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**THE IT ACT, 2000:A CRITIQUE:** Crimes in Millennium, Section 80 of the IT Act, 2000-AWeapon or a Farce?, Forgetting the Line between Cognizable and Non-Cognizable Offences, Arrest for "About to Commit" an Offence Under the IT Act, A tribute to Draco, Arrest, But No Punishment	CO1, CO2, CO3, CO4
II	**CYBER CRIME AND CRIMINAL JUSTICE: PENALTIES, ADJUDICATION AND APPEALS UNDER THE IT ACT, 2000:** Concept of Cyber Crime and the IT Act, 2000, Hacking, Teenage Web Vandals, Cyber Fraud and Cyber Cheating.	CO1, CO2, CO3, CO4
III	**TRADITIONAL COMPUTER CRIME: EARLY HACKER AND THEFT OF COMPONENTS:** Traditional Problems, Recognizing and Defining Computer Crime, Phreakers: Yesterday's Hackers, Hacking, Computer as Commodities, Theft of Intellectual Property.	CO1, CO2, CO3, CO4

IV	**IDENTITY THEFT AND IDENTITY FRAUD:** Typologies of Internet Theft/Fraud, Prevalence and Victimology, Physical Methods of Identity Theft.	CO1, CO2, CO3, CO4
V	**PROTECTION OF CYBER CONSUMERS IN INDIA:** Are Cyber consumers Covered under the Consumer Protection Act?, Goods and Services, Consumer Complaint, Restrictive and Unfair Trade practices	CO1, CO2, CO3, CO4

Learning Recourse(s)

Text Books

1. Vivek Sood, "Cyber Law Simplified", Tata McGraw Hill.
2. Marjie T. Britz, "Computer Forensics and Cyber Crime", Person.
3. Ferrera, "Cyber Laws Texts and Cases", Cengage.

Reference Books

1. Vakul Sharma, "Handbook Of Cyber Laws" Macmillan India Ltd, 2 nd Edition,PHI,2003.
2. Justice Yatindra Singh, " Cyber Laws", Universal Law Publishing, 1 st Edition,New Delhi, 2003.
3. Sharma, S.R., "Dimensions Of Cyber Crime", Annual Publications Pvt. Ltd., 1st Edition, 2004.
4. Augastine, Paul T.," Cyber Crimes And Legal Issues", Crecent Publishing Corporation, 2007

e- Resources & other digital material

1. https://www.coursera.org/lecture/cyber-conflicts/introduction-to-cybercrime-and-fundamental-issues-xndSq
2. https://www.youtube.com/watch?v=F7mH5vz1qEI&list=PLf8YqCm9HoI6fb4LdoY2tFgJfM0PrgInS&ab_channel=ComputingforAll
3. https://www.youtube.com/watch?v=F7mH5vz1qEI&t=41s&ab_channel=ComputingforAll

ENVIRONMENT AND ECOLOGY

Course Code	19ES5501D	**Year**	III	**Semester**	I
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	To develop an awareness, knowledge, and appreciation for the natural environment.	L2
CO2	To determining different types of conventional sources exist in nature.	L3
CO3	To articulate the environmental pollution and their effects.	L3
CO4	To distinguishing the different laws on environmental protection.	L3
CO5	To know the global environmental problems.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3					2	3	1	2			3	3	
CO2	3					2	3	1	2			3	3	
CO3	3					2	3	1	2			3	3	
CO4	3					2	3	1	2			3	3	
CO5	3					2	3	1	2			3	3	

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	Definition, Scope & Importance, Need For Public Awareness-Environment Definition, Ecosystem Human Activities – Food, Shelter, Economic and Social Security. Effects of human activities on environment-Agriculture, Housing, Industry, Mining and Transportation activities, Basics of Environmental Impact Assessment. Sustainable Development.	CO1
II	Natural Resources- Water Resources- Availability and Quality aspects. Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources, Forest Wealth, Carbon Cycles, Oxygen cycles, Nitrogen Cycles. Energy – Different types of energy, Conventional and Non-Conventional sources –Hydro Electric, Fossil Fuel based Nuclear, Solar, Biomass and Biogas.	CO2
III	Environmental Pollution and their effects. Water pollution, Land pollution. Noise Pollution, Public Health Aspects, Air Pollution, Deforestation, Major Causes of Deforestation and consequences of deforestation, Solid Waste Management. Current Environmental Issues of Importance: Population Growth,	CO3

	Climate Change and Global warming-Effects, Urbanization, Automobile pollution. Ozone Layer depletion, Acid Rain, impact of Acid rain.	
IV	Environmental Protection- Role of Government, Air Act, Water Act, Wild life Act, Environmental Act. Initiatives by Non-governmental Organizations, (NGO), Environmental Education, Women Education.	CO4
V	Evidence of Global warming, consequences of climatic change, consequences of climate change in India. Biodiversity and Legislation, Earth Summit, the Montréal protocol, Kyoto protocol on climatic change.	CO5

Learning Recourse(s)

Text Books

1. Text book of Environmental Science & Technology – M. Anji Reddy – BS Publication.
2. S. V. S. Rana, Essentials of Ecology and Environmental Science, Prentice Hall India, New Delhi, 2011.
3. Environmental Studies – Benny Joseph – Tata McGraw Hill-2005

Reference Books

1. Principles of Environmental Science and Engineering – P. Venugopalan Rao, Prentice Hall of India.
2. Environmental Science and Engineering – Meenakshi, Prentice Hall India.

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CONTEMPORARY RELEVANCE OF INDIAN EPICS

Course Code	19HS5501A	**Year**	III	**Semester**	I
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Gain preliminary understanding of various Indian epics.	L2
CO2	Develop a deep insight into the famous epics and cultivate national consciousness.	L3
CO3	Apply the knowledge gained to various real life situations.	L3
CO4	Analyze the contemporary relevance of Indian epics.	L4
CO5	Interpret and correlate the ideals to one's own life.	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2								3	2			2		
CO3								3	2			2		
CO4								3	2			2		
CO5								3	2			2		

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	Definition of the term epic Features of epic, Introduction to Indian epics, Characteristics of classical Indian epics, Importance of Indian epics.	CO1, CO4
II	Salient features of Ramayana, Epic qualities of Ramayana, Ideals to be imbibed from the first Indian epic, Moral essence in Ramayana, Impact of Ramayana on Indian society.	CO1, CO2, CO5
III	Mahabharata, Epic qualities of Mahabharata, Set of values to be acquired from the largest epic, Impact of Mahabharata on our culture and society.	CO1, CO5
IV	Relevance Of Indian Epics to the contemporary of Indian society, Relevance of Indian Epics to the contemporary world.	CO1, CO3,
V	Essence of Bhagavad Gita, justification of the triumph of virtue over vice, Importance of truth and Self-sacrifice.	CO1, CO2, CO5

Learning Recourse(s)
Text Books
1. *Ramayana* by R. K. Narayan (Penguin) 2. *Mahabharata* by R. K. Narayan (Penguin) 3. Geetha darshan by Rama krisha mission
Reference Books
1. The palace of illusion- Chitra Banerjee Divakaruni 2. My Gita- Devdutt Pattankaik 3. Asura:tale of Vanquished- Anand Neelakantan 4. Prince of Ayodhya:Book one-Ashok k.Banker 5. The Hindus: An Alternative History- Wendy Doniger 6. Myth and Reality: Studies in the Formation of Indian Culture-D.D. Kosambi 7. Mahabharath- William Buck

INDIAN NATIONAL MOVEMENT

Course Code	19HS5501B	**Year**	III	**Semester**	I
Course Category	Open Elective	**Branch**	Common to All Branches	**Course Type**	Theory
Credits	3	**L – T – P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Understand political, social and economic background of freedom struggle.	L2
CO2	Specify major stages of freedom struggle and their ideological distinctions	L5
CO3	Analyse the role of nationalist movement in the making of modern India.	L4
CO4	Develop an attitude of nationalism cutting across limited boundaries of religion in order to resist communal forces.	L5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						1			1					
CO2						2			2					
CO3						2			2					
CO4						2			2					
CO5						1			1					

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**MODULE -I** Back ground : Early British Colonialism in India, early rebellions – Pazhassi raja(the cotiote war -Kerala, 18 th century), Veerapandiyan Kattabomman (Taminadu/Madras Presedency-18 th century), Paik rebellion (Kalinga/ Odisha, early 19 th century), Vellore mutiny (early 19 th century); The Sepoy Mutiny of 1857 and its consequences.	CO1
II	**MODULE -II** Contributory Factors: Socio political consciousness, growth of Western education and its impact socio -religious movement, British Economic Policies and their impact .	CO1
III	**MODULE -III** Rise of Organized Movements: Emergence of Indian National Congress, its policies and programmes, partition of Bengal, rise of radical nationalists, Bal-Lal-Pal, formation of Muslim league; Minto-Morely reforms, the national movement during the first world war.	CO2
IV	**MODULE -IV** Gathering Momentum: Non-cooperation and civil disobedience, emergence of Gandhi, some prominent revolutionaries - Khudiram Bose,	CO3

	Prafulla Chaki, Bhupendra Nath Dutt,V.D. Savarkar, Sardar Ajit singh, Lala Hardayal, Sardar Bhagat Singh, Raj Garu, Sukh Deo, Chandra Shekhar Azad, development of socialist ideas, communal divide.	
V	**MODULE -V** Towards Independence: Constitutional developments, provincial elections, quit India movement and after, participation of women national movement during the second world war, Indian national army, naval mutiny of 1946, freedom and partition, impact on the world.	CO4

Learning Recourse(s)
Text Books
1. K. Majumdar, Advent of Indepedence, Bhartiya Vidya Bhavan, Bombay 1969. 2. R. Desai, Social Background of Indian Nationalism, 5th ed., Popular Prakashan, Mumbai, 1976. 3. Bandyopadhyay , Sekhar, Nationalist Movement in India. A reader, Oxford university press, 2008. 4. Chandra, Bipin, National and colonialism in modern India, Orient Longman Limited 5. NewDelhi,1979.

ENGINEERING SERVICES FOR COMMUNITY

Course Code	19HS5501C	**Year**	III	**Semester**	I
Course Category	Open Elective	**Branch**	Common to All Branches	**Course Type**	Theory
Credits	3	**L – T – P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Understand the intricacies of engineering profession.	L2
CO2	Examine the role that engineering might play in the different aspects of sustainability development.	L3
CO3	Solve basic analytical and design problems using engineering tools, and be proficient and efficient in the use of these tools.	L3
CO4	Explore various awareness methods about safety, risk & risk benefit analysis	L4
CO5	Analyze what constitutes social justice in different areas of social life and the role that engineering might play in these.	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						3	3	3				2	2	
CO2						3	3	3				2	2	
CO3						3	3	3				2	2	
CO4						3	3	3				2	2	
CO5						3	3	3				2	2	

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**THE ENGINEERING PROFESSION** 1.1 On being a Professional 1.2 Technical Expertise and Ethical Obligations 1.3 Organization of Professional Engineering Engineering Codes of Ethics	CO1, CO2, CO5
II	**ENGINEERING AND SUSTAINABLE COMMUNITY DEVELOPMENT** 2.1 Understanding Community 2.2 Engineers' Beliefs about Community Development 2.3 Measuring Sustainability Engineers as Problem Solvers	CO1, CO2, CO4
III	**ENGINEERS AND DEVELOPMENT** 3.1 Engineering Disasters: Lessons to be Learned 3.2 Technology for Community Development	CO1, CO3, CO4

	3.3 Renewable Sources of Energy Green and Smart Cities	
IV	**SAFETY OF THE PUBLIC** 4.1 Ethical Dilemmas 4.2 Calculating the Value of Life 4.3 Whistle blowing 4.4 Trusting the Experts 4.5 Case Studies: a. Sinking of the Titanic b. Bhopal Gas Tragedy	CO1, CO3, CO4
V	**ENGINEERING AND SOCIAL JUSTICE** 1.1 Social Justice in Engineering Sciences 1.2 Humanities and Social Sciences in Engineering Education 1.3 Transforming Engineering Education and Practice Making Social Justice Visible and Valued	CO1, CO3, CO5

Learning Recourse(s)

Text Books

1. Deborah G. Johnson. (2020) *Engineering Ethics: Contemporary and Enduring Debates*. Yale University Press.
2. Vesilind, P. Aarne., Gunn, Alastair S. (2010) *Hold Paramount: The Engineer's Responsibility to Society*. Cengage Learning.
3. Luegenbiehl, Heinz., Clancy, Rockwell. (2017) *Global Engineering Ethics*. Butterworth-Heinemann, UK.
4. Traer, Robert. (2018) *Doing Environmental Ethics*. New York: Routledge.
5. Leydens, Jon., Lucena, Juan. (2017) *Engineering Justice: Transforming Engineering Education and Practice.* Wiley: IEEE Press

PERSONALITY DEVELOPMENT COURSE

Course Code	19HS5501D	**Year**	III	**Semester**	I
Course Category	Open Elective	**Branch**	Common to All Branches	**Course Type**	Theory
Credits	3	**L – T – P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
After successful completion of the course, the student will be able to		
CO1	Understand the fundamentals of various aspects of personality traits.	L2
CO2	Apply various aspects of soft skills and personality development.	L3
CO3	Analyse the various techniques of stress management.	L4
CO4	Acquire the significant factors of affecting attitudes.	L4
CO5	Develop Interpersonal communication.	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2									3	3		3		
CO3									3	3		3		
CO4									3	3		3		
CO5									3	3		3		

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**PERSONALITY:** Grooming one's personality, Personality traits, Influence of heredity and environment on personality, Effective habits Emotional intelligence.	CO1, CO2
II	Conflict resolution Assertive nature Decision making skills.	CO1, CO2, CO4
III	Techniques of time management Teamwork Self confidence Stress management	CO1, CO3, CO5
IV	Attitude-concept Positive attitude-advantages Negative attitude -disadvantages	CO1, CO2, CO4
V	Qualities of successful leader Interpersonal relationship Good manners & etiquette.	CO1 , CO5

Learning Recourse(s)
Text Book:
1. Personality development &soft skills Barun K. Mith Oxford.
Reference Books:
1.Personal & emotional competence, V.Bhaskara Rao,B.S.P 2.Step by Step –Niruparani. K,Jayasree Mohanra, Pearson.
e- Resources & other digital material:
1. https://www.usingenglish.com/comprehension/; 2. https://www.englishclub.com/reading/short-stories.htm; 3. https://www.english-online.at/ All Skills: https://www.englishclub.com/; 4. http://www.world-english.org/ 5. http://learnenglish.britishcouncil.org

GANDHIAN PHILOSOPHY

Course Code	19HS5501F	**Year**	III	**Semester**	I
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	Infer Gandhi principles of life and peaceful methods for conflict resolution
CO2	Make use of Gandhi learned lessons in his early life, advantages of self-introspection and practice of the truth
CO3	Function as transformed individual to respect all faiths and follow non-discrimination with simple living
CO4	Take Part in Swatch Baharat and Atmanirbhar Bharat Abhiyaan

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H-High3, M-Medium-2, L- Low-1)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						3	3	3	3					
CO2						3	3	3	3					
CO3						3	3	3	3					
CO4						3	3		2			3		

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	Gandhi –The Man and His Times: Early life and education, lessons learnt from his wife, in South Africa, influence of Thoreau, Tolstoy and other thinkers, return to India, Sabarmati ashram, role in the Indian national movement, his impact during his life time	CO1,CO2
II	Interpretation and Pursuit of Truth: Learning through trial and error; power of introspection, truth in thought, speech and action, pursuit of truth as true devotion to god, truth leads to courage and victory.	CO1,CO2
III	Peace and Conflict Resolution: Ahimsa as practical idealism – the means to the goal of truth, non-violent civil resistance, living faith in the power of nonviolence, prerequisites for practice, faith, courage and humility, prevention of structural violence, two pronged approach – conflict resolution and establishing peace, examples of methods and practices.	CO1,CO2
IV	Transformation of the Individual: Liberating the mind from dogmatism, control of the senses, thoughts and actions, respect for all faiths and universalism, a few strategies- Anasakta Karma, non-discrimination, simple living and self-sufficiency.	CO2,CO3

V	Contemporary Relevance: Gandhi's social, political and economic thought, sarva dharma sambhava – tolerance, respect towards all religions, educational reform – basic education and adult education, social equality sarvodaya, removal of untouchability, communal unity, women empowerment, prohibition, service of backward classes, village sanitation, political solutions- swaraj, decentralization of power, democracy of enlightened majority, economic solutions – swadeshi, trusteeship, khadi and village industries, decentralization of wealth, sustainable development and equal opportunity, youth as agents of change.	CO4

Learning Resources

References

1. Gandhi M.K., Mahadev H. Desai, Gandhi An Autobiography: The Story of My Experiments With Truth, Beacon Press, 1993.
2. Fisher, Louis, The Essential Gandhi: An Anthology of His Writings on His Life, Work, and Ideas. Vintage Books, 1983.
3. http://www.mkgandhi.org/main.htm Comprehensive Website by Gandhian Institutions – Bombay Sarvodaya Mandal and Gandhi Research Foundation

PVP 19

INDIAN HISTORY

Course Code	19HS5501G	**Year**	III	**Semester**	I
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes	
Upon successful completion of the course, the student will be able to:	
CO1	Understand the socio-economic-cultural conditions of ancient India
CO2	Know the contribution of various dynasties to Indian Culture
CO3	Examine the invasion of different foreign rulers and their effect on Indian culture
CO4	Analyze the impact of British colonial rule on industrialization and introduction of western education in India
CO5	Describe the national movements against British rule.

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H-High3, M-Medium-2, L- Low-1)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						2						2		1
CO2						2						2		1
CO3						2						2		1
CO4						2						2		1
CO5						1						1		1

Syllabus

Unit No.	**Content**	**Mapped COs**
I	**ANCIENT INDIAN HISTORY AND CULTURE** –Indus Valley Civilization: Salient Features, Vedic and Later Vedic Culture, Doctrines of Jainism and Buddhism, Mauryans – Administration, Ashoka ‘s Dhamma, Satavahanas , Guptas –Socio-Economic-Cultural Conditions.	CO1
II	**MEDIEVAL INDIAN HISTORY AND CULTURE** – Delhi Sultanate, Great Mughals South Supremacy and Conflicts Pallavas, Cholas, Kakatiyas, Vijayanagara Empires their Contribution to Indian Culture.	CO2
III	**MODERN INDIAN HISTORY AND Culture** – European penetration In to India, Anglo-French Rivalry for Supremacy, The battle of Plassey establishment of British Power, Consolidation and expansion tools, Subsidiary Alliance, Doctrine of Lapse.	CO3
IV	**IMPACT OF BRITISH COLONIAL RULE** –Commercialization of Agriculture, de industrialization- decline of cottage Industries, famines and condition of Peasants, Introduction of Western Education in India, the great Revolt of 1857.	CO4
V	**THE RISE OF INDIAN NATIONAL MOVEMENT** – Socio- Religious Movements the Genesis of Freedom Movement –Birth of Indian National	CO5

	Congress, -Freedom Struggle (1885-1920) Moderate Phase Partition of Bengal-Emergence of Militant Nationalism-Swadeshi& Boycott Movement –Home Rule Movement Freedom Struggle (1920-1947) Gandhi's role in Indian National Movement .	

