ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

MECHANICAL ENGINEERING

B.Tech - Four Year Degree Course

(Applicable for the Batches Admitted from 2019 - 2020)

R-19

(Choice Based Credit System)

NEC
NARASARAOPETA
ENGINEERING COLLEGE
(AUTONOMOUS)

Kotappakonda Road, Yellamanda (P),
Narasaraopet - 522 601, Guntur Dist.,
Andhra Pradesh, INDIA.

R19
Academic Regulations, Course Structure and Syllabus

B.TECH

Mechanical Engineering

(4 Year Program)

NEC
NARASARAOPETA
ENGINEERING COLLEGE
(AUTONOMOUS)

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ENGINEERING COLLEGE
(AUTONOMOUS)

Kotappakonda Road, Yellamanda (Post), Narasaraopet – 522601, Guntur District, AP
Approved by AICTE, New Delhi & Permanently affiliated to JNTUK, Kakinada, Code: 47,
Accredited by NBA & NAAC, RTA Approved Pollution test Centre, ISO 9001 : 2008 Certified Institution
Phone : 08647-239905 Website:www.nrtec.in

INSTITUTE VISION AND MISSION

VISION:

To emerge as a Centre of excellence in technical education with a blend of effective student centric teaching learning practices as well research for the transformation of lives and community.

MISSION:

M1: Provide the best class infrastructure to explore the field of engineering and research

M2: Build a passionate and a determined team of faculty with student centric teaching, imbibing experiential, innovative skills

M3: Imbibe lifelong learning skills, entrepreneurial skills and ethical values in students for addressing societal problems.

DEPARTMENT VISION AND MISSION

VISION:

To strive for making competent Mechanical Engineering Professionals to cater the real time needs of Industry and Research organizations of high repute with Entrepreneurial Skills and Ethical Values.

MISSION:

M1: To train the students with state of art infrastructure to make them industry ready professionals and to promote them for higher studies and research.

M2: To employ committed faculty for developing competent Mechanical Engineering graduates to deal with complex problems.

M3: To support the students in developing professionalism and make them socially committed mechanical engineers with morals and ethical values.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The Students will be able to

I. Excel in profession with sound knowledge in mathematics and applied sciences

II. Demonstrate leadership qualities and team spirit in achieving goals

III. Pursue higher studies to ace in research and develop as entrepreneurs

PROGRAM SPECIFIC OUTCOMES (PSOs)

I. The students will be able to apply knowledge of modern tools in manufacturing enabling to conquer the challenges of Modern Industry.

II. The students will be able to design various thermal engineering systems by applying the principles of thermal sciences.

III. The students will be able to design different mechanisms and machine components of transmission of power and automation in modern industry.

ACADEMIC REGULATIONS R-19 FOR B.TECH

(Applicable for the students of B.Tech admitted from the academic year 2019-20)

1. PREAMBLE

The rapid transformation in every sphere of life is augmenting the need to prepare the present fast-paced generation to adapt to the changing knowledge & skill requirement on a life-long basis, in the fields of science, engineering, technology and humanities to influence society positively. The future looks up to multi-disciplinary, competent leaders who are Information and Communication Technology ready and driven by strong ethical values.

NEC envisions to nurture knowledge, skills, attitude and values of the aspiring youth to enable them to become global citizens and towards that process, the institution has evolved a flexible integrated academic curriculum.

NEC introduced Outcome Based Education (OBE) and Choice Based Credit System (CBCS), which emphasized on honing the skills and knowledge of the graduates.

NEC is ambitious to develop a new academic regulation, curricular framework and syllabi for its UG programmes. This effort is undertaken to address the present challenges in the educational system and also to be ahead of the curve with respect to innovative practices.

2. PROGRAMS OFFERED BY THE COLLEGE

Narasaraopeta Engineering College (NEC) offers a 4-year (8 semesters) **Bachelor of Technology** (B.Tech.) degree programme, under Choice Based Credit System (CBCS) for the following branches of Engineering.

S. No.	Name of the Program	Program Code
1.	Civil Engineering (CE)	01
2.	Electrical and Electronics Engineering (EEE)	02
3.	Mechanical Engineering (ME)	03
4.	Electronics and Communication Engineering (ECE)	04
5.	Computer Science and Engineering (CSE)	05
6.	Information Technology (IT)	12

3. ELIGIBILITY FOR ADMISSION

The total seats available as per the approved intake are grouped into two categories viz. category A and Category B with a ratio of 70:30 as per the state government guidelines vide G.O No.52.

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

a. Under Category A: 70% of the seats are filled through EAMCET counselling.
b. Under Category B: 30% seats are filled based on 10+2 merits in compliance with guidelines of APSCHE

Admission eligibility - Under Lateral Entry Scheme

Students with diploma qualification have an option of direct admission into 2nd year B. Tech. (Lateral entry scheme). Under this scheme 10% seats of sanctioned intake will be available in each course as supernumerary seats. Admissions to this three-year B Tech later entry Programme will be through ECET. The maximum period to complete B. Tech. under lateral entry scheme is six consecutive academic years from the date of joining.

Academic Calendar

For all the eight semesters a common academic calendar shall be followed in each semester by having sixteen weeks of instruction, one week for the conduct of practical exams and with three weeks for theory examinations and evaluation. Dates for registration, sessional and end semester examinations shall be notified in the academic calendar of every semester. The schedule for the conduct of all the curricular and co-curricular activities shall be notified in the planner.

4. AWARD OF B.TECH. DEGREE

A student will be declared eligible for the award of the B.Tech. degree if he/she fulfils the following academic regulations:

i) Pursue a course of study for not less than four academic years and not more than eight academic years.
ii) Registers for 160 credits and secures all 160 credits.

Students, who fail to fulfil all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall **forfeit** their seat in B.Tech. course and their admission stands cancelled.

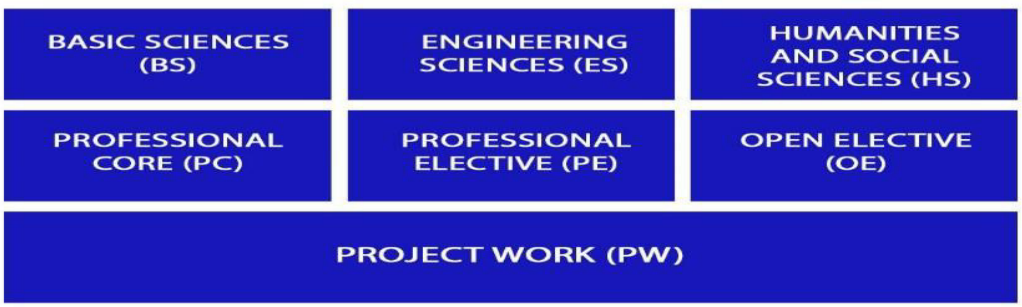
The medium of instruction for the entire undergraduate programme in Engineering and Technology will be in English only.