Learning Recourse(s)
Text Book:
1. Krishna Reddy, Indian History, McGraw Hill Education; Second edition, 2017
Reference Books:
1. Sailendranathsen, A text book of Indian history and culture, Primus, 2019. 2. VK Agnihotri, Indian History And Culture, Allied publisher private limited; 28th edition,2013
e- Resources & other digital material:
1. https://onlinecourses.swayam2.ac.in/cec20_hs04/preview http://www.world-english.org/ 2. http://learnenglish.britishcouncil.org

INTERNET OF THINGS LABORATORY

Course Code	19ES1552	**Year**	III	**Semester**	I
Course Category	Engineering Science	**Branch**	ME	**Course Type**	Practical
Credits	1	**L-T-P**	0 – 0 – 2	**Prerequisites**	Nil
Continuous Internal Evaluation	25	**Semester End Evaluation**	50	**Total Marks**	75

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to:		
CO1	**Develop** various sensor interfacing using Visual Programming Language.	L6
CO2	**Analyze** various Physical Computing Techniques.	L4
CO3	**Evaluate** Wireless Control of Remote Devices.	L5
CO4	**Design and develop** Mobile Application which can interact with Sensors and Actuators.	L6

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H-High3, M-Medium-2, L- Low-1)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	2	3	3	2	3	3	3	3	3	3
CO2	3	3	3	3	2	3	3	2	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	2	3	3	3	3	3	3

Syllabus		
Expt. No	**Content**	**Mapped COs**
1.	Digital I/O Interface - Multicolour Led, IR Sensor, PIR, Slot Sensor.	CO1
2.	Analog Read and Write - Potentiometer, Temperature Sensor, Led Brightness Control.	CO1
3.	Dc Motor Control - Dc Motor Speed and Direction Control.	CO2
4.	Read data from sensor and send it to a requesting client. (using socket communication) Note: The client and server should be connected to same local area network.	CO2
5.	Fabrication and direction control of wheeled robot using Arduino.	CO2
6.	Serial Communication - Device Control.	CO2
7.	Wireless Module Interface - Bluetooth and Wifi.	CO3
8.	Wireless Control of wheeled Robot using Bluetooth/Wifi.	CO3
9.	Basic Android App Development using MIT App Inventor.	CO4
10.	Smart Home Android App Development using App Inventor and Arduino.	CO4
11.	Develop IOT based smart lock system foe Motor cycle/Car	CO4
12.	Develop IOT based smart water flow system	CO4

Learning Recourse(s)
Text Book:
1. Sylvia Libow Martinez, Gary S Stager, “Invent To Learn: Making, Tinkering, and Engineering in the Classroom”, Constructing Modern Knowledge Press, 2016.
Reference Books:
1. Michael Margolis, “Arduino Cookbook”, Oreilly, 2011

MATERIAL TESTING NAD CHARECTERIZATION LAB

Course Code	19ME3551	**Year**	III	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Practical
Credits	1.5	**L-T-P**	0 – 0 – 3	**Prerequisites**	Nil
Continuous Internal Evaluation	25	**Semester End Evaluation**	50	**Total Marks**	75

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to:		
CO1	Apply methods to determine Mechanical properties and Elastic Constants.	L3
CO2	Appraise the students with the use of testing machines.	L4
CO3	Identify the microstructures of different ferrous and non-ferrous metals.	L1
CO4	Discuss the effect of cold working, heat treatment, and cooling rates on the properties of steels.	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H-High3, M-Medium-2, L- Low-1)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1		1		3					3			3	1
CO2	1		1		3					3			3	1
CO3	1	2	3	3	3	2	3			3			3	1
CO4	1	2	3	3	2	2	3			3			3	1

Syllabus		
Expt. No	**Content**	**Mapped COs**
SIX Experiments out of the following Ten are to be performed		
1.	Tension Test on UTM - Determination of the strength, percentage elongation and percentage reduction in area of the given specimen.	CO1 & CO2
2.	Deflection Test on Simply supported beam - Determination of Young's modulus of Simply Supported beam material.	
3.	Deflection Test on Cantilever beam - Determination of Young's modulus of cantilever beam material.	
4.	Torsion Test – Determination of modulus of rigidity of circular rod.	
5.	Brinnell's Hardness Test - Determination of Hardness Number for given specimen.	
6.	Rockwell Hardness test - Determination of Hardness Number for given specimen.	
7.	Izod Impact Test - Determination of impact strength of given specimen.	
8.	Charpy Impact Test - Determination of impact strength of given specimen.	
9.	Tests on helical spring - Determination of Modulus of Rigidity of Helical spring material.	
10.	Double shear Test - Determination of shear strength of given specimen.	
SIX Experiments out of the following Ten are to be performed		
1.	Preparation and study of microstructure of Iron, hypoeutectoid, eutectoid and hypereutectoid steels.	

2.	Study of microstructure of Cast Iron samples viz. Ductile, Malleable, Grey, White Cast Irons.	CO3 & CO4
3.	Preparation and study of microstructure of Aluminum and its alloy.	
4.	Study of microstructure of Copper and its alloy.	
5.	Study and quantification of micro phases in welded samples.	
6.	Study of microstructure of various treated and untreated steels.	
7.	Study of microstructure of 18/8 steel.	
8.	Hardness of various treated and untreated steels.	
9.	Hardenability of Steels by Jominy end Quench test.	
10.	Comparison between annealing and normalizing of cold worked mild steel	

MANUFACTURING TECHNOLOGY LAB

Course Code	19ME3552	**Year**	III	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Practical
Credits	1.5	**L-T-P**	0 – 0 – 3	**Prerequisites**	Nil
Continuous Internal Evaluation	25	**Semester End Evaluation**	50	**Total Marks**	75

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to:		
CO1	Perform various operations on Lathe machine.	L3
CO2	Perform Drilling, Reaming and Tapping operations using universal radial drilling machine	L3
CO3	Make plain and stepped surfaces using shaper, planner and surface grinder.	L3
CO4	Fabricate spur gear and splined shaft using milling machine and slotter respectively.	L3
CO5	Prepare single point cutting tool using Tool and cutter grinding machine.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H-High3, M-Medium-2, L- Low-1)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3								2	1		1	3	1
CO2	3								2	1		1	3	1
CO3	3								2	1		1	3	1
CO4	3								2	1		1	3	1
CO5	3								2	1		1	3	1

Syllabus

Expt. No.	**Content**	**Mapped COs**
1.	Step turning	CO1
2.	Taper turning by swiveling compound rest	
3.	Taper turning by taper turning attachment	
4.	Knurling	
5.	Thread cutting	
6.	Form Turning	
7.	Drilling and Boring	
NON-LATHE		
1.	Drilling, reaming and tapping operations	CO2
2.	Shaping a stepped surface	CO3
3.	Machining of flat surface using Planner	
4.	Surface grinding	
5.	Splined Shaft on slotting machine	CO4
6.	Spur Gear making on a Milling machine	
7.	Grinding of single point cutting tool angles	CO5

ENGINEERING ECONOMICS AND MANAGEMENT

Course Code	19HS1601	**Year**	III	**Semester**	II
Course Category	Humanities	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
Upon successful completion of the course, the student will be able to		
CO1	Use the theory of managerial economics, demand analysis and to model business organization.	L1
CO2	Theorize about characteristics and types of industrial organizations, concept of changing business environment in post-liberalization scenario.	L1
CO3	Justify about types and functions of financial management.	L4
CO4	Evaluate the best alternative for various capital budgeting options and calculation	L4
CO5	To develop knowledge of fundamentals of management and economics concepts, skills and tools, to aid in problem solving and decision making	L1

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3					2		2			3		1	3
CO2	3					2		2			3		1	3
CO3	3					2		2			3		1	3
CO4	3					2		2			3		1	3
CO5	3					2		2			3		1	3

Syllabus		
Unit No	**Contents**	**Mapped COs**
I	**INTRODUCTION TO MANAGERIAL ECONOMICS** Introduction to Managerial Economics & Demand Analysis: Definition of Managerial Economics, Characteristics and Scope – Managerial Economics and its relation with other subjects- Basic economic tools in Managerial Economics. **DEMAND ANALYSIS:** Meaning- Demand distinctions- Demand determinants- Law of Demand and its exceptions. Elasticity of demand & demand forecasting- Definition -Types of Elasticity of demand - Measurement of price elasticity of demand: Total outlay method, Point method and Arc method- Significance of Elasticity of Demand.	CO1
II	**TYPES OF INDUSTRIAL ORGANIZATION & INTRODUCTION TO BUSINESS CYCLES**: Characteristic features of Industrial organization, Features and evaluation of Sole Proprietorship, Partnership,	CO2

	Joint Stock Company, State/Public Enterprises and their types. Changing business environment in post-liberalization scenario.	
III	**FINANCIAL MANAGEMENT AND INTRODUCTION TO FINANCIAL ACCOUNTING:** Functions of financial management, simple and compound interest, Methods of evaluating alternatives- Present Worth method. Future worth Method, Annual equivalent method. Introduction to Double-entry system (simple problems)	CO3
IV	**DEPRECIATION** Introduction, common methods of depreciation: straight line method, Declining balance method, sum of year's digits method. **CAPITAL AND CAPITAL BUDGETING** Meaning of capital budgeting, Need for capital budgeting – Capital budgeting decisions (Examples of capital budgeting) - Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR), IRR and Net Present Value Method (simple problems)	CO4
V	**PRINCIPLES OF MANAGEMENT** Importance of management, definition of management, management process, roles of a manager; Management, a science or art - Management, a profession; Functions of management. **LEADERSHIP:** Difference between a leader and a manager, characteristics of leadership, functions of a leader, types of leadership.	CO5

Learning Recourse(s)
Text Book(s)
1. R. Panneerselvam, Engineering economics, 2nd Edition, PHI Learning Pvt. Ltd., 2013 2. J.V.Prabhakar Rao, Managerial Economics and Financial Analysis, Maruthi Publications, 2011 3. Koontz, H and Wihrich.H, Management, McGraw-Hill, New York, 10th Edition, 1995. 4. Ramasamy.T, Principles of Management, Himalaya Publishing House, New Delhi, 2000.
Reference Book(s)
1. Managerial Economics and Financial Analysis, by A R Aryasri, TMH 2011 2. Management-Aglobal Entrepreneurial Perspective,Weihrich,Cannice,Koontz, 13th Edition, Tata McGraw Hill.2012. 3. Financial Accounting,SN Maheswari,SK Maheswari, Vikas Publishing House Pvt Ltd., NewDelhi, 4th Edition,2006. 4. Entrepreneurship Narayana Reddy, Cengage learning, New Delhi, 2010 5. Entrepreneurship, Rajeev Roy, Oxford University Press, New Delhi, 2010 6. Projects, Prasanna Chandra, Tata McGraw-Hill Education, 2009.
e- Resources & other digital material
1.www.tectime.com 2.www.exinfm.com 3.www.economywatch.com 4.https://nptel.ac.in/courses/110/101/110101149/ 5..https://nptel.ac.in/courses/109/107/109107119/

PVP 19

HEAT TRANSFER

Course Code	19ME3601	**Year**	III	**Semester**	II
Course Category	Engineering Sciences	**Branch**	ME	**Course Type**	Theory
Credits	4	**L – T – P**	3 – 1 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Describe modes of heat transfer	L1
CO2	Formulate one dimensional steady and transient conduction heat transfer problems and explain concept of fins	L2
CO3	Explain concepts on forced convective heat transfer, significance of non-dimensional numbers and free convection heat transfer	L2
CO4	Solve problems based on boiling, condensation, LMTD and NTU methods.	L3
CO5	Describe basic concepts of radiation heat transfer including both black body radiation and gray body radiation.	L2

	Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	3				1							1	1
CO2	2	3				2							3	3
CO3	2	3				2							3	3
CO4	2	3				2							3	3
CO5	2	3				2							3	3

Syllabus		
Unit No	**Contents**	**Mapped COs**
I	**MODES AND MECHANISMS OF HEAT TRANSFER** – Basic laws of heat transfer –General discussion about applications of heat transfer. **CONDUCTION HEAT TRANSFER-**Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates.	CO1
II	**ONE DIMENSIONAL STEADY STATE CONDUCTION HEAT TRANSFER-**Steady, unsteady and periodic heat transfer – Initial and boundary conditions. Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – Critical radius of insulation - Variable Thermal conductivity – systems with and without heat generation. **EXTENDED SURFACE (FINS) HEAT TRANSFER** – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature. **ONE DIMENSIONAL TRANSIENT CONDUCTION HEAT TRANSFER**: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers Chart solutions of transient conduction systems.	CO2

III	**CONVECTIVE HEAT TRANSFER -**Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham Pi Theorem and method, application for developing semi – empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations. **FORCED CONVECTION-**External flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer Flat plates and Cylinders. FREE CONVECTION: Development of Hydrodynamic and thermal boundary layer along a vertical plate – Use of empirical relations for Vertical plates.	CO3
IV	**HEAT TRANSFER WITH PHASE CHANGE-**Boiling – Pool boiling – Regimes Calculations on Nucleate boiling, Critical Heat flux and Film boiling. CONDENSATION: Film wise and drop wise condensation – Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations. **HEAT EXCHANGERS-**Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.	CO4
V	**RADIATION HEAT TRANSFER-**Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann. Heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.	CO5

Learning Recourse(s)

Text Book(s)

1. Heat and Mass Transfer by Y.A Cengel, A J Ghajar, Mc Graw Hill education,2011.
2. Heat transfer, by J.P.Holman, TMH publications, 2008 .
3. Heat and Mass Transfer, by Sachdeva, New age International.

Reference Book(s)

1. Engineering Heat & Mass transfer by Mahesh.M.Rathor ,University science press ,2006
2. Heat Transfer -A Basic Approach, by N.Ozisik , MC Grawhill,1985
3. Heat transfer, by S.P.Sukhatme , Orient longman Pvt. Ltd. 2005
4. Introduction to Heat Transfer, by lncropera and Dewitt, Wiley Publishers,2001
5. Heat Transfer, by D.S. Kumar, SK. Kataria & sons,2009.

e-Resources & other digital material

1. https://nptel.ac.in/courses/112/108/112108149/
2. https://nptel.ac.in/courses/112/105/112105271/
3. https://nptel.ac.in/courses/103/103/103103031/#

Data book to be allowed in examination:

C.P.Kothandaraman & S. Subramanyam, Heat and Mass Transfer Data Book, New Age International Publishers – Sixth edition.

PVP 19

REFRIGERATION AND AIR CONDITIONING

Course Code	19ME4601A	**Year**	III	**Semester**	I
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Calculate the COP of air refrigeration systems	L2
CO2	Describe various components used in vapour-Compression refrigeration system and Estimate the performance	L1
CO3	Discuss the working principles of vapour absorption, steam jet, thermoelectric and vortex tube refrigeration systems	L1
CO4	Recognize the properties of air, summarize the various Psychometric processes and acquire the knowledge of load estimation	L3
CO5	Evaluate cooling and heating loads in an air conditioning and describe the various components of air conditioning system	L2

	Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	3				1							1	3
CO2	2	3				2							3	3
CO3	2	3				2							3	3
CO4	2	3				2							3	3
CO5	2	3				2							3	3

Syllabus		
Unit No	**Contents**	**Mapped CO s**
I	**INTRODUCTION TO REFRIGERATION** Necessity of refrigeration and air conditioning, applications, unit of refrigeration **Refrigeration:** Carnot cycle, Bell Coleman cycle and Brayton Cycle, Open and Dense air systems, Actual air refrigeration system –numerical problems. Refrigeration needs of air craft's, methods of air refrigeration systems.	CO1
II	**VAPOUR COMPRESSION REFRIGERATION SYSTEM** Cycles and performance Simple Vapour compression refrigeration cycle - working principle, essential components, COP, representation of cycle on T–S and p-h charts, effect of sub cooling and super heating– cycle analysis. Actual cycle, Influence of various parameters on system performance - numerical Problems Components Compressors – classification –single stage reciprocating compressors-Working Principle, work done with and without clearance	CO2

	volume, capacity control. Condensers –classification–Working of evaporative condensers Evaporators– classification–Working of flooded and dry expansion evaporators Expansion devices–Types–capillary tube, automatic expansion valve, thermostatic expansion valve. Refrigerants: Desirable properties–classification refrigerants	
III	**PERFORMANCE OF VAPOR ABSORPTION REFRIGERATION SYSTEM** Calculation of max COP, description and working of NH3–water system and Li Br– water (Two shell & Four shell) System. Principle of operation of three fluid absorption system, salient features. **STEAM JET REFRIGERATION SYSTEM** Working Principle and Basic Components Nonconventional refrigeration methods: Principle and operation f(i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.	CO3
IV	**INTRODUCTION TO AIR CONDITIONING** Psychometric Properties & Processes–Characterization of Sensible and latent heat loads.Need for Ventilation, Consideration of Infiltration, Load concepts of RSHF, GSHF, ESHF and ADP.	CO4
V	**HUMAN COMFORT AND LOAD CALCULATIONS** Requirements of human comfort and concept of effective temperature-Comfort chart– Com fort Air conditioning –Requirements of Industrial air-conditioning, Air-conditioning Load Calculations. Air Conditioning Systems Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers fans and blowers. Heat Pump –Heat sources– different heat pump circuits.	CO5

Learning Recourse(s)
Text Book(s)
1. SC Arora & Domkundwar, A Course in Refrigeration and Air conditioning, Dhanpatrai 2. CP Arora, Refrigeration and Air Conditioning, CP Arora, TMH.
Reference Book(s)
1. Refrigeration and Air Conditioning by R K Rajput, S K kataria & sons , 2010. 2. Refrigeration and Air Conditioning / Manohar Prasad / New Age. 3. Principles of Refrigeration, by Dossat ,Prentice Hall,1997. 4. Refrigeration and air conditioning, by Stoecker , Mc Graw hill Edu.,2004. 5. Basic refrigeration and air conditioning/PN Ananthanarayanan/Mc Graw hill education
e-Resources & other digital material
1. https://nptel.ac.in/courses/112/105/112105129/ 2. https://nptel.ac.in/courses/112/107/112107208/ 3. https://nptel.ac.in/courses/112/105/112105128/

Data Books

1. Refrigeration and Air conditioning Data book, CP Kothandaraman /New age publishers.
2. Refrigeration and Air conditioning Data book-Domakundwar & Domakundwar / Dhanpathi rai &Co

MECHANICAL VIBRATIONS

Course Code	19 ME 4601B	**Year**	III	**Semester**	II
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Analyze single degree freedom system for its natural frequency and vibration response.	L3
CO2	Analyze single degree freedom system for its natural frequency and damped vibration response	L3
CO3	determine response of Single degree freedom systems under harmonic excitations	L3
CO4	Determine the response of Two-degree freedom systems under free and forced vibrations	L3
CO5	Derive the equation of motion and find the natural frequencies mode shapes of a multi degree of freedom system	L3

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	1									3	1
CO2	3	3	1	1									3	1
CO3	3	3	1	1									3	1
CO4	3	3	1	1									3	1
CO5	3	3	1	1									3	1

Syllabus		
Unit No	**Contents**	**Mapped CO s**
I	**UNDAMPED FREE VIBRATIONS OF SDOF SYSTEMS** Introduction, basic concepts of vibration, importance of vibration study, elements of a vibrating system, types of vibration, methods of vibration analysis, harmonic motion, Equation of motion, free vibration of undamped translational system, free vibration of undamped torsional system, Raleigh's energy method.	CO1
II	**DAMPED FREE VIBRATIONS OF SDOF SYSTEMS** Introduction, types of damping, free vibration with viscous and coulomb damping, logarithmic decrement.	CO2
III	**HARMONICALLY EXITED VIBRATIONS** Introduction, equations of motion, response of undamped and damped systems under harmonic excitation, response of a damped system under harmonic motion of the base, response of a damped	CO3

	system under rotating unbalance, vibration, measuring instruments-vibrometer and accelerometer, critical speed	
IV	**TWO DEGREE OF FREEDOM SYSTEMS:** Introduction, equations of motion for forced vibration, free vibration analysis of an undamped system, torsional system, coordinate coupling and principal coordinates, forced vibration analysis. Dynamic vibration absorber	CO4
V	**MULTI-DEGREE OF FREEDOM SYSTEMS**: Introduction, modeling of continuous systems as multi degree of freedom systems, using Newton's second law to derive equations of motion, influence coefficients, Determination of natural frequencies and mode shapes.	CO5

Learning Recourse(s)
Text Book(s)
1. S.S.Rao,MechanicalVibrations,5/e,PearsonEducationInc.,2011. 2. G. K. Grover, Mechanical Vibrations, 8/e, Nem Chand & Bros
Reference Book(s)
1. L.Meirovich, Elements of Vibration Analysis,2/e.TataMcGrawHill,2007. 2. J.S.Raoand,K.Gupta,IntroductoryCourseonTheoryandPracticeofMechanicalVibrations,2/e, NewAge International,1999.
e-Resources & other digital material
1. https://nptel.ac.in/courses/112/103/112103112/ 2. https://nptel.ac.in/courses/112/103/112103111/

ADDITIVE MANUFACTURING

Course Code	19ME4601C	**Year**	III	**Semester**	II
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites:**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks:**	100

Course Outcomes		**Level**
Upon successful completion of the course, the student will be able to		
CO1	Summarize the working principle and process parameters of AM processes and Design and develop a product for AM process.	L3
CO2	Discuss the Vat Photopolymerization AM Process and their applications.	L2
CO3	Illustrate the Extrusion-Based AM Processes, Sheet Lamination AM Processes suitable material and process for fabricating a given product.	L3
CO4	Outline various Metal Additive Manufacturing process for different products.	L2

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1			1	1			1		2	3	1
CO2	3	2	1			1	1			1		2	3	1
CO3	3	2	1			1	1			1		2	3	1
CO4	3	2	1			1	1			1		2	3	1

Syllabus		
Unit No	**Contents**	**Mapped CO s**
I	**INTRODUCTION TO ADDITIVE MANUFACTURING:** Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages of AM and Types of materials for AM. **GUIDELINES FOR PROCESS SELECTION:** Introduction, Selection Methods for a Part, Challenges of Selection, Example System for Preliminary Selection, Process Planning and Control.	CO1
II	**VAT PHOTOPOLYMERIZATION AM PROCESSES:** Stereolithography (SL), Materials, Process Modeling, SL resin curing process, SL scan patterns, Micro-stereolithography, Mask Projection Processes, Two-Photon vat photo polymerization, Process Benefits and Drawbacks, Applications of Vat Photopolymerization, Material Jetting and Binder Jetting AM Processes.	CO2
III	**EXTRUSION-BASED AM PROCESSES:** Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Plotting and path control, Bio-Extrusion, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes.	CO3

	SHEET LAMINATION AM PROCESSES: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications.	
IV	**POWDER BED FUSION AM PROCESSES:** Selective laser Sintering (SLS), Materials, Powder fusion mechanism and powder handling, Process Modelling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes.	CO4
V	**DIRECTED ENERGY DEPOSITION AM PROCESSES:** Process Description, Material Delivery, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure-properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes.	CO5

Learning Recourse(s)

Text Book(s)

1. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, 2015.
2. Chua Chee Kai, Leong Kah Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015.

Reference Book(s)

1. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.
2. Patri K. Venuvinod and Weiyin Ma, "Rapid Prototyping: Laser-based and Other Technologies", Springer, 2004.

e-Resources & other digital material

1. https://nptel.ac.in/courses/110/106/110106146/
2. https://nptel.ac.in/courses/112/104/112104265/

PVP 19

STATISTICAL QUALITY CONTROL

Course Code	19ME4601D	**Year**	III	**Semester**	II
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Familiarize students with some of Quality Basics and History	L2
CO2	To discuss about Modeling Process Quality	L2
CO3	Imparted knowledge about Statistical Quality Control	L4
CO4	Awareness on basics of Control Charts for Attributes	L2
CO5	Attain basic knowledge on Acceptance Sampling	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H:High, M: Medium, L:Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1		1			2		2			3		1	3
CO2	1		1			2		2			3		1	3
CO3	1		1			2		2			3		1	3
CO4	1		1			2		2			3	3	1	3
CO5	1		1			2		2			3	3	1	3

Syllabus

Unit No	**Contents**	**Mapped CO**
I	**QUALITY BASICS AND HISTORY:** Meaning of quality, Factors effecting quality, Quality Principles, Quality function, Quality control, Aims and objectives of quality control, Characteristics, Cost of quality, Value of quality, Seven QC tools, Need of management of product quality, Historical perspective of quality control.	CO1
II	**MODELING PROCESS QUALITY:** Variation: Stem-leaf Plot, Frequency distribution Histogram, Box Plot, Discrete Distributions Hyper geometric Distribution, Binomial distribution, Poison Distribution, Continuous Distributions- Normal, Gamma, Exponential and Weibull's distribution.	CO2
III	**STATISTICAL QUALITY CONTROL:** Introduction, Concept of variability , Common vs. Special Causes, Types of Control charts, Measurement of control limits, Control charts for variables -large sample data, Warning limits, Revised control limits, Group control chart, Control chart with line trend.	CO3
IV	**CONTROL CHARTS FOR ATTRIBUTES:** Control charts for non-confirming Models, control charts for fraction non- conforming. Process and Measurement System Capability Analysis: Using Probability plot, process	CO4

	capability ratios, specification limits and Tolerances.	
V	**ACCEPTANCE SAMPLING:** Introduction, Advantages and Disadvantages of Sampling methods, Sampling techniques, Sampling Risks and indices, Operating characteristic curves, Average outgoing quality Limit. Sampling plans Single, Double, Multiple and Sequential Sampling Plans Tightened Inspection, Dodge-Rooming system, Sequential plans.	CO5

Learning Recourse(s)
Text Book(s)
1. E. L. Grant Richard, R.S. Leavenworth, Design Statistical Quality Control, 7th Edition, McGrawHill Pvt Ltd New Delhi, 2011. 2. D. C. Montgomery, Statistical Quality Control,7th Edition, John Wiley Sons, 2012.
Reference Book(s)
1. M. Mahajan, Statistical Quality Control, Revised Edition, Dhanapat Rai & Co, 2007. 2. W.W.Hines, D. C.Montgomery, Probability and Statistics in Engineering and Management Science, John Wiley and Sons, New York, 1990. 3. Kapoor, V.K. and Gupta, S.P. (1978): Fundamentals of applied statistics, Sultan Chand & Sons. Gupta, R.C.(1974): Statistical Quality Control.
e-Resources & other digital material
1. https://nptel.ac.in/courses/116/102/116102019/

DESIGN OF MACHINE ELEMENTS

Course Code	19ME3602	**Year**	III	**Semester**	I
Course Category:	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Describe the Design Procedure and understand various design considerations.	L2
CO2	Determine the size of simple mechanical components subjected to static and fluctuating loads	L3
CO3	Design and analyze riveted, bolted and welded joints under various loading conditions	L4
CO4	Design and analyze cotter joints, spur and helical gears	L4
CO5	Design and Analyze springs for the given loading	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H:High, M: Medium, L:Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	1						1		2	3	1
CO2	3	3	1	1						1		2	3	1
CO3	3	3	1	1						1		2	3	1
CO4	3	3	1	1						1		2	3	1
CO5	3	3	1	1						1		2	3	1

Syllabus

Unit No	**Contents**	**Mapped CO s**
I	**MECHANICAL ENGINEERING DESIGN:** Basic Procedure of Machine Design, Basic Requirements of Machine Elements, Design of Machine Elements, Traditional Design Methods, Design Synthesis, Use of Standards in Design, Selection of Preferred Sizes, esthetic Considerations in Design, Ergonomic Considerations in Design. **MECHANICAL PROPERTIES OF ENGINEERING MATERIALS,** BIS System of Designation of Steels, Selection of Material, Selection of Manufacturing Method.	CO1
II	**DESIGN FOR STATIC LOADS:** Modes of failure, design of components subjected to axial, bending, torsional loads. Theories of failure for static loads. **DESIGN FOR DYNAMIC LOADS:** Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, fatigue design for infinite	CO 2

	life. Fatigue theories of failure. Soderberg, Goodman and modified Goodman criterion for fatigue failure.	
III	**RIVETED JOINTS:** Types of riveted joints, Types of Failure, efficiency of riveted joint, eccentrically loaded riveted joints. **BOLTED JOINTS:** Load on bolt due to initial tightening, external loading, combined loading, eccentrically loaded bolted joints in shear, Eccentric load perpendicular to axis of bolt. **WELDED JOINTS:** Types of welded joints, Strength of Parallel Fillet welds, Strength of Transverse Fillet welds, Axially Loaded Unsymmetrical Welded Joints, eccentrically loaded welded joints	CO3
IV	**COTTER JOINTS:** Types of cotter joints, Design of Socket and Spigot Joint, Design of Sleeve and Cotter Joint, Design of Gib and Cotter Joint, knuckle joint **SPUR GEARS AND HELICAL GEARS:** Gear Terminology, Module and Face width-power rating calculations based on strength and wear considerations – Helical Gears – Pressure angle in the normal and transverse plane Equivalent number of teeth-. Estimating the size of the spur and helical gears.	CO4
V	**SPRINGS:** Types of springs, Terminology of Helical Springs, Styles of End, Stress and Deflection Equations, Series and parallel Connections, Design of Helical springs, Design against Fluctuating load, Leaf springs, Design of Leaf spring, nipping of Leaf Spring	CO5

Learning Recourse(s)
Text Book(s)
1. V.B. Bhandari, Design of Machine Elements, 3/e, Tata McGraw Hill, 2010.
Reference Book(s)
1. J.E. Shigley, Mechanical Engineering Design, 2/e, Tata McGraw Hill, 1986. 2. R.L. Norton, Machine Design an Integrated approach, 2/e, Pearson Education, 2004. 3. M.F.Spotts and T.E.Shoup, Design of Machine Elements, 3/e, Prentice Hall (Pearson education), 2013.
e-Resources & other digital material
1. http://ecoursesonline.iasri.res.in/course/view.php?id=521 2. https://nptel.ac.in/courses/112/105/112105124/ 3. https://nptel.ac.in/courses/112/105/112105125/

PVP 19

RENEWABLE ENERGY TECHNOLOGY

Course Code	19ME4602A	**Year**	III	**Semester**	II
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Classify Solar collectors and Solar energy storage methods.	L2
CO2	Explain the basic concepts of Wind Energy and Biomass Energy.	L2
CO3	Summarize fuel cell construction and working principles	L2
CO4	Generalize the fundamentals of Geothermal Energy and Ocean Energy.	L2
CO5	Illustrate different energy conversion Techniques	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H: High, M: Medium, L: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1		2		3	3					2	2	2
CO2	2					3	3					2	2	2
CO3	2	2	2	1	2	3	3					2	2	2
CO4	2					3	3					2	2	2
CO5	3	2	2	1	1	3	3					2	2	2

Syllabus

Unit No	**Contents**	**Mapped CO**
I	**ROLE AND POTENTIAL OF NEW AND RENEWABLE SOURCES**. Solar Energy: introduction- Solar Energy option, Solar energy collection-Flat plate collectors, Evacuated Tube Collectors, and concentrating collectors, classification of concentrating collectors-, Compound parabolic Collectors, Parabolic Throughs, Fresnel lens collector, Paraboloid dish collector. **SOLAR ENERGY STORAGE**- Different methods, sensible, latent heat and stratified storage, solar ponds: working principle. Solar applications- solar heating/ cooling techniques, solar distillation and drying	CO1
II	**WIND ENERGY**: Sources and potentials, classification of wind mills- horizontal and vertical axis wind mills, effect of wind speed on power generation, considerations for site selection, **BIO MASS ENERGY**: Properties, principles of production, classification- fixed dome-floating type, comparison, site selection, Plant models in India: floating gas holder- KVIC, fixed dome - Janata type, pragati model, deenbandhu model, constraints for implementation, Factors effecting biomass digestion.	CO2

III	**FUEL CELLS:** Principle of fuel cells, Faraday's laws, thermodynamic aspects. Performance limiting factors of fuel cells-reactivity-invariance, electrode losses-chemical polarization-concentration polarization-resistance polarization, **TYPES OF FUEL CELLS:** hydrogen-oxygen fuel cells: Proton exchange membrane fuel cell (PEMFC), Redox fuel cell (RFC), Phosphoric acid fuel cell (PFC); biochemical cells- depolarixatiori or concentration cell, product cell, and redox cell; Regenerative cells	CO3
IV	**GEOTHERMAL ENERGY**: Origin and Distribution of Geothermal Energy, Types of Geothermal Resources- Hydrothermal Resources, Geopressured Resources, Hot Dry Rock Resources, Magma Resources, Types of wells, , potential in India. **OCEAN ENERGY** **OTEC:** Principles, utilization, setting of OTEC plants, thermodynamic cycles. **Tidal Energy**: Origin and Potential, conversion techniques: types of basins **Wave Energy:** Origin and Potential, conversion techniques: Heaving Float type, pitching type, Heaving and Pitching type, Oscillating water column type, Surge devices.	CO4
V	**DIRECT ENERGY CONVERSION**: Need for DEC, limitations, principles of DEC. Thermoelectric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, Thermionic Generator. **MHD POWER CONVERSION:** MHD generators- principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator- construction and working, Advantages and limitations.	CO5

Learning Recourse(s)
Text Book(s)
1. G.D.Rai , Non-Conventional Energy Sources, Khanna publishers. 2. B. H. Khan, Non-Conventional Energy Sources, Tata Mc Graw Hill-2009
Reference Book(s)
1. S. Rao, Energy Technology – Non-Conventional, Renewable & Conventional, Khanna publishers. 2. S. P. Sukhame, Solar Energy- Principles and Applications, Tata Mc Graw Hill- 2006 3. G.N Tiwari and M.K Ghosal, Renewable energy resources, Narosa Publishing House-2005 4. M.P. Agrawal, Future Sources of Electrical Power, 1st edition, S. Chand & Co., 1999.
e-Resources & other digital material
1. https://nptel.ac.in/courses/121/106/121106014/ 2. https://nptel.ac.in/courses/112/105/112105050/ 3. https://nptel.ac.in/courses/108/108/108108078/

PVP 19

DESIGN OF TRANSMISSION SYSTEMS

Course Code	19ME4602B	**Year**	III	**Semester**	II
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Analyze and Design shafts, keys and couplings under loading conditions	L3
CO2	Select suitable belt drives and associated elements from manufacturers catalogues under given loading conditions	L3
CO3	Select suitable bearings and its constituents from manufacturers catalogues under given loading conditions	L4
CO4	Analyze friction clutches and power screws subjected to loading conditions	L3
CO5	Apply the design concepts to estimate the size of the bevel and worm gears	L4

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	1	1									3	1
CO2	3	3	1	1									3	1
CO3	3	3	1	1									3	1
CO4	3	3	1	1									3	1
CO5	3	3	1	1									3	1

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**SHAFTS:** Design of solid and hollow shafts for strength – For Bending, Torsion, Combined bending and torsion and combined bending, torsion and axial loads **KEYS & COUPLINGS:** Types of keys, Design of square and flat keys, Rigid couplings – Muff, split muff and Flange couplings, Flexible coupling- Bushed-Pin Flexible coupling.	CO1
II	**BELT AND CHAIN DRIVES:** Belts and their construction. Flat belts versus V- belts. Open and cross belt arrangements. Ratio of tensions, centrifugal tension, effect of centrifugal tension. Design of belts. Chain Drives: Roller chains, geometric relationships, polygonal effect of chain, power rating and design of chain drives.	CO 2
III	**SLIDING CONTACT BEARINGS:** Types of Bearings, bearing materials, Lubrication, types of lubricants, properties of lubricants, Lubrication modes, bearing modulus, McKee's equations, design of journal bearing. Bearing Failures.	CO3

	ROLLING CONTACT BEARINGS: Static and dynamic load capacity, Stribeck's Equation, equivalent bearing load, load-life relationships, load factor, selection of bearings from manufacturer's catalogue.	
IV	**FRICTION CLUTCHES:** Torque transmitting capacity of disc and centrifugal clutches. Uniform wear theory and uniform pressure theory. **POWER SCREWS:** Forms of threads – Torque required to lift and lower the load, self-locking screw, efficiency, collar friction, Design of screw and Nut, Design of Screw Jack.	CO4
V	**BEVEL AND WORM GEARS:** Straight bevel gear - tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: terminology, Merits and demerits. Design procedure and problems based on strength and wear considerations.	CO5

Learning Recourse(s)
Text Book(s)
1. V.B. Bhandari, Design of Machine Elements, 3/e, Tata McGraw Hill, 2010.
Reference Book(s)
1. J.E. Shigley, Mechanical Engineering Design, 2/e, Tata McGraw Hill, 1986. 2. R.L. Norton, Machine Design an Integrated approach, 2/e, Pearson Education, 2004. 3. M.F.Spotts and T.E.Shoup, Design of Machine Elements, 3/e, Prentice Hall (Pearson education), 2013.
e-Resources & other digital material
1. http://ecoursesonline.iasri.res.in/course/view.php?id=521 2. https://nptel.ac.in/courses/112/105/112105124/ 3. https://nptel.ac.in/courses/112/105/112105125/

PVP 19

MODERN MACHINING METHODS

Course Code	19ME4602C	**Year**	III	**Semester**	II
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		
Upon successful completion of the course, the student will be able to		
CO1	Illustrate advanced machining processes, mechanism of Mechanical machining processes, its applications and limitations.	L2
CO2	Classify the Electro Chemical machining process, economic aspects of ECM.	L2
CO3	Interpret Thermal Metal Removal Processes, characteristics of spark eroded surface & machine tool selection.	L3
CO4	Relate Generation and control of electron beam and laser beam and Plasma Arc for various machining applications.	L3

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2		2							2	2	1
CO2	3		2		2							2	2	2
CO3	3		2		2							2	2	1
CO4	2		2		2							2	2	1

Syllabus		
Unit No	**Contents**	**Mapped CO s**
1	**INTRODUCTION:** Need for non-traditional machining methods, Classification of modern machining processes, considerations in process selection, Materials, Applications. **ULTRASONIC MACHINING-**Elements of the process, mechanics of metal removal, process parameters, economic considerations, applications and limitations, recent developments.	CO1
II	**ABRASIVE JET MACHINING, WATER JET MACHINING AND ABRASIVEWATERJET MACHINEING:** Basic principles, equipment's, process variables, mechanics of metal removal, MRR, application and limitations, Magnetic abrasive finishing, Abrasive flow finishing.	CO2
III	**ELECTRO–CHEMICAL PROCESSES**: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM–Simple problems for estimation of metal removal rate. Electro stream drilling, Shaped tube electrolytic machining: Basic Principle of operation, advantages, disadvantages and applications.	CO3

	CHEMICAL MACHINING: Principle, maskants, etchants and applications.	
IV	**THERMAL METAL REMOVAL PROCESSES:** General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods, surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications. Comparison of thermal and non-thermal processes.	CO4
V	**ELECTRON BEAM MACHINING:** Generation and control of electron beam for machining, theory of electron beam machining. **LASER BEAM MACHINING:** General Principle and application of laser beam machining, thermal features, cutting speed and accuracy of cut. **PLASMA ARC MACHINING**: Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish, other applications of plasma in manufacturing industries.	CO5

Learning Recourse(s)
Text Book(s)
1. VK Jain, "Advanced machining processes", Allied publishers, New Delhi,2005. 2. Hasan Abadel, Gawad El – Hofy, "Advanced Machining Processes", , Mc Graw-Hill
Reference Book(s)
1. Pandey P.C. and Shah H.S, "Modern Machining Process", Tata McGraw-Hill Publishing. 1984 2. McGeough, J. A, "Advanced Methods of Machining" Springer publisher; 1988
e-Resources & other digital material
1. https://nptel.ac.in/courses/112/104/112104204/

PLANT LAYOUT AND FACILITIES PLANNING

Course Code	19ME4602D	**Year**	III	**Semester**	II
Course Category	Engineering Sciences	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Explain the concept of plant location selection and Layout planning.	L2
CO2	Apply numerical methods and optimize layout planning.	L3
CO3	Illustrate material handling systems in manufacturing firms.	L2
CO4	Estimate number of stations, production rate and cycle time for a given assembly line.	L2
CO5	Develop a best layout using line balancing algorithms.	L3

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	1					1	1			3	3
CO2	3	3	3	1					1	1			3	3
CO3	3												3	1
CO4	3	3	3	1					1	1			3	3
CO5	3	3	3	1					1	1			3	3