5. ABOUT PROGRAM RELATED TERMS

i. **Credit:** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (Lecture/Tutorial) or two hours of practical work/field work per week.
ii. **Academic Year:** Two consecutive (one odd + one even) semesters constitute one academic year.
iii. **Choice Based Credit System (CBCS):** The CBCS provides choice for students to select from the prescribed courses.
iv. Each course is assigned certain number of credits based on following criterion:

	Semester	
	Periods / Week	Credits
Theory (Lecture/Tutorial)	02	02
	03	03
	04	04
Practical	02	01
	03	1.5
	04	02
Project	14	07
MOOCs	-	01

v. Every B. Tech. Programme will have a curriculum consisting of theory, practical, project courses that shall be included in any of the following categories. The typical curriculum structure for UG degree programmes are based on AICTE and University norms and is given below.



5.1 SUBJECT / COURSE CLASSIFICATION

All subjects/ courses offered for the under graduate programme in B.Tech. degree are broadly classified as follows. NEC has followed almost all the guidelines issued by JNTUK/AICTE/UGC

S.No	Broad Course Classification	Course Group/Category	Course Description	No. of Credits
1	FOUNDATION COURSES	BS – Basic Sciences	Includes Mathematics, Physics and Chemistry Subjects	25
2		ES – Engineering Sciences	Includes fundamental engineering subjects like Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering, etc.	24
3		HS – Humanities and Social Sciences	Includes subjects related to Humanities, Social Sciences and Management Courses like English, Professional Ethics and Human Values, Communication skills and Environmental Science and Engineering	12
4	Core Courses	PC – Professional Core	Includes core subjects related to the parent discipline/ department/ branch of Engineering.	48
5	Electives	PE – Professional Electives	Includes elective subjects related to the parent discipline/ department/ branch of Engineering.	18
6		OE – Open Electives	Elective subjects which include inter- disciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering	18
7	Project Work	PR-Project Work	B.Tech. Project or UG Project or UG Major Project	14
8		Industrial training/ Internship	Industrial training/ Summer Internship	
9		Mini- project	Industrial Oriented Mini-project/ Mini-project	
10	Mandatory Courses (MC)	Mandatory Courses (non-credit)		0
11	MOOCS	PE – Professional Elective	Subjects related to the parent discipline/ department/ branch of Engineering.	01
Total				160

5.2. INDUCTION PROGRAM

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

A two-week induction program for first year B.Tech students is to be held in zero semester. Regular classes will start after the induction program.

The objectives of the program are as follows:

1. Assimilation in the ethos and culture of the institution
2. Exposure to a larger vision of life
3. Bonding among students and teachers
4. Learning a creative skill in arts
5. Regular lifestyle and professional discipline
6. Special assistance for needy students for improving proficiency in English and Mathematics

The above objectives will be achieved through the following activities:

1. Physical activity: Yoga, Mild Exercise, Games and sports etc.
2. Creative arts: Painting, Photography, music, dance etc.
3. Literary activity: General reading, writing summaries, debating, enacting a play etc.
4. Human Values: Discussion/Lectures in small groups of students with a faculty member
5. Lectures by eminent people: From industry, entrepreneurs, public life, social activists, alumni
6. Exposure to department/branch, Innovation, Exploring Engineering.

6. DISTRIBUTION AND WEIGHTAGE OF MARKS

The performance of a student in each semester shall be evaluated subject – wise with a maximum of 100 marks for Theory, 50 marks for Practical Subject / Mini Project and 50 marks for Practical Training / Internship. The Project Work shall be evaluated for 200 marks.

6.1. THEORY

For all theory subjects consisting of 5 units in each subject, the assessment shall be for 40 marks through internal evaluation and 60 marks through external end semester examination of 3 hours duration.

6. 1.a. INTERNAL EVALUATION

The internal evaluation will be based on two cycle tests conducted in each semester. The 40 internal marks will be awarded as sum of 75% of the best cycle and 25% of the least cycle examinations, where each cycle of examination contains

Descriptive test	- 20 Marks
Objective test	- 10 Marks
Assignment test	- 10 Marks

Syllabus is framed for 5 Units. **First descriptive** test question paper contains 3 questions from 50% of the syllabus i.e. 1st, 2nd and half of 3rd unit. **Second descriptive** test in remaining half of 3rd Unit, 4th Unit and 5th Units of each subject in a semester. The student has to answer all the 3 questions (10 marks questions from 1st and 2nd units and 5 marks question from half of the 3rd unit totalling to 25 marks). These 25 marks will be scaled down to 20 marks. The descriptive examination will be conducted in 1½ hour duration.

Each Objective type test 1 question paper (Online examination) contains 20 objective Multiple-choice questions for 10 marks covering the syllabus of 1st ,2nd and half of 3rd unit. The Objective Examination (online) will be conducted for a duration of the 20 minutes on the day of descriptive exam. Objective test 2 shall contains 20 Multiple choice questions for 10 marks covering the syllabus from the remaining half of the 3rd unit, 4th and 5th Units.

Two assignments will be conducted for each cycle. In first cycle first assignment will be from 1st unit for 10 marks. 5 or 6 questions will be given in the classroom at least one week in advance. Student must answer two questions in classroom which are given at random as per the schedule given by exam cell. Second assignment test for 10 marks of first cycle will be conducted from 2nd unit. 5 or 6 questions will be declared in the class room at least one week in advance. Student has to answer two questions in class room which are given at random as per the schedule given by exam cell.

First cycle assignment marks (10 marks) is calculated from the two assignments (1&2) i.e. 75% of best assignment and 25% of the least assignment.

Similarly, for second cycle assignment test 3 for 10 marks will be conducted from remaining half of the 3rd unit (after first mid syllabus) and half of the 4th unit. 5 or 6 questions will be given in the classroom at least one week in advance. Student must answer two questions in classroom which are given at random as per the schedule given by exam cell.

Assignment test 4 will be from remaining half the fourth unit and half of the 5th unit for 10 marks. 5 or 6 questions will be declared in the classroom at least one week in advance. Student has to answer two questions in class room which are given at random as per the schedule given by exam.

Second cycle assignment marks (10 marks) is calculated from the two assignments (3 &4) i.e. 75% of best assignment and 25% of the least assignment

First cycle (Descriptive, objective and assignment) is conducted for 1st ,2nd and half of 3rd Unit and second cycle is remaining half of 3rd unit, 4th & 5 units of each subject in semester.

Final internal semester marks shall be arrived at by considering the marks secured by the student in both the cycle examinations with 75% weightage given to the best cycle exam and 25% to the other.

Final internal marks = 75% of best cycle and 25% of the least cycle.
=(0.75 x best cycle) + (0.25 x least cycle)

If the student is absent for any one internal examination, the final internal semester marks shall be arrived at by considering 75% weightage to the marks secured by the student in the appeared examination and zero to the other.

Final internal marks = 75% of best cycle and 25% of the least cycle.
= (0.75 x best cycle) + (0.25 x 0)

6.1.b. EXTERNAL EVALUATION

End semester examinations will be conducted for 60 marks. The Question paper consists of five questions and each question carries 12 marks from all the five units. Each of the question is from one unit and may contain sub-questions. There will be two questions from each unit and student should answer any one of the two questions. The examination duration is 3 hours

6.2. PRACTICALS

For practical subjects there shall be continuous evaluation during the semester.

6.2.a. INTERNAL EVALUATION

There shall be continuous evaluation during the semester for 20 internal marks.
The internal marks shall be awarded as follows:

i) Day to day performance: Record (4M) +Experiment (4M) + Viva (2M) - 10Marks
ii) Internal Lab Test : 10 Marks

Total = i +ii =10+10 = 20 Marks.

6.2.b. EXTERNAL EVALUATION

For practical subjects there shall be an external examination at the end of the semester for 30 marks in the presence of an external examiner. The examination duration is 3 hours.

6.3 DRAWING SUBJECTS

For the subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, etc.,) and estimation, the distribution shall be 40 marks for Internal Evaluation and 60 marks for End Examination.

The 40 internal marks will be evaluated as follows:

Internal Tests : 20 marks. (1½ hour duration)
Day – to – day work: 20 marks (evaluation of charts)

In the internal test, 3 questions will be given to the student and he has to answer all the three questions (2 x10 =20 marks from 1st and 2nd units and 5 marks from half of the 3rd unit totalling 25 marks scaled down to 20 marks)

There shall be two internal tests in a semester. The sum of 75% of the best and 25% of the least of two internal tests shall be considered for the award of internal marks.
The syllabus for the subject "**Machine drawing and CAD Lab**" consists of two major portions:

1. Unit 1, 2 –Conventional drawing pattern.
2. Unit 3 and 4 - CAD lab using drafting packages

The distribution of internal and external marks is 40 and 60 marks respectively.

Internal Evaluation: Max Marks: 40

The total internal evaluation marks are distributed in the following two components:

1. Day-to-day work : 20 Marks (Evaluation of Charts)
2. Descriptive Test : 20 Marks

Cycle–I Examination – Conventional drawing pattern

In Cycle-I examination the 40 marks will be awarded as follows:

Day-to-day evaluation - 20 Marks
Internal Test - 20 Marks

In the Descriptive Test of duration 2 hours, one question for 20 marks will be given to the student.

Cycle–II Examination – Computer lab pattern using any drafting packages for duration of 2 hours.

In Cycle-II examination the 40 marks will be awarded as follows:

Day-to-day evaluation - 20 Marks
Internal Test - 20 Marks

Of two cycle examinations conducted during the semester, sum of 75% of the best and 25% of the least of two cycle examinations shall be considered for the award of internal marks.

End Examination (Total Duration: 4 hours, Max, marks: 60) in the presence of external examiner
Conventional drawing pattern (Duration: 2 Hours, Marks: 30)

Computer lab pattern using any drafting packages (Duration: 2 Hours, Max:30)
(Note: Both Conventional drawing pattern and Computer lab pattern using any drafting packages are compulsory and are to be conducted in separate sessions)

6.4. MANDATORY NON-CREDIT COURSES

A student is required to take up Non-Credit / Mandatory courses (zero credit), viz. Environmental Science, Constitution of India, Community service, Advanced Communication Skills (ACS), Quantitative Aptitude and Reasoning (QAR), MOOCs (Massive Open Online Courses) etc., as and when the courses are offered. The B.Tech degree shall only be awarded only if a student gets satisfactory grade in each of the mandatory non-credit courses besides acquiring 160 credits.

A student has to repeat the course if he does not get satisfactory grade in each non- credit course for getting the degree awarded.

Advanced Communication Skills (ACS) & Quantitative Aptitude & Reasoning (QAR) :

There will be two online internal examinations of 40 marks of each and another 20 marks will be awarded based on day to day evaluation. The student has to secure a minimum of 40 marks out of the above mentioned 100 marks to secure satisfactory report.

Community Service:

Community service gives an opportunity to explore the leadership skills, Team work and develop empathy in real world. Students have to spend time in hospitals, temples, at traffic signals, old age homes, and orphanage homes at least 24 hours during that semester.

Old age homes: The students will go to old age homes and fulfil the special needs and requirements that are unique to senior citizens. They help the old people by taking them to hospitals.

Hospitals: in hospitals the students help them to maintain hygiene, help the people who cannot understand the medical terms, give directions to the old people who are unable to read the signs, serve them by distributing food.

Traffic clearance: Help the people understand the traffic rules, help the disabled persons, Children and old people to cross the roads.

Temple services: During the festivals the students give the directions to pilgrims, distribute the food and help the old and disabled people to get their darshan in the temple.

6.5 PRACTICAL TRAINING / INTERNSHIP

As a part of curriculum in all branches of Engineering, it is mandatory for all students to undergo summer internship Programme at industries (core or allied) / R & D organization to get practical insight of their subject domain during summer break after the 6th semester. This internship

Programme shall be availed by the students in a duration of minimum 2 weeks or maximum of 4 weeks and the assessment shall be carried out by internal experts.

After the completion of internship, the student shall submit a certificate, a technical report and presentation to the concerned departmental committee constituted by the HOD for evaluation. 50 marks shall be awarded for the submission of certificate, technical report, presentation and Viva-Voce examination.

Students are advised to take up Industrial Internship. In case, the student is unable to obtain the internship, they can opt for Practical Training at College.

Assessment for Practical Training:

The practical training gained by student shall be assessed for 50 marks. The time duration for Practical Training shall be 2 to 4 weeks during the inter-semester break. The training shall be evaluated through continuous assessment. After the completion of Practical Training the student shall submit a report and presentation to the Departmental Committee constituted by HOD for evaluation. A total of 50 marks shall be awarded for day to day performance, submission of report, presentation and Viva-Voce examination.

6.6. MINI PROJECT

Mini Project shall be evaluated for a total of 50 marks. Out of a total of 50 marks, 20 marks shall be awarded for internal evaluation consisting of day-to-day work, reviews, the assessment of the project report and 30 marks will be awarded for the external evaluation. The external evaluation shall be conducted by the committee. The committee consists of an External Examiner, Head of the Department and Supervisor of the Project. The evaluation of mini project work shall be conducted as and when offered.

Mini Project:
Continuous Assessment (Internal Evaluation): 20 Marks
Distribution

Literature Survey	: 04 Marks
Innovativeness of the Project	: 04 Marks
Review 1	: 04 Marks
Review 2	: 04 Marks
Marks Final Presentation	: 04 Marks

6.7. PROJECT WORK

Out of a total of 200 marks for the project work, 80 marks shall be awarded for Internal Evaluation consisting of day-to-day work, reviews, the assessment of the project report and 120 marks are for the external evaluation. The external evaluation shall be conducted by the committee. The committee consists of an External Examiner, Head of the Department and Supervisor of the Project. The evaluation of project work shall be conducted at the end of the IV year II semester.