Syllabus		
Unit No.	**Contents**	**Mapped CO s**
I	**PLANT ENGINEERING:** Plant Layout, Introduction, Types of Plant Layout, Phases of Layout Planning, Plant Location, Urban v/s Rural Location, Single facility location problems, Multifacility location Problems.	CO1
11	**SYSTEMATIC LAYOUT PLANNING:** P-Q Analysis, Flow of Materials Analysis, Activity Relationship Analysis, Space Requirements & Availability, Modifying Considerations, Practical Limitations, Selection of Layout, Installation of Layout, CORELAP, CRAFT, ALDEP Algorithms Procedure and application, Problems.	CO 2
III	**MATERIAL HANDLING:** Functions, Principles of Material Handling, MH Equipment-Conveyors, MH Equipment-Cranes, MH Equipment-Trucks, Systematic Handling Analysis, Classification of Materials.	CO3
IV	**MASS PRODUCTION MANAGEMENT (LINE BALANCING):** Basic idea of assembly line balancing, Optimization of number of stations with given production rate, Minimization of cycle time with fixed number of stations.	CO4
V	**LINE BALANCING ALGORITHMS**: Kilbridge and Wester, Rank Positional Weight method, COMSOAL, Moodie and Young method.	CO5

Learning Recourse(s)
Text Book(s)
1. J.M. Apple, Plant Layout and Material Handling, McGraw Hill, 1972. 2. R. Panneerselvam, Production and operations management,3rd Edition, Prentice Hall Inc, 2012.
Reference Book(s)
1. R.L Francis and J.A White, Facilities layout and location: An analytical approach, Prentice Hall, 1992. 2. P. Rama Murthy, Production and operations management, 2nd Edition, New Age International, 2006.
e-Resources & other digital material
1. https://alison.com/course/fundamentals-of-plant-layout-in-industrial-engineering 2. https://www.youtube.com/watch?v=-aGk5-yx340 3. https://www.youtube.com/watch?v=swk6Fo-BoSA

ENGINEERING ETHICS

Course Code	19MC1601	**Year**	III	**Semester**	II
Course Category	Mandatory Course	**Branch**	ME	**Course Type**	Theory
Credits	0	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	100	**Semester End Evaluation**	0	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Understand the core values that shape the ethical behavior of an engineer and Exposed awareness on professional ethics and human values	L2
CO2	Understand the basic perception of profession, professional ethics, various moral issues &uses of ethical theories	L2
CO3	Understand various social issues, Industrial standards, code of ethics and role of professional ethics in engineering field	L2
CO4	Demonstrate responsibilities of an engineer for safety and risk benefit analysis, professional rights and responsibilities of an engineer	L3
CO5	Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives	L3

	Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						1	1	3	1	2				3
CO2						1	1	3	1	2				3
CO3						3	2	3		1				3
CO4						3	2	1						3
CO5						3	2	2		1	3			3

Syllabus		
Unit No	**Contents**	**Mapped Cos**
I	**HUMAN VALUES** Morals, values and Ethics –Integrity –Work ethic –Service learning –Civic virtue –Respect for others –Living peacefully –Caring –Sharing –Honesty –Courage –Valuing time –Cooperation –Commitment –Empathy –Self-confidence –Character –Spirituality –Introduction to Yoga and meditation for professional excellence and stress management.	CO1
II	**ENGINEERING ETHICS** Senses of „Engineering Ethics" –Variety of moral issues –Types of inquiry –Moral dilemmas –Moral Autonomy –Kohlberg"s theory –Gilligan"s theory –Consensus and Controversy –Models of professional roles –Theories about right action –Self-interest –Customs and Religion –Uses of Ethical Theories.	CO2

III	**ENGINEERING AS SOCIAL EXPERIMENTATION** Engineering as Experimentation –Engineers as responsible Experimenters – Codes of Ethics –A Balanced Outlook on Law.	CO3
IV	**SAFETY, RESPONSIBILITIESAND RIGHTS** Safety and Risk –Assessment of Safety and Risk –Risk Benefit Analysis and Reducing Risk –Respect for Authority –Collective Bargaining – Confidentiality –Conflicts of Interest –Occupational Crime –Professional Rights –Employee Rights –Intellectual Property Rights (IPR) – Discrimination.	CO4
V	**GLOBAL ISSUES** MultinationalCorporations–BusinessEthics-EnvironmentalEthics– ComputerEthics-Role in Technological Development–Weapons Development–Engineers as Managers–Consulting Engineers–Engineers as Expert Witnesses and Advisors–Honesty –Moral Leadership–Sample Code of Conduct.	CO5

Learning Recourse(s)

Text Book(s)

1. Mike W. Martin and Roland Scherzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

Reference Book(s)

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009

e-Resources & other digital material

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

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ENVIRONMENTAL MANAGEMENT

Course Code	19ES5601A	**Year**	III	**Semester**	II
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Analyze the sources and composition of Municipal Solid Waste	L2
CO2	Distinguish between different solid waste management methods and relate its effect on soil	L3
CO3	Determine different types of Hazardous wastes and their safe disposal methods	L2
CO4	Illustrate importance of EIA and its assessment methodologies	L2
CO5	Assess impacts of air and water and their significance	L3

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1		1		2	2					1	2
CO2	3		2		2		2	2					1	2
CO3	3		2		1		2	2					1	2
CO4	3		1		1		2		1				1	2
CO5	3		1		1		2		1				1	2

Syllabus		
Unit No	**Contents**	**Mapped CO s**
I	**INTRODUCTION**: Sources and types of municipal solid wastes-waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization, segregation of solid wastes – source reduction of waste – objectives of waste processing, elements of solid waste management – municipal and bio medical solid waste rules – public role in solid waste management.	CO1
II	**RESOURCE RECOVERY FROM SOLID WASTE COMPOSTING AND BIO METHANATION**: materials- soil pollution: sources, types of soil pollution, effects of fertilizers, pesticides and radioactive material on soils, land disposal of solid waste; sanitary landfills – site selection; landfill liners – management of leachate.	CO 2
III	**HAZARDOUS WASTE MANAGEMENT**: Sources and types of hazardous waste characteristics of hazardous wastes; collection-handling-processing techniques-disposal methods; hospital waste	CO3

	management - processing techniques - disposal.	
IV	**CONCEPTUAL FACTS OF EIA**: Introduction, definition and scope of EIA objectives in EIA, basic EIA principles, classification of EIA, strategic EIA (SEIA), regional EIA, sectoral EIA, project level EIA and life cycle assessment, project cycle, Environmental baseline monitoring (EBM), preliminary study to determine impact significance, Impact Assessment Methodologies.	CO4
V	**PREDICTION OF IMPACTS (AIR AND WATER):** Air and water environment, sources and basic information on water and air conceptual approach for addressing air and water environment impacts, assessment of impacts air, water, noise, soil, biological and socioeconomic impacts, assessment of impact significance.	CO5

Learning Recourse(s)
Text Book(s)
1. Hilary Theisen& Samuel A, "Vigil. McGraw Integrated Solid waste management", GoergeTchobanolous, Hill International Editions 2. Y. Anjaneyulu, Environmental Impact Assessment, B.S. Publications, 2003.
Reference Book(s)
1. CPCB Manual on solid waste Management 2. Technological guidance manuals of EIA, MoEF 3. M. Anjireddy, Textbook of Environmental Science and Technology, BS Publications, 2010.
e-Resources & other digital material
1. www.nptel.ac.in/courses/120108005 2. nptel.ac.in/courses/10510605 3. https://www.coursera.org/learn/solid-waste-management

TELECOMMUNICATIONS FOR SOCIETY

Course Code	19ES5601B	**Year**	III	**Semester**	II
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Infer the basic knowledge of telecommunication system, regulation and standards of telecom regulatory bodies	L2
CO2	Able to deduce cost of different devices such as mobile, Wi-Fi and DTH operators and carry out investigation of Frequency Management and Business on Bandwidth.	L3
CO3	Make use of revolutionary changes in mobile and wireless technologies to understand recent developments.	L3
CO4	Examine different optical communication components.	L4
CO5	Justify the use of satellite orbits, different components and sub-systems in advanced communication systems .	L4

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2								2	2	2
CO2	3	3	2	2								2	2	2
CO3	3	3	2	2								2	2	2
CO4	3	3	2	2								2	2	2
CO5	3	3	2	2								2	2	2

Syllabus		
Unit No	**Contents**	**Mapped CO s**
1	**TELECOMMUNICATION SYSTEMS:** Telephones, Telephone System, Facsimile, Internet Telephony. Telecommunication Standards and Regulations - International telecommunication union (ITU) - TRAI and its role – Frequency management – Cost computations – Mobile and DTH operations – Role of wireless planning commission (WPC) for telecommunications in India.	CO1
11	**TELECOM BUSINESS MANAGEMENT:** Automated teller machines – Teleconferencing – Telecommuting –Customer oriented communication aspects – Telecom billing - Concepts of data rate and bandwidth requirements – Digital subscriber line – Broadband technologies – Digital home – Voice enabled DSL.	CO 2
III	**CELL PHONE TECHNOLOGIES**: Cellular Telephone Systems, A Cellular Industry Overview, 2G and 3G Digital Cell Phone Systems,	CO3

	Long Term Evolution and 4G Cellular Systems **WIRELESS TECHNOLOGIES:** Wireless LAN, PANs and Bluetooth,ZigBee and Mesh Wireless Networks,WiMAX and Wireless Metropolitan-Area Networks	
IV	**OPTICAL COMMUNICATION:** Optical Principles, Optical Communication Systems, Fiber-Optic Cables, Optical Transmitters and Receivers.	CO4
V	**SATELLITE COMMUNICATION:** Satellite Orbits, Satellite Communication Systems, Satellite Subsystems, Ground Stations, Satellite Applications, Global Navigation Satellite Systems.	CO5

Learning Recourse(s)

Text Book(s)

1. Louis E. Frenzel Jr., Principles of Electronic Communication Systems, 4/e, Mc Graw Hill Publications, McGraw-Hill Education, 2016.
2. Willium C. Y. Lee, "Wireless & Cellular Telecommunications", McGraw-Hill Companies Inc, Third Edition, 2006.

Reference Book(s)

1. Wayne Tomasi, Electronic Communication Systems, 5/e, Pearson Education, 2009.
2. Wayne Tomasi, Advanced Electronic Communication Systems, 4/e, Pearson Education, 2013.
3. Dennis Roddy, Electronic Communications, 4/e, Pearson Education, 2003

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ANALYTICAL ESSAY WRITING

Course Code	19HS5601C	**Year**	III	**Semester**	II
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Understand the meaning of analysis and how to analyze the content of essays, paragraphs, reviews, books, articles etc.	L2
CO2	Classify various types of analytical topics according to context and make reports. Organize the topic and prepare hypothesis	L3
CO3	Construct meaningful arguments by following thematic information and suitable language	L3
CO4	Analyze thesis statement, topic sentences, evidence, and supporting ideas.	L4
CO5	Distinguish the general essays from analytical essays and reorganize the content.	L4

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1										1		1		
CO2										3		2		
CO3										3		2		
CO4										3		1		
CO5										3		3		

Syllabus		
Unit No.	**Contents**	**Mapped CO s**
I	Identifying the topic sentences – meaning of analysis – History of essay writing – Different types of essays – Role of analytical essays	CO1, CO5
II	Fundamental prose skills – explore the content – discover various approaches in writing essays – Hypothesis of the topic or research	CO1, CO2, CO5
III	Discussing and emulating different topics – traditional methods of essay writing – sophisticated way to present the topics	CO1, CO3 CO4
IV	Analyze the essays – anthology of essays – Using analytical essays in different contexts – Competitive exams orientation – Comprehensive questions	CO1, CO4, CO5
V	Types of essays – differentiation of essays – contemporary essayists like Hazlitt, David Foster Wallace, Montaigne, Jawaharlal Nehru, Jiddu Krishna Murthy, Iris Murdoch, Woolf Bacon, RW Emerson, Samuel Johnson, George Orwell, James Baldwin, Agatha Christie, Jane Austen	CO1, CO2, CO5

	etc.	

Learning Recourse(s)
Reference Book(s)
1. Ariel Levy, ed., The Best American Essays 2015, Houghton Mifflin, 2015 2. Philip Lopate, ed., The Art of the Personal Essay (Anchor Books 1997) 3. David Foster Wallace, Consider the Lobster and Other Essays, Back Bay Books, 2007 4. Revising Prose by Richard Lanham 5. 100 ways to improve your writing by Gary Provost 6. Bird by Bird by Anne Lamott 7. The Sense of Style by Steven Pinker
e-Resources & other digital material
1. https://canvas.harvard.edu/courses/8124 2. https://boomessays.com/blog/how-write-analytical-essay#definition 3. https://www.ranker.com/list/best-essayists/ranker-books

INDIAN ECONOMY

Course Code	19HS5601D	Year	III	Semester	II
Course Category	Open Elective	Branch	ME	Course Type	Theory
Credits	3	L – T – P	3 – 0 – 0	Prerequisites	Nil
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes		Levels
Upon successful completion of the course, the student will be able to		
CO1	To understanding of the fundamental concepts Indian economy and theoretical background.	L2
CO2	The ability to apply knowledge to evaluate the impact of the population, unemployment and poverty on the economic development.	L3
CO3	To understanding of the role of public and private sector in the Indian economy.	L2
CO4	To awareness on structure and growth of capital market in India industrial growth, how to align the management of a supply chain with corporate goals and strategies.	L2
CO5	The capability in the analyze Public expenditure trends, issues and Assessment of Indian planning.	L3

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2								3	3	
CO2	3	3		2								3	3	
CO3	3	3		2								3	3	
CO4	3	3		2								3	3	
CO5	3	3		2								3	3	

Syllabus		
Unit No	Contents	Mapped CO s
I	**ECONOMIC DEVELOPMENT: A THEORETICAL BACK GROUND:** Economic growth, development and underdevelopment. characteristics of under developed and developing countries. Nature of the Indian economy, role of natural resources in economic development. Environmental protection and sustainable development.	CO1
II	**POPULATION AND HUMAN DEVELOPMENT:** Indian population size and growth trends, reasons of the rapid growth of population, population and economic development. Employment and unemployment in India, the concept of poverty and rural poverty, income distribution in India.	CO 2
III	**INDUSTRIAL SECTOR AND SERVICES IN INDIAN ECONOMY:** various industrial policies, role of public and private	CO3

	sector in the Indian economy, LPG policy 1991, Industrial sickness in India. foreign trade and foreign capital, Balance of payments, WTO and India.	
IV	**MONEY AND BANKING:** characteristics of the Indian money market, price trends and inflation, commercial banking in India. Capital market in India, structure and growth of capital market in India industrial growth, RBI, Evolutional of institutional financing in India.	CO4
V	**PUBLIC FINANCE, ECONOMIC PLANNING AND POLICY:** fiscal policy and monetary policy, Indian tax structure. Public expenditure trends and issues. **ECONOMIC PLANNING AND POLICY:** Evaluation of the objectives of economic planning, important features of Indian plans, Assessment of Indian planning.	CO5

Learning Recourse(s)

Text Book(s)

1. Misra and Puri Indian economy Himalaya Publishing House twenty eight revised and updated edition 2010.
2. T. Dyson, 2008, –India‘s Demographic Transition and its Consequences for Development in Uma Kapila, editor, Indian Economy Since Independence, 19th edition, Academic Foundation.
3. Dr. S.K. Singh/Prof. T.N. Jha/Dr. vinita Singh Economic Development 21st Century Edition.
4. A. Musgrave and P.B. Musgrave, Public Finance in Theory & Practice,Mc Graw Hill Publications, 5th edition, 1989.

PUBLIC ADMINISTRATION

Course Code	19HS5601E	**Year**	III	**Semester**	II
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Describe the scope and significance of public administration	L2
CO2	Explain different administrative thoughts.	L2
CO3	Illustrate accountability and control over administration by different groups in society	L2
CO4	Explain the concepts of union and state government administration	L2
CO5	Summarize the administration process in civil services	L2

	Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						2		3	3		1			2
CO2						2		3	3		1			2
CO3						2		3	3		1			2
CO4						2		3	3		1			2
CO5						2		3	3		1			2

Syllabus		
Unit No.	**Contents**	**Mapped CO s**
I	**MODULE-1** Introduction: Meaning, Scope and Significance of Public Administration, evolution discipline and its present status, challenges of liberalization, privatization and globalization, good governance, electronic governance, concepts and applications, New Public Management (NPM)	CO1
II	**MODULE 2**: Administrative Thought: Scientific Management Theory, Classical Theory, Bureaucratic Theory, Human Relations Theory, Systems theory.	CO 2
III	**MODULE 3**: Accountability and control, Legislative, executive and judicial control over administration, role of media, Interest groups, NGOs, Civil society, Right to Information Act (RTI), Social audit, citizen chapter.	CO3
IV	**MODULE 4**: Union and State Government Administration: President, Prime minister, Council of Ministers, Cabinet, Central and State Secretariats,	CO4

	Boards and commissions, governor and chief minister, council of ministers, central-state relations, finance commission, Neeti ayog	
V	**MODULE 5:** Civil Services: Recruitment, Training and other conditions of service, district administration, role of collector, local self-governing institutes-73rd and 74th constitutional amendments act.	CO5

Learning Recourse(s)
Text Book(s)
1. Avasthi & Maheshwari (2012), Public Administration, Lakshminarayan Agarwal, Agra 2. B. L. Fadia, Kuldeep Fadia, Indian Administration, 8/e, Sahitya Bhavan, India, 2004
Reference Book(s)
1. Henry, Nicholas (2006), Public Administration and Public Affairs, Prentice Hall of India, New Delhi 2. Ravindra Prasad, D. Prasad, VSPrasad, Satyanarayana P, and Y.Pardhasaradhi, (eds.,)(2013), Administrative Thinkers, Sterling, New Delhi. 3. Basu, D.D. (2000), Introduction to the Constitution of India, Wadhwa and Company, New Delhi 4. Ramesh K. Arora and Rajni Goyal (2002), Indian Public Administration, Vishwa Parkashan, New Delhi..

NATIONAL SERVICE SCHEME (N.S.S.)

Course Code	19HS5601F	**Year**	III	**Semester**	II
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Understand the community in which they work and their relation.	L2
CO2	Identify the needs and problems of the community and involve them in problem-solving.	L3
CO3	Develop capacity to meet emergencies and natural disasters.	L3
CO4	Take part in national integration and social harmony.	L4
CO5	Apply their knowledge in finding practical solutions to individual and community problems.	L4

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						3	2					1	1	
CO2						3	2					1	1	
CO3						3	2					1	1	
CO4						3	2					1	1	
CO5						3	2					1	1	

Syllabus		
Unit No	**Contents**	**Mapped CO s**
1	**NATIONAL SERVICE SCHEME** A) History and its Objectives B) Organizational structure of N.S.S. at National, State, University and College Levels C) Advisory committee and their functions with special reference to college principal, Programme officer, N.S.S. group leader and N.S.S. volunteers in the implementation.	CO1, CO2, CO5
11	**NATIONAL INTEGRATION** A) Need of National integration B) Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc.	CO1 CO2, CO4
III	**N.S.S. REGULAR ACTIVITIES** A) Traffic regulation B) Working with Police Commissioner's Office C) Working with Municipal Corporation of Vijayawada D) Working with Health Department	CO1, CO3, CO4

	E) Blind assistance F) Garments collection G) Non-formal education H) 'Environmental Education, Awareness and Training (EEAT)' I) Blood donation	
IV	**SPECIAL CAMPING PROGRAMME** A) Nature and its objectives B) Selection of camp site and physical arrangement C) Organization of N.S.S. camp through various committees and discipline in the camp. D) Activities to be undertaken during the N.S.S. camp. E) Use of the mass media in the N.S.S. activities.	CO1, CO3, CO5
V	**SPECIAL PROGRAMME** A) Legal awareness B) Health awareness C) First-aid D) Career guidance E) Leadership training - cum - Cultural Programme F) Globalization and its Economic Social Political and Cultural impacts.	CO1, CO2, CO5

Learning Recourse(s)
Text Book(s)
1. National Service Scheme Manual, Government of India.
Reference Book(s)
1. Training Programme on National Programme scheme, TISS. 2. Orientation Courses for N.S.S. Programme officers, TISS. 3. Case material as Training Aid for field workers, Gurmeet Hans. 4. Social service opportunities in Hospitals, Kapil K.Krishan, TISS. 5. 5. Social Problems in India, Ram Ahuja.