Continuous Assessment (Internal Evaluation): 80 Marks

Distribution

Innovativeness of the Project	: 05 Marks
Literature Survey	: 05 Marks
Experimentation / Simulation	: 10 Marks
Result Analysis	: 05 Marks
Review 1	: 15 Marks
Review II	: 20 Marks
Final Presentation	: 10 Marks
Project Report	: 10 Marks

6.8. MOOCS:

Meeting with the global requirements, to inculcate the habit of self-learning and in compliance with AICTE/ UGC guidelines, MOOC (Massive Open Online Course) have been introduced, Student has to complete an on-line course to fulfil the academic requirement of B.Tech course. He/she can start doing the course from II Year I semester and submit the MOOCs certificate before the commencement of the end examinations wherever the MOOCs course is offered. The student shall register on-line Course offered by any reputed organization like NPTEL, SWYAM, JNTUK MOOCS, COURSERA, edX, Udacity, etc., approved by Departmental Committee constituted by HOD. Student has to submit the progress of the MOOC's course (such as assignment submission etc.,) to the mentor or departmental committee. B.Tech. degree shall be awarded only upon submission of MOOC's certificate.

7. PASS MARK CRITERIA

A student shall be deemed to have satisfied the pass mark, if he secures not less than 35% of marks in the end examinations and a minimum of 40% of marks in the sum total of the internal evaluation and end examination taken together as detailed below.

On passing a course of a program, the student shall earn the credits as assigned to that course.

S.No	Category of Subject	Max. Marks	Internal Marks	External Marks	External pass %	External pass mark	Over all pass %	Over all pass mark
1	Theory/ Drawing	100	40	60	35	21	40	40
2	Practical	50	20	30	35	11	40	20
3	Mini Project	50	20	30	35	11	40	20
4	Project work	200	80	120	35	42	40	80
5	Practical Training/ Internship	50	50	-	-	-	40	20
6	MOOCS	Certificate must be submitted before the end semester examinations of that semester in which MOOCS course is offered.						

8. PROMOTION POLICY

8.1. ATTENDANCE REQUIREMENTS

(1) A student shall be eligible to appear for the end examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

(2) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester for genuine medical reasons shall be approved by a committee duly appointed by the college. A fee stipulated by the college shall be payable towards condonation of shortage of attendance. However, the number of condonations is restricted to **four** for the entire course.

(3) A student who is short of attendance in a semester may seek re-admission into that semester when offered next time within 4 weeks from the date of commencement of class work.

(4) If any candidate fulfils the attendance requirement in the present semester, he shall not be eligible for re-admission into the same semester.

8.2. CREDIT REQUIREMENTS

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned above.

(1) A student shall be promoted from I to II year, if he puts up the minimum attendance requirement in I year II semester, irrespective of credits earned.

(2) A student shall be promoted from II year to III year, only if he fulfils the academic requirement of 40% of the credits up to II year II semester from all the examinations, irrespective of whether the candidate takes the examination or not.

(3) A student shall be promoted from III to IV year, only if he fulfils the academic requirements of 40% of the credits up to III year II semester from all the examinations, irrespective of whether the candidate takes the examination or not.

(4) A candidate, who is not promoted either to III year or IV year due to lack of required credits can seek admission into III / IV year in subsequent years after obtaining the required credits as stipulated above.

(5) A student registers for all 160 credits and earns all 160 credits. Marks obtained in the all the courses shall be considered for the calculation of grade points/division.

(6) The registrations in mandatory courses i.e. CI, ES, MOOCS, CS is compulsory and student should get a satisfactory report.

8.3. COURSE PATTERN

(1) The entire course of study is of FOUR academic years and each year will have TWO Semesters (Total EIGHT Semesters).

(2) A student is eligible to appear for the end examination in a subject, but absent for it or has failed in the end examinations may appear for that subject in supplementary examinations, when conducted next.

(3) When a student is detained due to lack of credits / shortage of attendance, he may be re-admitted in to the same semester / year in which he has been detained.

Re-admission Criteria:

i) A candidate, who is detained in a semester due to lack of attendance has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling the required norms stipulated by the college and by paying the required tuition fee .
ii) A candidate, who is not promoted either to III year or IV year due to lack of required credits can seek admission into III / IV year in subsequent years after obtaining the required credits as stipulated in regulation by paying the required tuition fee.

9. METHOD FOR AWARDING OF GRADE POINTS FOR A SUBJECT:

After each subject is evaluated for 100 marks, the marks obtained in each subject will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Theory/ Drawing / Laboratory / Practical Training / Internship / Mini Project / Project (% of marks in a subject)	Corresponding Grade Points	Letter Grade
91 - 100	10	O (Outstanding)
81 - 90	9	A (Excellent)
71 - 80	8	B (Very Good)
61 - 70	7	C (Good)
51 - 60	6	D (Satisfactory)
40 - 50	5	E (Pass)
<40	0	F (Fail)

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

To a student who has not appeared for an examination in any subject, '**AB**' grade will be allocated in that subject, and he is deemed to have '**Failed**'. A student will be required to reappear as a 'supplementary student' in the semester end examination, as and when offered next. In this case also, the internal marks in those subjects will remain the same as those obtained earlier. A Student who involved in malpractice during the examination will be marked as MP in that subject grade.

For mandatory courses, "**Satisfactory**" or "**Unsatisfactory**" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA

10. CRITERIA FOR AWARD OF GRADES/DIVISION

10.1.Calculation of Semester Grade Point Average (SGPA)* for semester

The performance of each student at the end of each semester is indicated in terms of SGPA. The SGPA is calculated by dividing the sum of credit points secured from all subjects registered in a semester by the total no.of credits of that semester.

The SGPA is calculated as given below:

$$SGPA = \frac{\sum(CR \times GP)}{\sum CR}$$

Where CR = Credits of a subject
GP = Grade Points awarded for a subject
*SGPA is calculated for a candidate who passed all the subjects in that semester.

10.2. Calculation of Cumulative Grade Point Average (CGPA) for Entire Program:

The CGPA is a measure of the overall cumulative performance of a student in all semesters considered for a registration. CGPA is the ratio of the total credit points secured by a student in all registered courses in all semesters and the total no.of credits in all semesters.

The CGPA is calculated as given below:

$$CGPA = \frac{\sum(CR \times GP)}{\sum CR}$$

Where CR= Credits of a subject
GP = Grade Points awarded for a subject

- The SGPA and CGPA shall be rounded off to 2 decimal point and reported in the transcripts.
- Equivalent percentage = (CGPA – 0.75) x 10

CGPA is calculated for a candidate who passed all the subjects of all previous and current semester.