PROFESSIONAL COMMUNICATION

Course Code	19HS5601G	Year	III	Semester	II
Course Category	Open Elective	Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	NIL
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes		Levels
Upon successful completion of the course, the student will be able to:		
CO1	Communicate proficiently in interviews and all social situations.	L2
CO2	Demonstrate an ability to use effective verbal and non-verbal communication skills.	L3
CO3	Use the formats, strategies and possible content of business communication at work place.	L3
CO4	Prepare professional documents including web related(On-line) communication.	L4
CO5	lAnalyze texts, diagrams and improve both reading and writing skills which would help in academics as well as professional career.	L4

ıtion of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (H-High3, M-Medium-2, L- Low-1)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1														
CO2									3	3		3		
CO3									3	3		3		
CO4									3	3		3		
CO5									3	3		3		

Syllabus		
Unit No.	**Contents**	**COs**
I	➢ Verbal communication – conciseness, clarity, correctness ➢ Non-verbal communication – body language ➢ Barriers to communication ➢ Reading Short Passages, News Articles, Technical Papers and Short Stories - Note making and note taking.	CO1, CO2, CO5
II	➢ Professional Letters – Purpose, Style and format. ➢ E- mail – format and etiquette. ➢ Presentation skills ➢ Group discussion	CO1, CO3, CO4
III	➢ Technical Report writing – Types: Business/Technical, Components, Style and Formats – Writing a Technical Proposal. ➢ Administrative drafting and correspondence - Memos, Minutes and Web notes.	CO1, CO3, CO4
IV	➢ Information transfer.	CO1,

	➢ Meeting skills ➢ Team dynamics	CO2, CO5
V	➢ Job application - Resume – Structure of Resume/CV – covering letter – writing SOPs. ➢ Interview Skills: types of interviews, successful interviews, interview etiquette, dress code, body language, telephone/online interviews, one-to-one interview & panel interview, FAQs related to job interviews, answering strategies.	CO1, CO2, CO4

Learning resources
Reference Books:
1. Basu B.N. Technical Writing, 2011 Kindle edition 2. C Muralikrishna & Sunitha Mishra, Communication Skills for Engineers, 2 nd edition, NY: Pearson, 2011. 3. Bailey, Stephen. *Academic writing: A handbook for international students*. Routledge, 2014. 4. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
e- Resources & other digital material:
1. https://www.britishcouncil.org/english 2 http://www.5minuteenglish.com/ 3. http://www.bbc.co.uk/learningenglish/ 4. http://www.better-english.com/ 5. http://www.nonstopenglish.com/ 6. https://www.usingenglish.com/comprehension/ 7. https://www.englishclub.com/reading/short-stories.htm 8. https://www.english-online.at/ 9. https://www.englishclub.com/ 10. http://www.world-english.org/ http://learnenglish.britishcouncil.org/ Online Dictionaries: Cambridge dictionary online; MacMillan dictionary; Oxford learner's dictionaries

PVP 19

BASICS OF FINANCE

Course Code	19HS5601H	**Year**	III	**Semester**	II
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	To understanding of the basics of finance and objective of finical management	L2
CO2	The ability knowledge in financial planning and implementation of financial plans	L3
CO3	To understanding problems of over-capitalisation and under-capitalisation	L3
CO4	To know about time value of money and financial forecast	L4
CO5	The capability to analyse various sources of loans and identify the best source of loan for finance.	L4

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3		2								3	3	
CO2	3	3		2								3	3	
CO3	3	3		2								3	3	
CO4	3	3		2								3	3	
CO5	3	3		2								3	3	

Syllabus		
Unit No	**Contents**	**Mapped CO s**
I	**INTRODUCTION:** Business Finance Defined-Traditional and Modern Views; Scope and Functions of Finance; Finance Function vs. Accounting Function; Objectives of Financial Management-Profit Maximization vs. Wealth Maximization.	CO1
II	**FINANCIAL PLANNING:** Concept of Financial Planning; Process of Financial Planning; Characteristics of Sound Financial Plans; Factors Affecting Financial Plan.	CO2
III	**CAPITALISATION AND CAPITAL STRUCTURE**: Concept, Nature and Scope of Capitalisation; Earnings Theory and Cost Theory of Capitalisation; Over-Capitalisation; Under-Capitalisation; Capital Structure Theories and Factors Determining Capital Structure	CO3
IV	**FINANCIAL FORECASTING AND TIME VALUE of Money**: Concept of Financial Forecasting; Sales Forecast; Income Forecast; Financial Position Forecast; Forecasting for Growth and External Funds Requirements; Time Value of Money-Discounting and Compounding.	CO4
V	**PATTERN OF CAPITAL REQUIREMENTS**: Long-Term and	CO5

	Medium-Term Financing – Purpose, Sources and Instruments; Short-Term Financing-Purpose, Sources and Instruments.	

Learning Recourse(s)

Text Book(s)

1. Brealey, Richard A and Steward C. Myers: Corporate Finance, McGraw Hill, Int.Ed., New York.
2. Chandra, Prasanna : Financial management, Tata Mc Graw Hill, Delhi.
3. Hampton, John: Financial Decision Making, Prentice Hall, Delhi.
4. Pandey, I.M.: Financial Management, Vikas Publishing House, Delhi.
5. Van Horne, J.C. and J.M. Wachowicz Jr. : Fundamentals of Financial Management, Prentice-Hall, Delhi.

Reference Book(s)

1. Van Horne, James C Financial Management ; Harper and Row, New York.
2. Pinches, George E : Essentials of Financial Management ; Harper and Row, New York.
3. Khan MY, Jain PK : Financial Management ; Tata McGraw Hill, New Delhi.
4. Archer, Stephen, H., Chate G Marc, Racette, George; Financial management ; John Wiley, New York.
5. Block, Stanley B, Geoffrey A Hilt : Foundations of Financial Management ; Richard D. Irwin, Homewood.
6.

BASICS OF MARKETING

Course Code	19HS5601I	**Year**	III	**Semester**	II
Course Category	Open Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Understand issues of marketing with an emphasis on learning to develop responsive marketing strategies that meet customer needs	L2
CO2	Make use of the key analytical frameworks and tools used in marketing in relation to segmenting and targeting of products	L3
CO3	Get acquainted with the components of marketing mix, stages in new product development	L3
CO4	Analyse the objectives and methods for pricing products and selecting channel members	L4
CO5	Evaluate the techniques of promotion mix	L4

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1							3	3	2			3		3
CO2							3	3	2			3		3
CO3							3	3	2			3		3
CO4							3	3	2			3		3
CO5							3	3	2			3		3

Syllabus		
Unit No	**Contents**	**Mapped CO s**
I	**INTRODUCTION TO MARKETING**: Definition, Nature, Scope, Importance of Marketing, Core Concepts of Marketing, Philosophies of Marketing.	CO1
II	**MARKET SEGMENTATION:** Targeting and Positioning: Definition, Levels of Segmentation, Bases of Segmentation, Target Market, Positioning Strategies.	CO2
III	**MARKETING MIX:** 4P's, Classification of Products, Product Life Cycle (PLC)-Stages, New Product Development (NPD)- Types, Process	CO3
IV	**PRICING**: Definition, Objectives, Pricing Strategies- Channels of Distribution: Definition, Functions, Levels	CO4
V	**PROMOTION MIX** Definition, Objectives, Importance, Elements, Integrated Marketing Communication(IMC)	CO5

Learning Recourse(s)

Text Book(s)

1. Philip Kotler, Gary Armstrong and Prafulla Agnihotri, Principles of Marketing, Pearson India, 17th Edition. New Delhi: 2018
2. Rajan Saxena, Marketing Management, Tata-McGraw Hill, Fifth Edition New Delhi :2015

Reference Book(s)

1. Etzel, Walker, Stanton &Pandit, "Marketing Concepts & Cases", Tata McGraw Hill, New Delhi.
2. Govindarajan M., "Marketing Management, Concepts, Cases, Challenges and Trends", PHI Private Limited, New Delhi, 2007.
3. Karunakaran, "Marketing Management", Himalaya Publishing House, Mumbai.
4. Charles W. Lamb, Joseph F. Hair, Carl McDaniel, Harish Kapoor, Henry Klaise "MKTG", Cengage Learning, New Delhi, 2012.

e- Resources & other digital material

1. https://nptel.ac.in/courses/110/104/110104068/
2. https://nptel.ac.in/courses/110/107/110107147/
3. https://nptel.ac.in/courses/110/104/110104070/
4.

CAD/CAM LAB

Course code	19ME3651	Year	III	Semester	II
Course category	Program Core	Branch	ME	Course Type	Lab
Credits	1.5	L-T-P	0-0-3	Prerequisites	Nil
Continuous Internal Evaluation	25	Semester End Evaluation	50	Total Marks	75

Course Outcomes		Levels
Upon successful completion of the course, the student will be able to		
CO1	Demonstrate the main stages of Finite Element analysis.	L3
CO2	Perform modeling and analysis of structural and heat transfer problems.	L4
CO3	Machine simple components on CNC machines	L3
CO4	Use CAM software to generate NC code	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3: High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3		2	3				1			2	2	3
CO2	1	3		2	3				1			2	2	3
CO3	1				3				1			2	2	3
CO4	1				3				1			2	2	3

Syllabus

Expt. No	Contents	Mapped CO
	CAD LAB	
1.	Static analysis of indeterminate/ composite bars	CO1 CO2
2.	Shear force and bending moment diagrams of a beam	
3.	Thermal stress in bar.	
4.	static analysis of plane or 3-space truss/frame	
5.	Evaluation of Stress concentration factor in a rectangular plate with central hole	
6.	Stress distribution in thick a cylinder subjected to internal and/external pressures	
	CAM LAB	
7.	Rectangular contouring on XL MILL	CO3
8.	Arbitrary contouring on XL MILL	
9.	Step turning on XLTURN	
10.	Taper Turning on XLTURN	
11.	Rectangular and Arbitrary contouring NC code generation using ESPRIT	CO4
12.	Step turning and Taper Turning NC code generation using ESPRIT	

HEAT TRANSFER LAB

Course code	19ME3652	**Year**	III	**Semester**	II
Course category	Professional Core	**Branch**	ME	**Course Type**	Theory
Credits	1.5	**L – T – P**	0 – 0 – 3	**Prerequisites:**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation:**	70	**Total Marks:**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Evaluate heat transfer through lagged pipe, Insulating powder and Drop and Film wise condensation.	L3
CO2	Experiment the Thermal conductivity of a given metal Rod.	L3
CO3	Measure the Heat transfer coefficient for Pin Fin, Forced convection, Natural Convection and parallel and counter flow heat exchanger.	L3
CO4	Test Emissivity, Stefan Boltzmann Constant and Critical Heat flux.	L3
CO5	To determine the overall heat transfer coefficient for a composite slab.	L3

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2		3									3	3
CO2	1	2		3									3	3
CO3	1	2		3									3	3
CO4	1	2		3									3	3
CO5	1	2		3									3	1

Syllabus		
Expt. No	**Contents**	**Mapped CO**
1.	Determination of Heat Transfer through Lagged Pipe.	CO1
2.	Measurement of Thermal Conductivity for a given Asbestos Insulating powder	
3.	Determination of Heat Transfer through Drop Wise and Film Wise Condensation.	
4.	Determination of Thermal Conductivity for a Given Copper Metal Rod.	CO2
5.	Determination of Heat Transfer through Pin-Fin.	CO3
6.	Determination of Heat Transfer through Forced Convection	
7.	Determination of Heat Transfer through Natural Convection.	
8.	Determination of overall heat transfer coefficient for Parallel and Counter Flow Heat Exchanger.	
9.	Emissivity Measurement	CO4
10.	Measurement of Stefan Boltzmann constant.	
11.	Determination of Critical Heat Flux for a given Nichrome wire.	
12.	Determination of Overall Heat Transfer Co-Efficient for Composite Wall.	CO5

Learning Recourse(s)
Text Book(s)
1. Heat and Mass Transfer by Y.A Cengel, A J Ghajar, Mc Graw Hill education,2011. 2. Heat transfer, by J.P.Holman, TMH publications, 2008 . 3. Heat and Mass Transfer, by Sachdeva, New age International.
Reference Book(s)
1. Engineering Heat & Mass transfer by Mahesh.M.Rathor ,University science press ,2006 2. Heat Transfer -A Basic Approach, by N.Ozisik , MC Grawhill,1985 3. Heat transfer, by S.P.Sukhatme , Orient longman Pvt. Ltd. 2005 4. Introduction to Heat Transfer, by lncropera and Dewitt, Wiley Publishers,2001 5. Heat Transfer, by D.S. Kumar, SK. Kataria & sons,2009.
e-Resources & other digital material
1. https://nptel.ac.in/courses/112/108/112108149/ 2. https://nptel.ac.in/courses/112/105/112105271/ 3. https://nptel.ac.in/courses/103/103/103103031/#

OPERATIONS RESEARCH

Course Code	19HS1702	**Year**	IV	**Semester**	I
Course Category	Humanities	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Formulate practical situations by using linear programming and solving problems such as transportation, allocation and sequencing of jobs.	L2
CO2	Assess the utilization of facility by applying waiting line theory and solve sequencing problems	L2
CO3	Establish decisions about replacement of items that deteriorate with time and solve game theory problems	L2
CO4	Solve practical problems by using inventory control and simulate real time problems	L2

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3		2					1		2		3	2
CO2	3	3		2					1		2		3	2
CO3	3	3		2					1		2		3	2
CO4	3	3		2					1		2		3	2

Syllabus		
Unit No.	**Contents**	**Mapped CO s**
I	**INTRODUCTION TO OPERATIONS RESEARCH**: History, definition, operations research models, phases of implementing operations research in practice, applications. **LINEAR PROGRAMMING**: Introduction, formulation, graphical solution, simplex method, artificial variable techniques – Big M and two-phase methods, duality principle.	CO1
II	**TRANSPORTATION MODEL**: Formulation, initial feasible solution, optimal solution – MODI method, unbalanced transportation problems, degeneracy in transportation problems. **ASSIGNMENT MODEL**: Formulation, optimal solution, Hungarian method, travelling salesman problem.	CO1
III	**QUEUING MODELS**: Introduction, Kendall's notation, classification of queuing models, single server and multi-server models, Poisson arrival, exponential service, infinite population **SEQUENCING MODELS**: Introduction, assumptions, processing n-jobs through two machines, n-jobs through three machines, and graphic	CO2

	solution for processing 2 jobs through n machines with different order of sequence.	
IV	**GAME THEORY**: Introduction, game with pure strategies, game with mixed strategies, dominance principle, graphical method for 2xn and mx2 games. **REPLACEMENT MODELS**: Introduction, replacement of items that deteriorate with time - value of money unchanging and changing, simple probabilistic model for replacement of items that fail completely.	CO3
V	**INVENTORY**: Introduction, inventory costs, Economic Order Quantity (EOQ)Demand rate Uniform and replenishment rate infinite, demand rate non uniform replenishment rate infinite, Demand rate uniform, replenishment rate infinite (shortages allowed)models with and without shortages, inventory model with single price break. **SIMULATION**: Definition, Types of simulation models, phases of simulation, applications of simulation	CO4

Learning Recourse(s)
Text Book(s)
1. Operations Research, by S.D.Sharma, Kedarnath & Ramnath publications (15th edition),2013. 2. Introduction to Operations Research, by Taha, Pearson Education,New Delhi, (8th edition), 2008.
Reference Book(s)
1. A.M .Natarajan, P. Balasubramani Operations Research, "ATamilarasi, Pearson Education", New Delhi, 2009. 2. R.Pannerselvam, "Operations Research", 2009, PHI Publications, Noida Wagner, "Operations Research", 2007, PHI Publications, Noida 3. J.K.Sharma, "Operation Research", 2009, MacMilan publishers, ndia Ltd. New Delhi.
e-Resources & other digital material
1. http://nptel.ac.in/courses/112106134/ 2. http://nptel.ac.in/courses/112106131/

MEASUREMENTS AND METROLOGY

Course Code	19ME3701	**Year**	IV	**Semester**	II
Course Category	Professional Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Explain the concepts of measurements.	L2
CO2	Illustrate the construction and working of instruments used for linear and angular measurement.	L2
CO3	Discuss the methods/devices used for the measurement of gear and screw thread parameters.	L2
CO4	Estimate the surface roughness and flatness of machined surfaces.	L2
CO5	Summarize the working principles of field quantities measurement.	L2

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1					1			1	3	1
CO2	3	2	1	1					1			1	3	1
CO3	3	2	1	1					1			1	3	1
CO4	3	2	1	2					1			1	3	1
CO5	3	2	1	2					1			1	3	1

Syllabus		
Unit No.	**Content**	**Mapped CO s**
I	**CONCEPT OF MEASUREMENT:** Generalized measurement system and its functional elements, classification of instruments. Basic standards, primary, secondary and working standards. Instrument characteristics (static and dynamic), errors in measurement, calibration of an instrument. **LIMITS, FITS AND TOLERANCES**: Terminology of limits, fits and tolerances. Hole basis and shaft basis system, interchangeability and selective assembly.	CO1
II	**LINEAR AND ANGULAR MEASUREMENT:** Vernier instruments, Micrometers, slip gauges, Tool maker's microscope and Profile projector. Limit gauges and Tylor's principle of gauge design, Bevel protractor, sine bar and angle dekkor. **COMPARATORS**: Mechanical-Johansson Mikrokator, sigma and reed type, Pneumatic-Solex and differential type, Electrical- visual gauging and multi gauging.	CO2
III	**SCREW THREAD METROLOGY**: Screw thread terminology, errors in threads, measurement of pitch, thread angle, major diameter, minor diameter	CO3

	and effective diameter (two wire and three wire methods). **GEAR METROLOGY:** Gear terminology, Gear measurement: runout, backlash, profile error, tooth thickness (chordal thickness method, constant chord and base tangent methods) and Parkinson gear tester.	
IV	**SURFACE TEXTURE:** Orders of geometric irregularities**,** difference between surface roughness and surface waviness, Numerical assessment of surface finish - CLA, RMS and ten point height method. Measurement of surface finish- Profilometer, Tomlinson surface meter, Taylor Hobson Talysurf. **FLAT SURFACE MEASUREMENT:** Instruments used –straight edges, surface plates, Auto collimator and optical flats.	CO4
V	**STRESS AND STRAIN MEASUREMENTS:** Various types of stress and strain measurements- electrical strain gauge, gauge factor, method of usage resistance strain gauge for determining bending, compressive and tensile strains, strain gauge rosettes. **MEASUREMENT OF TEMPERATURE, FORCE, TORQUE AND POWER:** Thermometers, bimetallic strip, thermocouple and Pyrometers. Load cells, proving rings, Torsion bar, block type Prony brake and eddy current dynamometer.	CO5

Learning Recourse(s)
Text Book(s)
1. I.C. Gupta, "A Textbook of Engineering Metrology", Dhanpat Rai Publications, 2018. 2. G Beckwith, Roy D. Marangoni, John H. Lienhard V, "Mechanical Measurements, Thomas. Pearson Education, 2020.
Reference Book(s)
1. A Textbook of Metrology, M. Mahajan, Danpath Rai & Co. (P), 2010. 2. Metrology for Engineers, by J.F.W. Galyer , Charles Reginald Shotbolt, Cengage Learning EMEA; 5th Edition. 3. Mechanical Measurements & control, Dr. D.S.Kumar, Metropolitan Book Co. Pvt. Ltd., 2015
e-Resources & other digital material
1.https://nptel.ac.in/courses/112/104/112104250/

COMPUTATIONAL FLUID DYNAMICS

Course Code	19ME4701A	**Year**	III	**Semester**	II
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Levels**
Upon successful completion of the course, the student will be able to		
CO1	Develop an understanding for the major theories, approaches and methodologies used in CFD	L2
CO2	Understand physical behaviour of partial difference equations	L1
CO3	Apply numerical math to convert PDE's into Finite Difference equations	L5
CO4	Build up the skills in Grid generation techniques	L3
CO5	Use finite volume technique to discretise diffusion and convection problems	L2

	Contribution of Course Outcomes towards achievement of Program Outcomes Strength of correlations (3: High, 2: Moderate, 1: Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3							3	3	2
CO2	3	3	3	3	3							3	3	2
CO3	3	3	3	3	3							3	3	2
CO4	3	3	3	3	3							3	3	2
CO5	3	3	3	3	3							3	3	2

Syllabus		
Unit No	**Contents**	**Mapped CO**
I	**INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS AND PRINCIPLES OF CONSERVATION:** Computational Fluid Dynamics: What, When, and Why?, CFD Applications, Numerical vs Analytical vs Experimental, Modeling vs Experimentation. Fundamental principles of conservation, Reynolds transport theorem, Conservation of mass, Conservation of linear momentum: Navier-Stokes equation, Conservation of Energy	CO1
II	**CLASSIFICATION OF PARTIAL DIFFERENTIAL EQUATIONS AND PHYSICAL BEHAVIOR:** Mathematical classification of Partial Differential Equation, Illustrative examples of elliptic, parabolic and hyperbolic equations Physical examples of elliptic, parabolic and hyperbolic partial differential equations.	CO 2
III	**FUNDAMENTALS OF DISCRETIZATION:** Discretization principles: Preprocessing, Solution, Postprocessing, Finite Element Method, Finite difference method, Well posed boundary value problem, Possible types of boundary conditions, Conservativeness,	CO3

	Boundedness, Transportiveness. Finite volume method (FVM), Illustrative examples: 1-D steady state heat conduction without and with constant source term	
IV	**GRID GENERATION:** Transformation of coordinates. General principles of grid generation – structured grids in two and three dimensions, algebraic grid generation, differential equations based grid generation; Elliptic grid generation. Grid clustering, Grid refinement, Adaptive grids, Moving grids. Algorithms, CAD interfaces to grid generation.	CO4
V	**FINITE VOLUME METHOD:** Introduction, Application of FVM in diffusion and convection problems, NS equations – staggered grid, collocated grid, SIMPLE algorithm. Solution of discretized equations using TDMA.Finite volume methods for unsteady problems – explicit schemes, implicit schemes.	CO5

Learning Recourse(s)

Text Book(s)

1. John. D. Anderson, JR, "Computational Fluid Dynamics - Basics with Applications ", McGraw Hill Education (India) Edition 2012.
2. T. J. Chung, "Computational Fluid Dynamics", Cambridge University Press, 2nd Edition, 2014

Reference Book(s)

1. Niyogi, Chakravarty, Laha, "Introduction to computational fluid mechanics", Pearson pub. 1st ed. 2009.
2. S.V. Patankar, "Numerical heat transfer and fluid flow", Hemisphere Pub. 1st ed.
3. K. Muralidhar and T. Sundararajan, "Computational Fluid flow and Heat transfer", Narosa Pub. 2nd ed. 2003.

e-Resources & other digital material

1. http://ocw.mit.edu/courses/mechanical-engineering/2-29-numerical fluidmechanics-fall-2011/
2. http://nptel.ac.in/courses/112105045/(IIT Kharagpur)
3. http://nptel.ac.in/courses/112107080/(IIT Roorkee)
4. http://nptel.ac.in/courses/112104030/(IIT Kanpur)
5. http://www.nptelvideos.in/2012/11/computational-fluid- dynamics.html (IIT Madras)

FINITE ELEMENT METHODS

Course Code	19ME4701B	**Year**	IV	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Solve mechanics of solids problems by implementing numerical methods with the concepts of elasticity.	L3
CO2	Formulate and solve axially loaded bar Problems.	L3
CO3	Formulate and solve truss and beam problems.	L3
CO4	Develop formulations for 2-D Problem using triangular and quadrilateral elements.	L3
CO5	Develop formulations and solve eigen value problems.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	1								2	3	1
CO2	3	3	1	1								2	3	1
CO3	3	3	1	1								2	3	1
CO4	3	3	1	1								2	3	1
CO5	3	3	1	1								2	3	1

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**FUNDAMENTAL CONCEPTS**: Historical Background of FEM, Stress and Equilibrium, Boundary conditions, Strain displacement relations, stress-strain relations, Potential energy and equilibrium, Principle of Virtual work, The Rayleigh-Ritz method.	CO1
II	**AXIALLY LOADED BARS**: Finite Element Formulations, Fundamental concepts, Two node bar element, Shape functions, Formulation of stiffness matrix and Load Vectors, Assembly of element stiffness matrices and load vectors, Boundary conditions: Elimination method, Penalty Method, Temperature effects, Examples of Axially Loaded Members.	CO2
III	**ANALYSIS OF PLANE TRUSSES:** Plane Trusses, Local and Global Coordinate systems, Element Stiffness Matrix, Stress Calculations, Example of plane Truss with three members **ANALYSIS OF BEAMS**: Two nodes beam Element, shape functions, element stiffness matrix and load vectors, simple problems on beams with distributed and point loads.	CO3
IV	**TWO DIMENSIONAL PROBLEMS**: Finite Element Modeling,	CO4

	isoperimetric representation, Constant Strain Triangle (CST) Element Stiffness, Force terms, Stress calculation, Problem modeling and boundary conditions. Plane Stress and plane Strain Problems using CST Element, formulation of 4-noded quadrilateral element. Problems on isoperimetric formulation of 4-noded quadrilateral element, Numerical integration – Gaussian Quadrature approach.	
V	**FINITE ELEMENTS IN STRUCTURAL DYNAMICS**: Dynamic equations, eigen value problems, and their solution methods, simple problems on bar and beam.	CO5

Learning Recourse(s)
Text Book(s)
1. Introduction to Finite Elements in Engineering (revised 4th edition), by Tirupathi R. Chandrupatla, Ashok D. Belegundu, Pearson Education Limited, 2011
Reference books
1. Singiresu S.Rao, Finite element Method in Engineering, 5ed, Elsevier, 2012. 2. Reddy, J.N., Finite Element Method in Engineering, Tata McGraw Hill, 2017.
e- Resources & other digital material
1. https://nptel.ac.in/courses/112/104/112104115/

ROBOTICS AND ITS APPLICATIONS

Course Code	19ME4701C	**Year**	IV	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Understand the basic anatomy of robots.	L2
CO2	Solve kinematic and dynamic problems of the robot.	L3
CO3	Develop robot program and joint trajectory for path planning.	L3
CO4	Describe working principle of various robot sensors.	L2
CO5	Outline the applications of robots in industry.	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3					1		1				1	3	1
CO2	3	3	2									1	3	1
CO3	3	3	2									1	3	1
CO4	3											1	3	1
CO5	3					1						1	3	1

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION:** Basic concepts - Robot anatomy - classification, robot specifications and Work volume, Types of Robot actuators- Pneumatic, Hydraulic actuators, electric and stepper motors **END EFFECTORS**- types of end effectors, grippers and tools, Requirements and challenges of end effectors.	CO1
II	**TRANSFORMATIONS**- Homogeneous coordinates for translation and rotation **MANIPULATOR KINEMATICS:** D-H notation, Forward and inverse kinematics, simple problems, Dynamics- lagrangian formulation, introduction to jacobian computation.	CO2
III	**TRAJECTORY PLANNING** :Trajectory planning with cubic polynomial, blending, higher order trajectories **ROBOT PROGRAMMING:** Robot language classification - programming methods - off and on-line programming - Lead through method - Teach pendent method - VAL systems and language, simple programs.	CO3
IV	**SENSORS:** Sensor devices, Types of sensors - contact, position and displacement sensors, Force and torque sensors - Proximity and range	CO4

	sensors - acoustic sensors –slip sensors, Robot vision systems	
V	**INDUSTRIAL APPLICATIONS:** Application of robots - material handling - machine loading and unloading, assembly, inspection, welding, spray painting, **Recent Developments in Robotics:** mobile robot, microbots, safety considerations.	CO5

Learning Recourse(s)
Text Book(s)
1. Mikell P. Groover. Industrial Robotics Technology Programming and Applications, McGraw Hill Co., Singapore, 1995. 2. Robotics and Control / Mittal R K & Nagrath I J / TMH.2017
Reference books
1. Robotic Engineering by Richard D.Klafter, Prentice Hall 2. Introduction to Robotics – Saeed B.Niku, Prentice Hall 3. Introduction to Robotics – John J. Craig, Addison Wesley
e- Resources & other digital material
1. http://nptel.ac.in/downloads/112101098/ 2. https://nptel.ac.in/courses/112/105/112105249/ 3. https://nptel.ac.in/courses/107/106/107106090/

PRODUCTION PLANNING AND CONTROL

Course Code	19ME4701D	**Year**	IV	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Discuss the objectives, functions, applications of PPC and forecasting techniques.	L2
CO2	Explain different Inventory control and optimization techniques with help of case studies.	L1
CO3	Analyze routing and scheduling problems.	L4
CO4	Summarize various aggregate production planning techniques.	L1
CO5	Describe way of integrating different departments to execute production control functions.	L1

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2		3	1	1	1		1			1		2	3
CO2	2		3	1	1	1		1			1		2	3
CO3	2		3	1	1	1		1			1		2	3
CO4	2		3	1	1	1		1			1		2	3
CO5	2		3	1	1	1		1			1		2	3

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION:** Objectives of production planning and control, definitions, functions of production planning and control organization of production planning and control department, internal organization of department. **FORECASTING:** Importance - Forecasting Techniques- qualitative methods: Jury/Expert Method, Survey method, Sales force composite method, Delphi method and quantitative methods: Simple average, moving average, smoothing coefficient, Least Square method.	**CO1**
II	**INVENTORY MANAGEMENT:** Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems - Introduction to MRP-I, MRP-II & ERP, JIT inventory, Kanban system **SYSTEMATIC CONTROL OF INVENTORY:** Introduction to Computer based inventory control systems. Case study – Inventory management in automobile manufacturing units.	**CO2**
III	**ROUTING:** Definition – Routing procedure –Route sheets – Bill of material – Factors affecting routing procedure. **SCHEDULING:** Definition – Activities-Difference with loading,	

	Scheduling types: Forward, Backward scheduling, Job shop scheduling methods – Arrival pattern, processing pattern, number of workers available, machine varieties available, Priority rules for job sequencing FIFO, FILO, SPT, SOT, EDD, STR, CR. Johnson's job sequencing rules- n jobs on 2machines, n jobs on 3 machines.	**CO3**
IV	**PRODUCTION PLANNING:** Scope of planning, types of production planning - short term and long-term planning - make and buy decisions. **AGGREGATE PLANNING:** Introduction, Inputs to aggregate planning, strategies- Line strategy, chase strategy, capacity options, demand options.	**CO4**
V	**DISPATCHING:** Centralized and Decentralized Dispatching- Activities of dispatcher – Dispatching procedure – follow-up – definition – Reason for existence of functions – types of follow up - Application of computers in production planning and control.	**CO5**

Learning Recourse(s)

Text Book(s)

1. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
2. James.B.Dilworth,"Operations management – Design, Planning and Control for manufacturing and services" McGraw Hill International edition 1992.

Reference books

1. MartandTelsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition, John Wiley and Sons, 2000.
3. KanishkaBedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.
4. Melynk, Denzler, "Operations management – A value driven approach" Irwin McGraw hill.
5. Norman Gaither, G. Frazier, "Operations Management", 9th edition, Thomson learning IE, 2007

e- Resources & other digital material

1. https://www.tandfonline.com/toc/tppc20/current
2. https://www.managementstudyguide.com/production-planning-and-control.htm
3. https://nptel.ac.in/courses/112/107/112107143/

POWER PLANT ENGINEERING

Course Code	19ME4702A	**Year**	IV	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Describe various energy sources and combustion processes in steam power plants.	L1
CO2	Classify diesel and gas turbine power plants layout with auxiliaries.	L2
CO3	Relate hydro projects classifications, fusion and fission reactions in nuclear power plants and types of reactors.	L2
CO4	Estimate the advantages of combined working of different power plants and importance of measurement and instrumentation in power plant.	L3
CO5	Explain the concepts of power plant economics and impact of its effluents on environment.	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3				1							2	1
CO2	3	3				2							2	2
CO3	3	3				2							2	3
CO4	3	3				1							2	2
CO5	3	3				2							2	1

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO THE SOURCES OF ENERGY:** Resources and Development of Power in India. STEAM POWER PLANT: Plant Layout, Working of different Circuits, Fuel and handling equipment, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems. **COMBUSTION PROCESS:** Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, and spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, Dust collectors, cooling towers and heat rejection, dearation. Corrosion and feed water treatment.	CO1
II	**DIESEL POWER PLANT:** Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging, application and comparison with other plants. GAS TURBINE POWER PLANT: Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed	CO2

	and open cycle gas turbines. Combined Cycle Power Plants and comparison, Permanence evaluation of the gas turbine plant.	
III	**HYDRO ELECTRIC POWER PLANT:** Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways. HYDRO PROJECTS AND PLANT: Classification – Typical layouts – Site selection of hydro plant - plant auxiliaries – plant operation pumped storage plants. **NUCLEAR POWER PLANT**: Fusion and fission Reactions, Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation, Fuel moderator and coolant. TYPES OF REACTORS: Pressurized water reactor, Boiling water reactor, sodium graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.	CO3
IV	**HYBRID POWER PLANTS:** Introduction, Advantages of combined working, Load division between power stations, Storage type hydro-electric plant in combination with steam plant, Run off River plant in combination with steam plant, Pump storage plant in combination with steam or Nuclear power plant, Coordination of hydro electric and gas turbine stations, coordination of hydroelectric and Nuclear power stations, coordination of different types of Power plants. **POWER PLANT INSTRUMENTATION AND CONTROL:** Importance of measurement and instrumentation in power plant, measurement of water purity, Gas analysis, O2 and CO2 measurements, measurement of smoke and dust, measurement of moisture in CO2 circuit, Nuclear measurements.	CO4
V	**POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS:** Capital cost, investment of fixed charges, operating costs, cost per KWh, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.	CO5

Learning Recourse(s)

Text Book(s)

1. Arora and Domkundwar, A Course In Power Plant Engineering by –, Dhanpatrai & co.2011.
2. Power Plant Engineering, by P.K.Nag, TataMcHill-2008.

Reference books

1. A Text Book of Power Plant Engineering, by R K Rajput, Lakshmi Publications, 2008.
2. Power Plant Engineering, by P.C.Sharma, S.K.Kataria Publications, 2009.
3. Power plant Engineering, by Ramalingam, Scietech Publishers-2010.
4. 4.An Introduction to Power Plant Technology, by G.D. Rai, Khanna publications-1996.

e- Resources & other digital material

1. https://nptel.ac.in/courses/112/107/112107291/

PRODUCT DESIGN

Course Code	19ME4702B	**Year**	IV	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Illustrate the product design and development processes in manufacturing industry.	L2
CO2	Discuss about the components and their functions of product design processes	L2
CO3	Plan a product design	L3
CO4	Apply industrial design techniques in product development	L3
CO5	Carry out cost and benefit analysis through various cost models and then apply new product development process during pre-market phase of extended product life cycle.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3								2	2	3	1
CO2	3	3	3								2	2	3	1
CO3	3	3	3								2	2	3	1
CO4	3	3	3								2	2	3	1
CO5	3	3	3								2	2	3	1

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	Introduction: Design methodology and philosophy, types of design, design models, development product life cycle. Product development process, reverse engineering and redesign of product development process, theory and methodology in design.	**CO1**
II	Design Process: Need, analysis, scope of the product, mission statement, customer study, Kano- diagram. Establishing product function, functional decompositions, FAST and SOP, functions structures. Building up a design team. Designing quality into product, product discovery.	**CO2**
III	Plan for Design: Product teardown, planning for deliverables, building a plan, product specifications- QFD, contradiction to generate ideas, theory of inventive machines-TRIZ, Decision matrix.	**CO3**
IV	Industrial Design: Need for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user driven products – assessing the quality of industrial design.	**CO4**

V	Value Engineering: Cost evaluation, categories of cost, overhead cost, methods of development cost estimate, manufacturing cost, value analysis costing. New Product Development Process: Expanded product life cycle, Flow chart for new product development, Models utilized in various phases of new product development.	**CO5**

Learning Recourse(s)
Text Book(s)
1. A K Chitale and R C Gupta, Product Design and Manufacturing, Prentice Hall of India, New Delhi, 2003. 2. Kevin Otto and Kristin Wood, Product Design, Pearson, 2004.
Reference books
1. Ulrich and Steven D. Eppinger, Production Design and Development, Tata McGraw Hill, 2007. 2. David G. Ullman, The Mechanical Design Process, McGraw Hill, 2003. 3. George E. Dieter, Engineering Design, McGraw Hill, 2000.
e- Resources & other digital material
1. https://nptel.ac.in/courses/112/107/112107217/ 2. https://www.classcentral.com/course/swayam-product-design-and-development-7922

MANUFACTURING METHODS IN PRECESSION ENGINEERING

Course Code	19ME4702C	**Year**	IV	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Illustrate various precision manufacturing methods and documentation for precision equipment	L2
CO2	Explain Various accuracies required in machines and errors in numerical positioning	L2
CO3	Apply standards and applications of Lasers in Precision measuring systems.	L3
CO4	Identify various in-process or In-situ process measurement and Optical features of measurement	L3
CO5	Select various Nano positioning systems and Servo positioning systems in Precision manufacturing.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3										1	2	3	1
CO2	3	2								1	1	2	3	1
CO3	3	2			2	1	1			1	1	2	3	1
CO4	3	2	1			1	1			1	1	2	3	1
CO5	3	2	1		2	1	1			1	1	2	3	1

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**Introduction to manufacturing and precision engineering:** Introduction to manufacturing process, precision engineering and conventional and unconventional machining process, micromachining, Precision machining and finishing operations. Methods of measurements during machining and during assembly **Assembly and tolerancing:** Documentation for manufacture of precision equipment	**CO1**
II	**Concepts of accuracy:** Introduction - concept of accuracy of machine tools, spindle and displacement accuracies, Accuracy of numerical control systems, Errors due to numerical interpolation, Displacement measurement system and velocity lags	**CO2**
III	**Precision measuring systems**: Units of length, legal basis for length measurement, traceability, Processing system of nanometer, accuracies - LASER light source - LASER interferometer, LASER	**CO3**

	alignment telescope - LASER micrometer-on-line and in-process, measurements of diameter and surface roughness using LASER - Micro holes and topography measurements,	
IV	**In processing or in situ measurement**: Introduction, In processing or in situ measurement of position of processing point-Post process and on-machine measurement of dimensional features and surface, mechanical and optical measuring systems. - Straightness and flatness measurement – Optoelectronic Measurement Systems in Metrology, Optoelectronic devices contact and noncontact types.	**CO4**
V	**Nano positioning systems of Nano accuracy & repeatability:** Guide systems for moving elements - Servo control systems for tool positioning, Computer aided digital and ultra-precision position control.	**CO5**

Learning Recourse(s)

Text Book(s)

1. M. V. Suryaprakash , "Precision Engineering", Narosa publications.
2. V C Venkatesh, "Precision Engineering" Mc GRAW HILL Publications
3. Hiromu Nakazawa, "Principles of precision engineering", Oxford University Press

Reference books

1. Kalpakjian, "Manufacturing engineering & technology", Addison – Wesley, 2nd Edition
2. Debitson A., "Hand book of precision engineering"
3. J. A. McGeough, "Advanced methods of machining", Chapman and Hall, London, 1988
4. Jain V. K., "Introduction to micromachining", Narosa Publishers
5. G. Chryssolouris, "Laser machining – theory and practice", Springer Verlag, New York, 1991

MANAGEMENT INFORMATION SYSTEMS

Course Code	19ME4702D	**Year**	IV	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Outline the basic concepts of MIS	L2
CO2	Explain the decision-making process.	L2
CO3	Interpret the applications of MIS	L2
CO4	Summarize the Decision support systems and BPR	L2
CO5	Discuss about E-Commerce opportunities	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1			3			2	1	3	2	1	2	3
CO2	1	1			3			2	1	3	2	1	2	3
CO3	1	1			3			2	1	3	2	1	2	3
CO4	1	1			3			2	1	3	2	1	2	3
CO5	1	1			3			2	1	3	2	1	2	3

Syllabus

UNIT No.	**Contents**	**Mapped COs**
I	**Introduction to MIS**: Definition of MIS, Role and Impact of MIS, MIS: Support to the management, As tool for Management Process, Basic model of organization, Modifications to the basic model, organization as a system, MIS: organization, Strategic management of business.	**CO1**
II	**Decision Making:** Concepts, Methods, Tools, Procedures, Organizational decision making, MIS and Decision-making concepts, Information: A Quality Product, Classification of information, Value of information, General model of Human as information processor, Types of systems, Handling system complexity, Development of long range plans of the MIS, Development and implementation of MIS, Factors of Success and failure for MIS.	**CO2**
III	**Applications:** Applications in Manufacturing Sector, Personnel, financial, production, materials, marketing management, Applications in service sector, creating a Distinctive service, MIS in service industry, Technology of Information systems, Data processing, Transaction processing, Application processing, TQM of Information systems, Programming languages for system coding.	**CO3**

IV	**Decision support systems and BPR:** Concept and philosophy, Deterministic systems, Artificial Intelligence systems, Knowledge based expert system, Enterprise Management systems, ERP basic features EMS and MIS, Business Process Re- Engineering, Process model of organization, Value stream model of the organization MIS and BPR.	**CO4**
V	**E-Commerce:** Electronic commerce environment and opportunities: back ground, electronic commerce Environment, Modes of electronic commerce: Approaches to safe electronic commerce, Overview, Secure transport protocols, Secure Transactions, Secure Electronic Payment Protocol, and Secure Electronic Transaction.	**CO5**

Learning Recourse(s)

Text Book(s)

1. W.S. Jawadekar, Management Information Systems: A Global Digital Enterprise Perspective, 5th Edition, McGraw Hill Education, 2013.
2. D. Minoli, Web Commerce Technology Hand Book, 1st edition, McGraw Hill Education, 2000.