10.3 Award of Division:

After satisfying the requirements prescribed for the completion of the program, the student shall be eligible for the award of B.Tech Degree and shall be placed in one of the following classes:

CGPA	Class	
≥ 7.75	First Class with Distinction *(with no subject failures)	From the CGPA secured from 160 credits
≥ 6.75	First Class (with subject failures)	
≥ 5.75 & < 6.75	Second Class	
≥ 4.75 to < 5.75	Pass Class	

***First Class with Distinction:** A candidate who qualifies for the award of the Degree having passed all the courses of study of all the eight semesters (six semesters for lateral entry candidates) at the first attempt, within eight consecutive semesters (six consecutive semesters for lateral entry candidates) after the commencement of his /her study and securing a CGPA of 7.75 and above shall be declared to have passed in First Class with Distinction.

10.4. CONSOLIDATED GRADE MEMO

A Consolidated Grade Memo containing credits and grades obtained by the candidate will be issued after the completion of the four year B.Tech program.

11. REVALUATION/CHALLENGE EVALUATION

1. Student can submit the application for revaluation, along with the prescribed fee for revaluation of his answer script(s) of theory subject(s) as per the notification issued by the Controller of Examinations.
2. The Controller of Examinations shall arrange for revaluation of such answer script(s).
3. An External evaluator, other than the first evaluator shall revaluate the answer script(s).

12. MINIMUM INSTRUCTION DAYS

The minimum instruction days for each semester shall be **90 working days.**

13. There shall be **no branch transfer** after the completion of admission process.

14. WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the college or if any case of indiscipline/malpractice is pending against him, the result of such student will be kept withheld. His degree will be withheld in such cases.

15. TRANSITORY REGULATIONS

Discontinued or detained candidates are eligible for readmission as and when next offered.
A candidate, who is detained or discontinued in a semester, on readmission shall be required to do all the subjects in the curriculum prescribed for the batch of students in which the student joins subsequently. However, exemption will be given to those candidates who have already passed such subjects in the earlier semester(s) he was originally admitted into and substitute subjects are offered in place of them as decided by the Board of Studies. However, the decision of the Board of Studies will be final.

15.1 A student who is following JNTUK curriculum and detained due to shortage of attendance at the end of the first semester of first year shall join the autonomous batch of first year first semester. Such students shall study all the subjects prescribed for the batch in which the student joins and considered on par with regular candidates of Autonomous stream and will be governed by the autonomous regulations.

15.2 A student who is following JNTUK curriculum, detained due to lack of credits or shortage of attendance at the end of the second semester of first year or at the subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies

concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the subjects of the semester(s) of the batch which he had passed earlier and substitute subjects will be offered in place of them as decided by the Board of Studies. The student has to clear all his backlog subjects up to previous semester by appearing for the supplementary examinations conducted by JNTUK for the award of degree will be sum of the credits up to previous semester under JNTUK regulations and the credits prescribed for the semester in which a candidate seeks readmission and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

15.3 Transfer candidates (from non-autonomous college affiliated to JNTUK)

A student who is following JNTUK curriculum, transferred from other college to this college in second year first semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the subjects of the semester(s) of the batch which he had passed earlier and substitute subjects are offered in their place as decided by the Board of Studies. The student has to clear all his backlog subjects up to previous semester by appearing for the supplementary examinations conducted by JNTUK for the award of degree. The total number of credits to be secured for the award of the degree will be the sum of the credits up to previous semester under JNTUK regulations and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

15.4 Transfer candidates (from an autonomous college affiliated to JNTUK)

A student who has secured the required credits up to previous semester as per the regulations of other autonomous institutions shall also be permitted to be transferred to this college.

A student who is transferred from the other autonomous colleges to this college in second year first semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree.

However, exemption will be given in the subjects of the semester(s) of the batch which he had passed earlier and substitute subjects are offered in their place as decided by the Board of studies.

The total number of credits to be secured for the award of the degree will be the sum of the credits up to previous semester as per the regulations of the college from which he has transferred and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

16. Scope

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

2. In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.

3. The college may change or amend the academic regulations, course structure or syllabi at any time, and the changes or amendments made shall be applicable to all students with effect from the date notified by the College Authorities.

ACADEMIC REGULATIONS (R-19) FOR B. TECH. (LATERAL ENTRY SCHEME)

(Effective for the students getting admitted into II year from the Academic Year 2020- 21 and onwards)

1. AWARD OF B. TECH. DEGREE

A student will be declared eligible for the award of the B. Tech. Degree if he fulfils the following academic regulations.

(a) Pursue a course of study for not less than three academic years and not more than six academic years counted from the academic year of admission.

(b) The candidate registers for 120 credits and secures all the 120 credits.

CGPA	Class	
≥ 7.75	First Class with Distinction *(with no subject failures)	From the CGPA secured from 120 credits from 2nd year to 4th year
≥ 6.75	First Class (with subject failures)	
≥ 5.75 & < 6.75	Second Class	
≥ 4.75 to < 5.75	Pass Class	

2. The attendance regulations of B.Tech (Regular) shall be applicable to B.Tech (LES), whereas the number of condonations are restricted to 3.

3. PROMOTION RULE:

(a) Attendance requirement is same as regular course.

(b) A lateral entry student will be promoted from II to III year if he puts up the minimum required attendance in II year II semester irrespective of credits earned.

(c) A student shall be promoted from III to IV year only if he fulfils the academic requirements of 40% of the credits up to III Year II semester from all the examinations, whether the candidate takes the examinations or not.

4. TRANSITORY REGULATIONS:

4.1 A student who is following JNTUK curriculum and detained due to shortage of attendance at the end of the first semester of second year shall join the autonomous batch of second year first semester. Such students shall study all the subjects prescribed for the batch in which the student

joins and considered on par with Lateral Entry regular candidates of Autonomous stream and will be governed by the autonomous regulations.

4.2 A student who is following JNTUK curriculum, detained due to lack of credits or shortage of attendance at the end of the second semester of second year or at the subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the subjects of the semester(s) of the batch of them as decided by the Board of Studies.

The student has to clear all his backlog subjects up to previous semester by appearing for the supplementary examinations conducted by JNTUK for the award of degree. The total number of credits to be secured for the award of the degree will be sum of the credits up to previous semester under JNTUK regulations and the credits prescribed for the semester in which a candidate seeks readmission and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

5. All the other regulations as applicable for B. Tech. Four- year degree course (Regular) will be applicable for B. Tech. (Lateral Entry Scheme).

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT INEXAMINATIONS

- The Principal shall refer the cases of Malpractices in Internal Assessment Test and Semester end examinations to a malpractice prevention committee constituted by him for the purpose. Such committee shall follow the approved levels of punishment. The Principal shall take necessary action against the students based on the recommendations of the committee.
- Any action by the candidate trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained here under:

	Nature of Malpractices/ Improper conduct	**Punishment**
	If the candidate:	
1(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall	Expulsion from the examination hall and cancellation of the performance in that subject only.

	include any marks on the body of the candidate which can be used as an aid in the subject of the examination).	
1(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled and sent to the college.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and to 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 college examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all college examinations. The continuation of the

		course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the 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 result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s)has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already

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

OTHER MATTERS:

1. Physically challenged candidates who have availed additional examination time and a scribe during their intermediate / EAMCET examinations will be given similar concessions on production of relevant proof / documents.
2. The Principal shall deal in an appropriate manner with any academic problem which is not covered under these rules and regulations, in consultation with the Heads of the departments and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of regulation, approved in the meetings of the Heads of the departments shall be reported to the Academic Council for ratification.