Reference books

1. K.C. Laudon and J. Laudon, Management Information Systems: Managing a Digital firm, 11th Edition, Pearson Education, 2012.
2. D. Gordon and M. Oslon, Management Information Systems :Conceptual Foundations,
3. Structure and Development, 2nd Edition, McGraw Hill Education Pvt Ltd, India, 2
4. R.G. Murdic, J.E. Ross and J.R. Clagget, Information Systems for Modern Management, 3rd Edition, PHI, 2008.
5. K.Ravi and A.B. Whinston, Frontiers of Electronic Commerce, 1st edition, Pearson India, 2002.

e- Resources & other digital material

1. https://nptel.ac.in/courses/111/105/111105039/
2. https://nptel.ac.in/courses/106/108/106108056/
3. https://nptel.ac.in/courses/111/104/111104071/
4. https://nptel.ac.in/courses/112/105/112105235/

RENEWABLE ENERGY SOURCES

Course Code	19EE2701C	**Year**	IV	**Semester**	I
Course Category	Inter Disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Understand the basics of solar energy, wind energy, bio mass, geothermal energy, Ocean energy and principles of energy conversion.	L2
CO2	Explain and classify instruments for measuring solar radiation solar collectors, solarenergy storages, wind turbines, geothermal, MHD and fuel cell.	L2
CO3	Analyze different types of solar collectors, solar cell, combustion characteristics of bio-gas, thermodynamic cycles, operating conditions of fuel cell.	L4
CO4	Outline about solar radiation, power from solar module, performance characteristics of wind mill, potential and conversion techniques of tidal and wave energy, mini-hydel power plants and their economics.	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2		3			2	2	1			2	2	3
CO2	3	3		1		3	3	2	1			1	3	2
CO3	3	3		3			2					1	2	2
CO4	3	2		1			1					1	3	3

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	Principles of Solar Radiation and Solar Energy Collection Role and potential of new and renewable source, the solar energy option, environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data. Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors	CO 1 CO 2 CO 3 CO 4
II	Solar Energy Storage, Applications and Photovoltaic Energy Conversion Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications solar heating/cooling technique, solar distillation and drying. Solar cell fundamentals, solar cell classification, performance of solar cell- powerfrom solar module.	CO 1 CO 2 CO 3 CO 4

III	Wind Energy and Bio-Mass Sources and potentials, horizontal and vertical axis windmills, performancecharacteristics, Betz criteria. Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of bio-gas digesters, gasyield, combustion characteristics of bio-gas, utilization for cooking	CO 1 CO 2 CO 3 CO 4
IV	Geothermal Energy and Ocean Energy Resources, types of wells, methods of harnessing the energy, potential in India. OTEC, principles of utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques.	CO 1 CO 2 CO 3 CO 4
V	Energy Conversion Principles of energy conversion, MHD generators, principles, MHD power generation systems. Fuel cells, principles, of fuels and operating conditions, merits and demerits of different types of fuel-cells, mini-hydel power plants and their economics.	CO 1 CO 2 CO 3 CO 4

Learning Recourse(s)

Text Book(s)

1. Non-Conventional Energy Sources by G.D. Rai, Khanna publishers, 5th edition,2014.
2. Renewable Energy Sources and Emerging Technologies by D.P Kothari, K.C Singal, Rakesh Ranjan , PHI learning Pvt Ltd, 2nd edition ,2012.

Reference books

1. Renewable Energy resources by Tiwari and Ghosal, publisher Narosa, 2005
2. Renewable Energy Resources by John Twidell and Tony Weir , publisher Taylor andFrancis, 2nd edition 2006
3. Solar Photo Voltaics Fundamentals, Technology and application by Chetan Singh Solanki, publisher PHI learning Pvt Ltd, 3rd edition,2019
4. Wind Energy Theory and Practice by Siraj Ahmed publisher PHI learning Pvt Ltd ,3rd edition, 2016

WEB TECHNOLOGIES

Course Code	19IT2701C	**Year**	IV	**Semester**	I
Course Category	Inter Disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	JAVA
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Understand the basic concepts of HTML,CSS,XML,JDBC connectivity, Servlets and JSP	L2
CO2	use Java script for validation of web pages	L3
CO3	Analyse the concepts of DOM,JDBC Architecture and life cycles of Servlets and JSP	L4
CO4	Compare the concepts of HTML and XML, Servlets and JSP	L4
CO5	Develop simple web applications using JDBC, Servelet and JSP	L6

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1			2		2								2	2
CO2			2		2								2	2
CO3			2		2									
CO4			2		2									
CO5			2	2	2									

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO WEB TECHNOLOGIES:** History of the web, Overview of HTTP, HTML Introducing HTML document structure, Creating Headings, links, paragraph, images, tables, frames, forms and html controls on a web page.	CO1
II	**INTRODUCING CASCADING STYLE SHEETS:** Inline, External, Internal, Style class, Multiple styles, Introducing JavaScript , Using Variables, Using Operators, Working with Control Flow statements, Working with functions, Handling Events, Using Arrays, Creating objects in Java Script	CO2
III	**WORKING WITH XML:** Introduction to XML, XML Basics, XML Technologies, Extensible HTML (XHTML), Java API for XML Processing, Document Object Model (DOM)	CO1 CO3

IV	**WORKING WITH DATABASE:** Getting started with JDBC, Defining ODBC, Introduction to JDBC, Components of JDBC, JDBC Architecture, Types of Drivers, Working with JDBC APIs, creating a Simple Application, Working with Prepared Statement, Using Callable Statement	CO1 CO3 CO4 CO5
V	**WORKING WITH SERVLETS**: Introducing the MVC architecture, Describing Servlets, Understanding Servlets, what are servlets, introducing the Servlet API, Servlet Life Cycle, Developing First Servlet Application **WORKING WITH JSP:** Introduction to JSP, Understanding JSP, Describing the JSP Life Cycle, Creating a Simple JSP pages	CO1 CO3 CO4 CO5

Learning Recourse(s)

Text Book(s)

1. Web Technologies, Black Book, Kogent Learning Solutions Inc, Dreamtech Press.
2. 2. JDBC, Servlets, and JSP, New Edition, Santhosh Kumar K, Kogent Learning Solutions Inc, Dreamtech Press.

Reference books

1. Web Technologies ,Uttam K. Roy, Volume 2 , Oxford University
2. Core Servlets and Java Server Pages Volume 1 CORE TECHNOLOGIES , Marty Hall and Larry Brown Pearson
3. Internet and World Wide Web – How to program ,Dietel and Nieto.
4. An Introduction to Web Design and Programming –Wang-Thomson
5. Professional Java Server Programming S.AllamRaju and othersApres(dreamtech)
6. Java Server Programming ,IvanBayross and others,The X Team,SPD
7. Beginning Web Programming-Jon Duckett WROX.
8. Java Server Pages, Pekowsky, Pearson.
9. Java Script,D.Flanagan,O‟Reilly,SPD.

e- Resources & other digital material

1. http://nptel.ac.in/courses/106105084/13
2. http://www.w3schools.com/
3. https://www.javatpoint.com/html-tutorial

OPTIMIZATION TECHNIQUES

Course Code	19ME2701B	**Year**	IV	**Semester**	I
Course Category	Inter Disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Apply various Classical optimization techniques	L3
CO2	Select suitable Numerical method for optimization of Engineering Problems.	L4
CO3	Analyze multi stage decision making process through dynamic programming	L4
CO4	Enumerate fundamentals of Integer programming technique	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	3	2		2		2		2		2	2	2
CO2	2	3	3	2		2		2		2		2	2	2
CO3	2	3	3	2		2		2		2		2	2	2
CO4	2	2	3	2		2		2		2		2	2	2

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**Introduction to optimization**: Introduction, engineering applications of optimization, statement of an optimization problem-design vector, design constraints, constraint surface, objective function, classification of optimization problems, optimization techniques. **Classical Optimization techniques:** Introduction, single variable optimization, multi variable optimization with no constraints, multi variable optimization with equality constraints-Lagrange multiplier method.	CO1
II	**Non-linear programming, I**: One Dimensional Minimization Methods: Introduction, unimodal function, elimination methods- unrestricted search, exhaustive search, interval halving method, Fibonacci method, golden section method, interpolation method,	CO2
III	**Non-linear programming II:** Direct Search Method- Nelder- Mead Simplex method, Indirect search methods- steepest descent method (Cauchy's method), Newton Method, Marquardt Method	CO2
IV	**Dynamic Programming:** Multistage decision processes, Concepts of sub optimization- calculus method and tabular methods, Linear programming as a case of D.P	CO3

V	**Integer Programming**: Introduction, Graphical Representation, Gomory's cutting plane method, Balas algorithm for zero-one programming, Branch-and- bound method, Penalty Function method; Basic approaches of Interior and Exterior penalty function methods.	CO4

Learning Recourse(s)
Text Book(s)
1. S.S.Rao, Engineering optimization theory and practice, , 3rd Edition, New age international,2007. 2. Van Wylen, Fundamentals of Classical Thermodynamics, .John Wylie.
Reference books
1. H.A.Taha, Operations Research, , 9th Edition, Prentice Hall of India, 2010. 2. F.S.Hillier, and G.J.Lieberman, Introduction to Operations Research, , 7th Edition, TMH, 2009.
e- Resources & other digital material
1. https://nptel.ac.in/courses/111/105/111105039/ 2. https://nptel.ac.in/courses/106/108/106108056/ 3. https://nptel.ac.in/courses/111/104/111104071/ 4. https://nptel.ac.in/courses/112/105/112105235/

PROJECT MANAGEMENT & OPTIMIZATION

Course Code	19ME2701C	**Year**	IV	**Semester**	I
Course Category	Inter Disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Explain basics of project management	L2
CO2	Analyze activities involved in project.	L3
CO3	Describe various project cost management techniques	L2
CO4	Apply various Linear programming techniques and sequencing methods	L3
CO5	select transportation and assignment technique to minimize the cost	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3			2		2			3	2	2	3
CO2	2	2	3	2	2				2		3	2	2	3
CO3	2	2	3			3		2			3	2	2	3
CO4	2	2	3			3		2			3	2	2	3
CO5	2	2	3			3		2			3	2	2	3

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**Concepts of project management:** Meaning, definition and characteristics of a project, technical and socio-cultural dimensions; project life cycle phases, project planning and graphic presentation; work breakdown structure, manageable tasks; size of network; blow down NW; identity and logic dummy activity; Fulkerson rule for numbering NW; time-scaled NW	CO1
II	**NW analysis:** Network modelling, Probabilistic model-various types of activity times estimation, programme evaluation review techniques (PERT), probability of completing the project, deterministic model-critical path method (CPM), critical path calculation, crashing of simple of networks	CO2
III	**Project duration and control:** Importance and options to accelerate project completion; time cost trade off; fixed variable and total costs; use of floats and cost optimization; project performance measures; project monitoring info and reports; project control process; Gant chart and control chart; cost-schedule S-graph; planned cost of work schedule (PV), budgeted/ earned cost of work completed (EV) and actual cost of	CO3

	work completed (AC); schedule and cost variances (SV, CV) forecasting final project costs.	
IV	**LINEAR PROGRAMMING:** Linear Programming Problem Formulation, Graphical solution Simplex method, artificial variables techniques-Two–phase method, Big-M method, Duality Principle **SEQUENCING**: Introduction, sequencing of n jobs through two machines, n jobs through three machines –two jobs through 'm' machines	CO4
V	**TRANSPORTATION PROBLEM:** Formulation, Optimal solution, U-V method, unbalanced transportation problems, Degeneracy. **ASSIGNMENT PROBLEM:** Formulation, Optimal solution, Variants of Assignment Problem-Traveling Salesman problem.	CO5

Learning Recourse(s)

Text Book(s)

1. Prasanna Chandra, Projects Planning, Implementation and Control, Tata McGraw Hill Publishing Company Limited, New Delhi, 1995.
2. Operations Research, by S.D.Sharma, Kedarnath & Ramnath publications (15th edition),2013

Reference books

1. Project Management Institute (PMI), A Guide to the Project Management of Knowledge Newton Square, PA, 1996
2. J.R. Meredith and S.J. Mantel, Project Management: A Managerial Approach. John Wiley and Sons, New York, 1995.
3. L.S. Srinath, PERT & CPM Principles & Applications, 3rd edition, East west Press,2001.
4. Operations Research, (2nd edition) by R.Pannerselvam, 2009,PHI Publications, Noida

e- Resources & other digital material

1. https://nptel.ac.in/courses/105/106/105106149/
2. https://nptel.ac.in/courses/110/104/110104073/
3. https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-ce06/
4. https://nptel.ac.in/courses/112/106/112106134/

PVP 19

MEASUREMENTS AND METROLOGY LAB

Course Code	19ME3751	**Year**	IV	**Semester**	I
Course Category	Program Core	**Branch**	ME	**Course Type**	Practical
Credits	1	**L – T – P**	0 – 0 – 2	**Prerequisites**	Nil
Continuous Internal Evaluation	25	**Semester End Evaluation**	50	**Total Marks**	75

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Demonstrate the use of instruments for measuring linear, angular dimensions and surface roughness.	L3
CO2	Perform alignment tests on various machine tools.	L3
CO3	Calibration of instruments used for measuring field quantities.	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1		2					2	1		1	3	2
CO2	3	1		2					2	1		1	3	2
CO3	3	1		2					2	1		1	3	2

Note: Any ***'SIX'*** experiments from Each Section are to be performed

Syllabus		
Expt. No	**Contents**	**Mapped COs**
METROLOGY		
1.	Measurement of bore by internal micro meters and dial bore indicator / rollers and slip gauges.	CO1
2.	Use of gear teeth vernier calipers for checking the chordal addendum and chordal thickness of spur gear.	
3.	Alignment test on the lathe/milling machine using dial indicators.	CO2
4.	Measurement of linear and angular dimensions using Tool makers microscope.	CO1
5.	Angle and taper measurements by Bevel protractor, Sine bars, spirit level etc.	
6.	Measurement of effective diameter of a thread using Two wire/ Three wire method.	
7.	Surface roughness measurement by Talysurf instrument.	
MEASUREMENTS		
1.	Calibration of Pressure Gauge using dead weight pressure gauge tester.	CO3
2.	Calibration of thermocouple.	
3.	Calibration of LVDT.	
4.	Calibration of capacitive transducer.	
5.	Calibration of photo and magnetic speed pickup transducer.	
6.	Calibration of Strain gauge.	
7.	Measurement of flow using rotameter	

PROJECT PHASE – 1

Course Code	19ME3761	**Year**	IV	**Semester**	I
Course Category	Project	**Branch**	ME	**Course Type**	Theory
Credits	2	**L – T – P**	0 – 0 – 6	**Prerequisites**	Nil
Continuous Internal Evaluation	100	**Semester End Evaluation**	-	**Total Marks**	100

INTERNSHIP

Course Code	19ME3771	**Year**	IV	**Semester**	I
Course Category	Project	**Branch**	ME	**Course Type**	Theory
Credits	2	**L – T – P**	0 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	75	**Semester End Evaluation**	-	**Total Marks**	75

AUTOMOBILE ENGINEERING

Course Code	19ME4801A	**Year**	IV	**Semester**	II
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Explain basic components of an Automobile.	L2
CO2	Illustrates the working of various systems of engines.	L2
CO3	Describe the working of various automobile systems.	L2
CO4	Discuss various alternative energy resources, emissions standards in automobiles.	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	1	1									1	3	1
CO2	3	1	1									1	3	1
CO3	3	1	1									1	3	1
CO4	3	1	1				2					1	3	1

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION** Components of four-wheeler automobile – chassis and body – power unit –power transmission – rear wheel drive, front wheel drive, 4-wheel drive. Types of automobile engines, engine construction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation –engine service, reboring, decarburization, Nitriding of crank shaft.	CO1 CO2
II	**FUEL SYSTEM** S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters– carburetor – types – air filters – petrol injection. C.I. Engines: Requirements of diesel injection systems, types of injection systems, fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. **COOLING SYSTEM:** Cooling Requirements, Air Cooling, Liquid Cooling, Thermosyphon, Forced Circulation System, evaporating cooling and pressure sealed cooling – antifreeze solutions. **IGNITION SYSTEM:** Ignition System-, battery, magneto, Electronic ignition	CO2
III	**TRANSMISSION SYSTEM:** Clutches: Principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel. Gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter.	CO3

	Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres. **SUSPENSION SYSTEM:** Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.	
IV	**STEERING SYSTEM:** Steering geometry – camber, castor, king pin rake, combined angle toe-in, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages. **BRAKING SYSTEM:** Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder, tandem master cylinder, Requirement of brake fluid, Pneumatic and vacuum brakes.	CO3
V	**ELECTRICAL SYSTEM:** Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc. **EMISSION FROM AUTOMOBILES:** Pollution standards National and international – Pollution Control– Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection. Energy alternatives – Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels and gaseous fuels, electrical-their merits and demerits.	CO4

Learning Recourse(s)
Text Book(s)
1. Automotive Mechanics-Vol.1 & Vol.2, by Kirpal sing, Standard Publishers, New Delhi 2008. 2. Automobile Engineering, (3rd edition), by William crouse, TMH Distributors, New Delhi
Reference Book(s)
1. Automobile Engineering Theory and Servicing, by James D. Halderman and Chase D. Mitchell, Pearson education inc, 2001. 2. Automobile Engineering, by Newton steeds & Garrett Automotive Mechanics Heitner, Butterworth International, London.
e- Resources & other digital material
1. https://nptel.ac.in/courses/107/106/107106088/