GENERAL:

1. The academic council may, from time to time, revise, amend or change the regulations, schemes of examinations and / or syllabi.
2. Where ever the words ‘’he’’ ‘’him’’ ‘’his’’, occur in the regulations, they include ‘’she’’, ’’her’’, ’’hers’’.
3. The academic regulation should be read as a whole for the purpose of any interpretation.
4. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

R19 COURSE STRUCTURE

I B.TECH- I SEMESTER

S.No	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Communicative English -I	19BCC1TH01	HS	40	60	100	2	-	-	2
2	Engineering Physics	19BCC1TH02	BS	40	60	100	2	1	-	3
3	Linear Algebra & Calculus	19BCC1TH03	BS	40	60	100	3	-	-	3
4	Engineering Drawing	19BCC1TH04	ES	40	60	100	1	-	4	3
5	C Programming	19BCC1TH10	ES	40	60	100	2	1	-	3
6	English Communication Skills Lab - I	19BCC1LB01	HS	20	30	50	-	-	3	1.5
7	Engineering Physics Lab	19BCC1LB02	BS	20	30	50	-	-	3	1.5
8	C Programming Lab	19BCC1LB07	ES	20	30	50	-	-	3	1.5
9	Engineering Workshop Practice	19BCC1LB04	ES	20	30	50	-	-	3	1.5
10	Environmental Studies (MC)	19BCC1MC01	BS	-	-	-	3	-	-	0
	Total									**20.0**

I B.TECH – II SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Communicative English -II	19BCC2TH01	HS	40	60	100	2	-	-	2
2	Differential Equations & Vector Calculus	19BCC2TH02	BS	40	60	100	3	-	-	3
3	Engineering Mechanics	19BCC2TH11	ES	40	60	100	2	1	-	3
4	Engineering Chemistry	19BCC2TH03	BS	40	60	100	3	-	-	3
5	Elements of Electrical & Electronics Engineering	19BCC2TH14	ES	40	60	100	3	-	-	3
6	Mechanical Workshop Practice	19BME2LB01	ES	20	30	50	-	-	3	1.5
7	Elements of Electrical & Electronics Engineering Lab	19BCC2LB02	ES	20	30	50	-	-	3	1.5
8	Engineering Chemistry Lab	19BCC2LB03	ES	20	30	50	-	-	3	1.5
9	IT workshop	19BCC2LB07	BS	20	30	50	-	-	3	1.5
10	Constitution of INDIA(MC)	19BCC2MC01	MC	-	-	-	3	-	-	0
	Total									**20**

II B.TECH – I SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Fluid Mechanics & Hydraulic Machinery	19BME3TH02	PC	40	60	100	2	1	-	3
2	Materials Science and Metallurgy	19BME3TH04	PC	40	60	100	3	-	-	3
3	Thermodynamics	19BME3TH05	PC	40	60	100	2	1	-	3
4	Mechanics of Solids	19BME3TH06	PC	40	60	100	2	1	-	3
5	Numerical Methods & Transformations	19BCC3TH01	BS	40	60	100	2	1	-	3
6	Machine Drawing & Basic Design Engg. Soft. Lab.	19BME3TH03	ES	40	60	100	1	-	4	3
7	Fluid Mechanics & Hydraulic Machinery Lab	19BME3LB01	PC	20	30	50	-	-	3	1.5
8	Mechanics of Solids & Metallurgy Lab	19BME3LB02	PC	20	30	50	-	-	3	1.5
9	Quantitative Aptitude & Reasoning	19BCC3MC01	MC	-	-	-	3	-	-	0
10	Community Service	19BCC3MC02	MC	-	-	-	-	-	-	0
Total										**21**

II B.TECH– II SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Kinematics of Machinery	19BME4TH01	PC	40	60	100	2	1	-	3
2	Manufacturing Technology	19BME4TH02	PC	40	60	100	3	-	-	3
3	Metrology & Instrumentation	19BME4TH03	PC	40	60	100	3	-	-	3
4	Applied Thermo Dynamics	19BME4TH04	PC	40	60	100	2	1	-	3
5	**Open Elective-1**		OE	40	60	100	3	-	-	3
6	Applied Thermo Dynamics Lab	19BME4LB01	PC	20	30	50	-	-	3	1.5
7	Metrology & Instrumentation Lab	19BME4LB02	PC	20	30	50	-	-	3	1.5
8	Manufacturing Technology Lab	19BME4LB03	PC	20	30	50	-	-	3	1.5
9	English Communication Skills Lab - II	19BCC4LB01	HS	20	30	50	-	-	3	1.5
	Total									**21**

III B.TECH– I SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Business Management Concepts for Engineers	19BME5TH02	HS	40	60	100	3	-	-	3
2	Metal Cutting & Machine Tools	19BME5TH03	PC	40	60	100	3	-	-	3
3	Heat Power Engineering	19BME5TH04	PC	40	60	100	2	1	-	3
4	Design of Machine Elements -I	19BME5TH05	PC	40	60	100	2	1	-	3
5	Entrepreneurship and Innovation	19BCC5TH01	HS	40	60	100	2	-	-	2
6	**Open Elective-2**		OE	40	60	100	3	-	-	3
7	Engineering Skills Lab	19BME5LB01	PR	20	30	50	-	-	3	1.5
8	Metal Cutting & Machine Tools Lab	19BME5LB02	PC	20	30	50	-	-	3	1.5
9	Heat Power Engineering Lab	19BME5LB03	PC	20	30	50	-	-	3	1.5
Total										**21.5**

III B.TECH– II SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Design of Machine Elements -II	19BME6TH02	PC	40	60	100	2	1	-	3
2	Heat Transfer	19BME6TH03	PC	40	60	100	2	1	-	3
3	Dynamics of Machinery	19BME6TH04	PC	40	60	100	2	1	-	3
4	Complex Variables, Probability & Statistics	19BME6TH01	BS	40	60	100	2	1	-	3
5	**Professional Elective-1**		PE	40	60	100	2	1	-	3
	Automobile Engineering	19BME6PE05								
	Refrigeration and air conditioning	19BME6PE06								
	Operations Research	19BME6PE07								
	Unconventional Machining Processes	19BME6PE08								
6	**Open Elective-3**		OE	40	60	100	3	-	-	3
7	Heat Transfer Lab	19BME6LB01	PC	20	30	50	-	-	3	1.5
8	Machine Dynamics Lab	19BME6LB02	PC	20	30	50	-	-	3	1.5
9	Mini Project	19BME6MP	PR	20	30	50	-	-	3	1.0
10	Advanced Communication Skills	19BCC6MC01	MC	-	-	-	3	-	-	0
	Total									**22.0**