GEOMETRIC DIMENSIONING AND TOLERANCING

Course Code	19ME4801B	**Year**	IV	**Semester**	II
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Interpret Geometric Dimensioning Tolerance symbols on a print	L2
CO2	Identify basic principles of Tolerancing	L2
CO3	Set up and use basic rectangular datum reference frames	L2
CO4	Understand procedure followed for indicating form and Profile tolerances with applied material conditions	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	3	3				1	1	2		2	3	1
CO2	3		3	3				1	1	2		1	3	1
CO3	3		3	3				1	1	2		1	3	1
CO4	3	2	3	3				1	1	2		2	3	1
CO5	3	2	3	3				1	1	2		2	3	1

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**Introduction:** Scope, Definitions, Fundamental Rules, Units of Measure, Types of Dimensioning, Application of Dimensions, Dimensioning Features, Location of Features **Symbology:** Use of Notes to Supplement Symbols, Symbol Construction, Feature Control Frame Symbols, Feature Control Placement, Definition of Tolerance Zone, Tabulated Tolerances	CO 1
II	**Principles of Tolerancing:** Direct Tolerancing Methods, Tolerance Expression, Interpretation of Limits, Single Limits, Tolerance Accumulation, Limits of Size, Applicability of Modifiers on Geometric Tolerance Values and Datum Feature References, Screw Methods, Gears and Splines, Boundary Conditions, Angular Surfaces, Conical Tapers, Flat Tapers, Radius, Tangent Plane, Statistical Tolerancing.	CO 2
III	**Datum Reference Frames:** Degrees of Freedom, Degrees of Freedom Constrained by Primary Datum Features, Regardless of Material Boundary, Constraining Degrees of Freedom of a Part, Datum Feature Simulator, Theoretical and Physical Application of Datum Feature Simulators, Datum Reference Frame, Datum Features and Controls, Specifying Datum Features in an Order of Precedence, Establishing	CO 3

	Datums, Multiple Datum Features, Mathematically Defined Surface, Multiple Datum reference Frames, Functional Datum Features, Rotational Constraint about a Datum Axis or Point, Application of MMB, LMB and RMB to Irregular Features of Size, Datum Feature Selection Practical Applications, Simultaneous Requirements, Restrained Condition, Datum Reference Frame Identification, Customized Datum Reference Frame Construction, Application of a Customized Datum Reference Frame, Datum Targets	
IV	**Form Tolerances:** Form Control, Specifying Form Tolerances, Application of Free-State Symbol Orientation Tolerances: Orientation Control, Orientation Symbols, Specifying Orientation Tolerances, Tangent Plane, Alternative Practice **Location Tolerances:** Positional Tolerancing, Positional Tolerancing Fundamentals – I and II, Pattern Location, Coaxial Feature Controls, Tolerancing for Symmetrical Relationships	CO 4
V	**Profile Tolerances:** Profile, Tolerance Zone Boundaries, Profile Applications, Material Condition and Boundary Condition Modifiers as **Composite Profile,** Multiple Single-Segment Profile Tolerancing, Combined Controls **Runout Tolerances:** Runout, Runout Tolerance, types of Runout Tolerances, Applications, Specification.	CO 4

Learning Recourse(s)
Text Book(s)
1. Geometric Dimensioning and Tolerancing by P.S. Gill, (Publ.) S. K. Kataria & Sons
Reference Book(s)
1. . Geometric Dimensioning and Tolerancing: Applications and Techniques for Use in Design: Manufacturing, and Inspection, by James D. Meadows, CRC Press, 1995 2. Simplified GD & T: Based on ASME-Y 14.5-2009 by Ashok Kumar 2nd Edition, Azuko Publishing **2009**

AUTOMATION IN MANUFACTURING

Course Code	19ME4801C	**Year**	IV	**Semester**	II
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Describe the basic concepts of automation and automated flow lines	L2
CO2	Analyze automated flow lines and line balancing methods.	L2
CO3	Explain the importance of material handling, automated inspection systems in automated assembly.	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3											1	3	1
CO2	3	3	2			2				2		1	3	1
CO3	3	2	2									1	3	1

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**INTRODUCTION TO AUTOMATION:** Automation in Production Systems-Types of Automation, Automation Principles and Strategies, Basic elements of an automated system, Advanced automation Functions - Safety Monitoring, Maintenance and Repair Diagnostics, Error Detection and Recovery, Levels of automations-Five levels of automation and control in manufacturing. **AUTOMATED FLOW LINES**: Methods of work part transport, Work part Transfer Mechanisms, Storage Buffer	CO 1
II	**ANALYSIS OF AUTOMATED FLOW LINES:** General terminology, analysis of transfer lines with and without buffer storage, partial automation, implementation of automated flow lines. **LINE BALANCING:** Line Balancing Algorithms-Largest Candidate Rule, Kilbridge and Wester Method, Ranked Positional Weights Method, ways for improving line balance.	CO 2
III	**AUTOMATED ASSEMBLY SYSTEMS:** Types and configurations, Parts delivery at workstations, Applications, Calculation of feed rates, cycle time for single station assembly system, Partial Automation Product design for automated assembly.	CO 3

IV	**AUTOMATED GUIDED VEHICLE SYSTEMS**: Types of Vehicles, AGVS Applications, Vehicle guidance technologies, Vehicle Management, Vehicle Safety, Rail guided vehicles, Conveyor systems **AUTOMATED STORAGE SYSTEMS:** Fixed-Aisle Automated Storage/Retrieval Systems, Types, AS/RS Applications, Carousel Storage Systems, Carousel Applications.	CO3
V	**AUTOMATED INSPECTION SYSTEMS:** Overview of Automated Identification Methods, Bar Code Technology, Radio Frequency Identification, Other AIDC Technologies-Magnetic Stripes, Optical Character Recognition, and Machine Vision	CO3

Learning Recourse(s)

Text Book(s)

1. Mikell P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing*"* 4th Edition, *Pearson Education*, 2003.
2. Assembly Automation and Product Design, by Geoffrey Boothroyd, 2nd Edition, Taylor and Francis

Reference Book(s)

1. Morris, S.Brian (1994), "Automated Manufacturing Systems", (McGraw Hill) ISBN: 0-07-113999-0.
2. Automation by W. Buekinsham.

e- Resources & other digital material

1. https://nptel.ac.in/courses/112/104/112104288/

OPTIMIZATION TECHNIQUES

Course Code	19ME4801D	**Year**	IV	**Semester**	II
Course Category	Program Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Apply various Classical optimization techniques	L3
CO2	Select suitable Numerical method for optimization of Engineering Problems.	L4
CO3	Analyze multi stage decision making process through dynamic programming	L4
CO4	Enumerate fundamentals of Integer programming technique	L3

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	3	2		2		2		2		2	2	2
CO2	2	3	3	2		2		2		2		2	2	2
CO3	2	3	3	2		2		2		2		2	2	2
CO4	2	2	3	2		2		2		2		2	2	2

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**Introduction to optimization**: Introduction, engineering applications of optimization, statement of an optimization problem-design vector, design constraints, constraint surface, objective function, classification of optimization problems, optimization techniques. **Classical Optimization techniques:** Introduction, single variable optimization, multi variable optimization with no constraints, multi variable optimization with equality constraints-Lagrange multiplier method.	CO 1
II	**Non-linear programming, I**: One Dimensional Minimization Methods: Introduction, unimodal function, elimination methods- unrestricted search, exhaustive search, interval halving method, Fibonacci method, golden section method, interpolation method,	CO1
III	**Non-linear programming II:** Direct Search Method- Nelder- Mead Simplex method, Indirect search methods- steepest descent method (Cauchy's method), Newton Method, Marquardt Method	CO2
IV	**Dynamic Programming:** Multistage decision processes, Concepts of sub optimization- calculus method and tabular methods, Linear programming as a case of D.P	CO3

V	**Integer Programming**: Introduction, Graphical Representation, Gomory's cutting plane method, Balas algorithm for zero-one programming, Branch-and- bound method, Penalty Function method; Basic approaches of Interior and Exterior penalty function methods.	CO4

Learning Recourse(s)
Text Book(s)
1. S.S.Rao, Engineering optimization theory and practice, , 3rd Edition, New age international,2007. 2. Van Wylen, Fundamentals of Classical Thermodynamics, .John Wylie.
Reference Book(s)
1. H.A.Taha, Operations Research, , 9th Edition, Prentice Hall of India, 2010. 2. F.S.Hillier, and G.J.Lieberman, Introduction to Operations Research, , 7th Edition, TMH, 2009.
e- Resources & other digital material
1. https://nptel.ac.in/courses/111/105/111105039/ 2. https://nptel.ac.in/courses/106/108/106108056/ 3. https://nptel.ac.in/courses/111/104/111104071/ 4. https://nptel.ac.in/courses/112/105/112105235/

INTRODUCTION TO PYTHON PROGRAMMING

Course Code	19CS2801D	**Year**	IV	**Semester**	II
Course Category	Inter Disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Understand the basic constructs of Python Programming.	L2
CO2	Apply Python Programming constructs to solve problems and make an effective report.	L3
CO3	Apply python packages to write programs for a given application.	L3
CO4	Analyze and choose appropriate data structure for solving problems	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2	3								3	3				
CO3	3													
CO4		3												

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**Introduction to Python** Features of Python, Writing and Executing First Python Program, Literal Constants, Variables and Identifiers, Reserved Words, Data Types, Input Operation, Operators and Expressions, Operations on Strings, Type Conversion, Conditional statements and iterative statements.	CO1, CO2
II	**Functions in Python** Functions: Introduction, Built-in Math Functions, User Defined Functions: Function Call, Variable Scope and Lifetime, The return statement, Lambda Functions, Recursive functions Packages in python.	CO1, CO2
III	**Strings and File Handling in Python** **Strings:** Introduction, Built-in String Functions, Slice Operation, Comparing Strings, Iterating String, Regular Expressions. **File Handling:** open, close, read and write operations.	CO1, CO2
IV	**Data Structures in Python** **Lists:** Accessing values in lists, Nested Lists, Basic List Operations. **Tuples:** Creating Tuple, Accessing values in a tuple, Basic Tuple Operations. **Dictionaries**: Creating and Accessing Dictionaries, Built-in Dictionary functions, List Vs Tuple Vs Dictionary.	CO1, CO4

V	**Packages:** Numpy -- Create, reshape, slicing, operations such as min, max, sum, search, sort, math functions etc. Pandas -- Read/write from csv, excel, json files, add/ drop columns/rows, aggregations, applying functions Matplotlib -- Visualizing data with different plots, use of subplots.	CO1, CO3

Learning Recourse(s)
Text Book(s)
1. Python Programming using Problem Solving Approach, Reema Thareja, 2017, OXFORD University Press 2. Python for Data Analysis, Wes McKinney, 2012, O.Reilly.
Reference Book(s)
1. Core Python Programming, R. Nageswara Rao, 2018, Dreamtech press. 2. Programming with python, T R Padmanabhan, 2017, Springer.
e-Resources and other Digital Material
1. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf 2. https://zhanxw.com/blog/wp-content/uploads/2013/03/BeautifulCode_2.pdf

INSTRUMENTATION AND SENSOR TECHNOLOGIES OF CIVIL ENGINEERING APPLICATIONS

Course Code	19EC2801B	**Year**	IV	**Semester**	II
Course Category	Inter Disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Summarize various performance characteristics of instruments and the quality of measurement.	L2
CO2	Interpret the type of transducer based on the transduction principles.	L2
CO3	Identify the relevant transducer for measurement of physical quantities.	L3
CO4	Discover the additional attributes in advanced sensors and their role in Civil Engineering.	L4

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	2	1										2
CO2	2	1	2	1										2
CO3	2	1	2	1										2
CO4	2	1	2	1										2

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**Introduction:** Definition of sensor/transducer-Block Diagram-elements of measurement system-classification of sensors/transducers-static characteristics-accuracy, precision, resolution, linearity, sensitivity, range, loading effect, threshold, dead time, dead zone, span. **Errors in measurement**: True value, static error, static correction, scale range and scale span, error calibration curve, readability, repeatability & reproducibility, drift and noise	CO1
II	**Resistive Transducers:** Potentiometers-Linear POT, Rotary POT, characteristics of POT. Thermistors- Construction and its Resistance- Temperature characteristics. Thermocouples- Construction and its Resistance-emf characteristics **Inductive Transducers**: Principle of change of self-inductance, Principle of change of mutual inductance, Linear variable differential transformer (LVDT), Rotary variable differential transformer (RVDT).	CO2, CO3

III	**Capacitive Transducers**: Introduction-Variable area type-variable air gap type- differential arrangement in capacitive transducers, variation of dielectric constant for measurement of liquid level, , variation of dielectric constant for measurement of displacement, advantages & disadvantages of Capacitive transducers . **Piezoelectric Transducers**: Measurement of Force, Modes of operation of Piezoelectric crystals, properties of Piezoelectric crystals, use of Piezoelectric Transducers.	CO2, CO3
IV	**Hall effect Transducers:** Hall effect element, Measurement of displacement, current and power. **Optical Transducers:** Vacuum photo emissive cell and its characteristics, semiconductor photo electric transducer- Photo conductive cell and its characteristics, photo diode and its characteristics, photo voltaic cell and its characteristics.	CO2, CO3
V	**Digital and Smart Sensors:** Introduction to digital encoding transducer- digital displacement transducers- shaft encoder-optical encoder, Introduction to Smart Sensors, Overview in Applications of sensors in Civil Engineering.	CO4

Learning Recourse(s)

Text Book(s)

1. A.K.Ghosh, "Introduction to Measurements & Instrumentation", IIIrded, PHI
2. A.K.Sawhney&PuneetSawhney, "A Course in MechnanicalMeasuremnets& Instrumentation",DhanapatRai& Co.
3. D.V.S.Murty, "Transducers & Instrumentation", PHI.

Reference Book(s)

1. Raman Pallas-Arney& John G.Webster, "Sensors & Signal Conditioning",2012.
2. D.Patranabis, "Sensors and Transducers" 2nd edition., PHI, 2013.
3. BC Nakra, KK Chaudhry "Instrumentation, Measurement and Analysis", 2nd Edition,TMH

LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Course Code	19HS2801A	**Year**	IV	**Semester**	II
Course Category	Inter Disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	To understanding of the fundamental logistics and supply chain management concepts.	L2
CO2	The ability to apply knowledge to evaluate and measuring logistics costs and performance.	L2
CO3	To understanding of the foundational role of logistics as it relates to Source and transportation.	L3
CO4	To awareness on how to align the management of a supply chain with corporate goals and strategies.	L4
CO5	The capability to analyze and improve pricing product and documentation	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)														
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3		2								3	3	
CO2	3	3		2								3	3	
CO3	3	3		2								3	3	
CO4	3	3		2								3	3	
CO5	3	3		2								3	3	

Syllabus		
Unit No.	**Contents**	**Mapped COs**
I	**Introduction to Logistics Management**: Introduction, Objectives, Concept of Logistics, Objectives of logistics, Types of logistics, Concept of Logistics Management, Evolution of Logistics, Role of Logistics in an Economy, Difference between Logistics and Supply Chain Management.	CO1
II	**Measuring logistics costs and performance**: The concept of Total Cost analysis – Principles of logistics costing – Logistics and the bottom-line – Impact of Logistics on shareholder value.	CO2
III	**Logistics and Supply chain relationships**: Benchmarking the logistics process and SCM operations –Mapping the supply chain processes – Supplier and distributor benchmarking–identifying logistics performance indicators – Channel structure.	CO3

IV	**Sourcing and Transporting:** sourcing decisions and transportation in supply chain – infrastructure suppliers of transport services – transportation economics.	CO4
V	**Pricing Product and Documentation:** Pricing - Revenue Management Lack of coordination and Bullwhip Effect - Impact of lack of coordination - Documentation - functions and types.	CO5

Learning Recourse(s)

Text Book(s)

1. Donald J.Bowersox and David J.Closs: "Logistical Management" The Integrated Supply Chain Process, TMH, 2011.
2. Edward J Bradi, John J Coyle: " A Logistics Approch to Supply Chain Management, Cengage Learning, New Delhi, 2012.

Reference Book(s)

1. D.K.Agrawal: "Distribution and Logistics Management", MacMillan Publishers, 2011
2. Sunil Chopra and Peter Meindl: "Supply chain Management: Strategy, Planning and Operation", Pearson Education, New Delhi 2013
3. Rahul V Altekar: Supply Chain Management, PHI Learning Ltd, New Delhi, 2009

TOTAL QUALITY MANAGEMENT

Course Code	19ME2801B	**Year**	IV	**Semester**	II
Course Category	Inter Disciplinary Elective	**Branch**	ME	**Course Type**	Theory
Credits	3	**L – T – P**	3 – 0 – 0	**Prerequisites**	Nil
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes		**Level**
After successful completion of the course, the student will be able to		
CO1	Develop an understanding on quality management philosophies and frameworks	L2
CO2	Acquire knowledge of quality costs and leadership	L2
CO3	Illustrate concepts of customer focus, continuous quality improvement and supplier partnership	L2
CO4	Explain TQM tools to improve management processes.	L2
CO5	Determine the set of indicators to evaluate performance excellence of an organization	L2

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3-High, 2: Medium, 1: Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2				2	3		3	3	1	2	1	3	2
CO2	2				2	3		3	3	1	2	1	3	2
CO3	2				2	3		3	3	1	2	1	3	2
CO4	2				2	3		3	3	1	2	1	3	2
CO5	2				2	3		3	3	1	2	1	3	2

Syllabus

Unit No.	**Contents**	**Mapped COs**
I	**Introduction:** Definition of Quality, Factors effecting quality, Quality management, Quality Dimensions, four phases of quality, Total Quality, Salient features of Total Quality Management (TQM)-definition of TQM, Elements of TQM, Principles of TQM, Pillars of TQM, Traditional Approach and TQM Approach. **Characteristics of TQM:** TQM Enablers, Approaches, relevance, Barriers to TQM Implementation	CO1
II	**Quality costs:** Cost classification, Basic cost of quality. Applications and Importance of quality cost. **Quality leadership:** Quality of leadership, Quality of successful leader, leadership for TQM, Deming Philosophy, Contributions of Gurus of TQM	CO2
III	**Customer Focus:** Customer Complaints and suggestions, panels, Customer satisfaction, Customer Perception of Quality, Customer driven quality circles, Customer focus and activities, needs and expectations,	CO3

	Organizations action from the customer point of view. **Continuous Quality Improvement** - Juran Trilogy, PDCA Cycle, Kaizen-kaizen suggestion's, program introduction at work place, principles of kaizen. Supplier Partnership - Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development	
IV	**TQM Tools:** Benchmarking - Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) - House of Quality, QFD Process, Benefits. Taguchi Quality Loss Function. **Total Productive Maintenance (TPM)** - Concept, Improvement Needs, FMEA - Stages of FMEA, the seven tools of quality, Process Capability-Concept, Methods of calculating process capability, Process capability index, Concept of six sigma.	CO4
V	Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, documentation Quality Auditing – QS 9000 - ISO 14000 - Concepts, Requirements and Benefits – TQM, Implementation in manufacturing and service sectors.	CO5

Learning Recourse(s)
Text Book(s)
1. Dale H.Besterfiled, "Total Quality Management", Pearson Education, Delhi, 2006. 2. K. C. Arora, "Total Quality Management", Kataria & sons., New Delhi, 2005.
Reference Book(s)
1. Subburaj Ramasamy, "Total Quality Management", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2005. 2. Narayana V and Sreenivasan N.S., Quality Management - Concepts and Tasks, New Age International, Delhi, 1996.
e- Resources & other digital material
1. https://nptel.ac.in/courses/110/105/110105039/ 2. https://nptel.ac.in/courses/110/104/110104085/ 3. https://nptel.ac.in/courses/110/104/110104080/# 4. https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-mg18/

PROJECT PHASE – II

Course Code	19ME3861	**Year**	IV	**Semester**	I
Course Category	Project	**Branch**	ME	**Course Type**	Theory
Credits	7	**L – T – P**	0 – 0 – 14	**Prerequisites**	Nil
Continuous Internal Evaluation	100	**Semester End Evaluation**	100	**Total Marks**	200