IV B.TECH– I SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Mechatronics	19BME7TH01	PC	40	60	100	3	-	-	3
2	Finite Element Methods	19BME7TH02	PC	40	60	100	2	1	-	3
3	Industrial Engineering and Management	19BME7TH03	PC	40	60	100	2	1	-	3
4	**Professional Elective-2**		PE	40	60	100	2	1	-	3
	Advanced Mechanics of Solids	19BME7PE04								
	Nonconventional Source of Energy	19BME7PE05								
	Quality Concepts in Design	19BME7PE06								
	CAD/CAM	19BME7PE07								
5	**Professional Elective-3**		PE	40	60	100	2	1	-	3
	Design for Manufacturing	19BME7PE08								
	Power Plant Engineering	19BME7PE09								
	Optimization Techniques	19BME7PE10								
	Smart Manufacturing	19BME7PE11								
6	**Open Elective-4**		OE	40	60	100	3	-	-	3
7	Mechatronics & Simulation Lab	19BME7LB01	PC	20	30	50	-	-	3	1.5
8	MOOCS	19BCC5MOOC	PE	-	-	-	-	-	-	1
9	Internship / Practical Training	19BCC7IPT	PR	50	-	50	-	-	-	1
	Total									**21.5**

IV B.TECH– II SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	**Professional Elective-4**		PE	40	60	100	2	1	-	3
	Experimental Stress Analysis	19BME8PE01								
	Solar Energy Systems	19BME8PE02								
	Total Quality Management	19BME8PE03								
	Robotics and Applications	19BME8PE04								
2	**Professional Elective-5**		PE	40	60	100	2	1	-	3
	Mechanical Vibrations	19BME8PE05								
	Waste Heat Recovery Systems	19BME8PE06								
	Production Planning and Control	19BME8PE07								
	Automation in Manufacturing	19BME8PE08								
3	PROJECT	19BME8PW	PR	80	120	200	-	-	14	7
Total										**13**

Distribution of Credits

S.No.	Year/Sem	HS	BS	ES	PC	PE	OE	PR	MC	TOTAL
1	I-I	3.5	7.5	9	-	-	-	-	ES	**20**
2	I-II	2	7.5	10.5	-	-	-		CI	**20**
3	II-I	-	3	3	15	-	-		QAR,CS	**21**
4	II-II	1.5	-	-	16.5	-	3			**21**
5	III-I	5	-	-	12	-	3	1.5		**21.5**
6	III-II	-	3	-	12	3	3	1.0	ACS	**22.0**
7	IV-I	-	-	-	10.5	7	3	1.0		**21.5**
8	IV-II	-	-	-	-	6	-	7		**13**
TOTAL(Actual)		**12**	**21**	**22.5**	**66**	**16**	**12**	**10.5**	**0**	**160**

S.No.	Course Work-Subject areas	Credits (as per AICTE)	Credits (as per NEC -MECH)
1	Humanities and Social Sciences (HS)	12	12
2	Basic Sciences (BS)	25	21
3	Engineering Sciences (ES)	24	22.5
4	Professional Core (PC)	48	66
5	Professional Elective (PE)	18	16
6	Open Elective (OE)	18	12
7	Project/Practical Training/Internship/Skills Lab (PR)	15	10.5
	Total Credits	**160**	**160**

LIST OF OPEN ELECTIVES OFFERED BY ALL DEPARTMENTS

Open Elective-I

S.No.	Open Elective-I Subject Title	Department Offering the Subject	Sub Code	No. of periods per week		No. of Credits
				L	T	C
1	MEMS	EEE	19BCC4OE03	3	-	3
2	Energy Audit, Conservation & Management	EEE	19BCC4OE04	3	-	3
3	RPT &3D Printing (Other than ME)	ME	19BCC4OE05	3	-	3
4	Operations Research	ME	19BCC4OE06	3	-	3
7	DBMS (Other Than CSE)	CSE	19BCC4OE11	3	-	3
8	Web Development Using Mean Stack Tech	CSE	19BCC4OE12	3	-	3
9	Principles of Signals, Systems & Communications(Other than ECE)	ECE	19BCC4OE09	3	-	3
10	Medical Electronics	ECE	19BCC4OE10	3	-	3
11	GIS	CE	19BCC4OE02	3	-	3
12	Public Health Engineering	CE	19BCC4OE01	3	-	3

Open Elective-II

S.No.	Open Elective-II Subject Title	Department Offering the Subject	Sub Code	No. of periods per week		No. of Credits
				L	T	C
1	Non-Conventional Energy Resources	EEE	19BCC5OE03	3	-	3
2	Basics in Electrical and Electronics Engineering (Other than EEE)	EEE	19BCC5OE04	3	-	3
3	Work Study	ME	19BCC5OE05	3	-	3
6	Mechatronics **(Other than ME)**	ME	19BCC5OE08	3	-	3
7	Artificial Intelligence	CSE	19BCC5OE11	3	-	3
8	OOPS through JAVA	CSE	19BCC5OE13	3	-	3
9	Fundamentals of Image Processing (Other than ECE)	ECE	19BCC5OE09	3	-	3
10	Consumer Electronics	ECE	19BCC5OE10	3	-	3
11	Disaster Management	CE	19BCC5OE01	3	-	3
12	Green Building And Sustainability	CE	19BCC5OE02	3	-	3

Open Elective-III

S.No.	Open Elective-III Subject Title	Department Offering the Subject	Sub Code	No. of periods per week		No. of Credits
				L	T	C
1	Soft Computing	EEE	19BCC6OE03	3	-	3
2	Industrial Electronics	EEE	19BCC6OE04	3	-	3
3	Automotive Vehicles	ME	19BCC6OE05	3	-	3
4	Nano Technology	ME	19BCC6OE06	3	-	3
7	Cloud Computing	CSE	19BCC6OE12	3	-	3
8	Block Chain Technologies	CSE	19BCC6OE13	3	-	3
9	Introduction to Embedded Systems (Other than ECE)	ECE	19BCC6OE09	3	-	3
10	Global Positioning System(GPS)	ECE	19BCC6OE10	3	-	3
11	Solid And Hazardous Waste Management	CE	19BCC6OE01	3	-	3
12	Ground Water Development And Management	CE	19BCC6OE02	3	-	3

Open Elective-IV

S. No.	Open Elective-IV Subject Title	Department Offering the Subject	Sub Code	No. of periods per week		No. of Credits
				L	T	C
1	Control System	EEE	19BCC7OE03	3	-	3
2	Embedded Control of Electric Drives	EEE	19BCC7OE04	3	-	3
3	Pneumatics & Hydraulic Automation	ME	19BCC7OE05	3	-	3
6	Industrial Robotics **(Other than ME)**	ME	19BCC7OE08	3	-	3
7	Cyber Security	CSE	19BCC7OE11	3	-	3
8	Ethical Hacking	CSE	19BCC7OE12	3	-	3
9	Introduction to Micro Processors & Micro Controllers(Other than ECE)	ECE	19BCC7OE09	3	-	3
10	Automotive Electronics	ECE	19BCC7OE10	3	-	3
11	Water Shed Management	CE	19BCC7OE01	3	-	3
12	Modern Construction Material	CE	19BCC7OE02	3	-	3

III B.TECH– I SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Business Management Concepts for Engineers	19BME5TH02	HS	40	60	100	3	-	-	3
2	Metal Cutting & Machine Tools	19BME5TH03	PC	40	60	100	3	-	-	3
3	Heat Power Engineering	19BME5TH04	PC	40	60	100	2	1	-	3
4	Design of Machine Elements -I	19BME5TH05	PC	40	60	100	2	1	-	3
5	Entrepreneurship and Innovation	19BCC5TH01	HS	40	60	100	2	-	-	2
6	**Open Elective-2**		OE	40	60	100	3	-	-	3
7	Engineering Skills Lab	19BME5LB01	PR	20	30	50	-	-	3	1.5
8	Metal Cutting & Machine Tools Lab	19BME5LB02	PC	20	30	50	-	-	3	1.5
9	Heat Power Engineering Lab	19BME5LB03	PC	20	30	50	-	-	3	1.5
10	MOOCS	19BCC5MOOC	MC	-	-	-	-	-	-	00
Total										**21.5**

I B.TECH- I SEMESTER

S.No	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Communicative English -I	19BCC1TH01	HS	40	60	100	2	-	-	2
2	Engineering Physics	19BCC1TH02	BS	40	60	100	2	1	-	3
3	Linear Algebra & Calculus	19BCC1TH03	BS	40	60	100	3	-	-	3
4	Engineering Drawing	19BCC1TH04	ES	40	60	100	1	-	4	3
5	C Programming	19BCC1TH10	ES	40	60	100	2	1	-	3
6	English Communication Skills Lab - I	19BCC1LB01	HS	20	30	50	-	-	3	1.5
7	Engineering Physics Lab	19BCC1LB02	BS	20	30	50	-	-	3	1.5
8	C Programming Lab	19BCC1LB07	ES	20	30	50	-	-	3	1.5
9	Engineering Workshop Practice	19BCC1LB04	ES	20	30	50	-	-	3	1.5
10	Environmental Studies (MC)	19BCC1MC01	BS	-	-	-	3	-	-	0
	Total									**20.0**

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	0	0	40	60	100	2
Code: 19BCC1TH01	**COMMUNICATIVE ENGLISH - I (Common to All Branches)**						

COURSE OBJECTIVES:

- To equip the students with appropriate oral and written communication skills.
- To inculcate the skills of listening, reading and critical thinking.
- To enhance the students' proficiency in reading skills enabling them meet the academic needs of their course.
- To enable the engineering students develop their basic communication skills in English for academic and social purposes.

COURSE OUTCOMES:

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

CO 1: **Infer** explicit and implicit meaning of a text, recognize key passages; raise questions and summarize it.

CO 2: **Compose** paragraphs, essays as creative writing**.**

CO 3: **Build** grammatically correct sentences using a variety of sentence structures.

CO 4: **Enhance** word power and usage of lexicons.

CO 5: **Compile** emails, letters, reports, resume and information transfer.

UNIT– I

1. **Akio Morita**
   a) **Speaking**: Introducing self and others.
   b) **Reading**: Skimming for main idea, scanning for specific piece of information.
   c) **Writing**: Note – making flowed by paragraph writing, effective opening sentences, introducing the topic, key words, main idea, summarize the main idea.
   d) **Grammar and Vocabulary**: Content words and function words, verbs, nouns, adjectives and adverbs. Basic sentence structure and simple question form, framing jargon, technical vocabulary (15 words)

UNIT–II

2. **Dhirubhai Ambani**
   a) **Speaking**: Discussions on specific topic
   b) **Reading**: Identifying the sequence of ideas and recognizing verbal techniques to link the ideas in a paragraph.
   c) **Writing**: Paragraph writing, using key words/phrases and organizing points in a coherent manner.
   d) **Grammar and Vocabulary**: Linkers, articles and prepositions.

UNIT–III

3. **Louis Braille**
   a) **Speaking**: Discussions on specific topic
   b) **Reading**: Sequencing of ideas and recognizing verbal techniques to link the ideas in a paragraph.
   c) **Writing**: Paragraph writing, using key words/phrases and organizing points in a coherent manner.
   d) **Grammar and Vocabulary**: Cohesive devices, articles and prepositions

UNIT-IV

4. **Mallika Srinivasan**
   a) **Speaking:** Role plays, asking for and giving information/directions/instructions
   b) **Reading**: Understand and interpret graphic elements used in texts.
   c) **Writing**: Information transfer.
   d) **Grammar and Vocabulary**: Adjectives, adverbs and antonyms.

UNIT-V

5. **Muhammad Yunus**
   a) **Speaking**: Oral presentations
   b) **Reading:** Reading for comprehension.
   c) **Writing**: Essay writing
   d) **Grammar and Vocabulary**: Articles, prepositions, tenses, subject verb agreement and technical jargon (15 words)

TEXT BOOKS:

1**.** **"**Modern Trail Blazers", Orient Black Swan Pvt.Ltd.Publisher, 1ST edition. 2013

2. English All Round -I (Communication skills for Under Graduate Learners)– Orient Black Swan Pvt.Ltd.Publisher, 1st edition,2019

REFERENCE BOOKS:

1. Raymond Murphy, *Murphy's English Grammar,* Cambridge University Press 2004
2. Meenakshi Raman, Sangeeta Sharma, *Technical Communication: English Skills for Engineers*, Oxford University Press, 2009
3. Michael Swan, *Practical English Usage,* Oxford University Press, 1996

Web References:

1. https://app.grammarly.com/
2. https://www.grammarly.com/blog
3. https://www.englishclub.com/
4. https: www.nonstopenglish.com/
5. https://www.fluentu.com/blog/english/
6. https://www.fluentu.com/blog/english/
7. http://freerice.com soon migrating to https://beta.freerice.com/

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	40	60	100	3
Code:19BCC1TH02	**ENGINEERING PHYSICS(Common to All branches)**						

COURSE OBJECTIVES:

- To impart knowledge in basic concepts of wave optics, fiber optics, properties of solid crystal materials and magnetic materials, acoustics, superconductors.
- To familiarize the applications of materials relevant to engineering field.

COURSE OUTCOMES:

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

CO 1: **Find** the experimental evidence of wave nature of light and interference in thin films, Diffraction grating and Polarisation in various fields.

CO 2: **Analyse** various types of lasers & optical fibers.

CO 3: **Explain** the crystal structures and XRD techniques.

CO 4: **Develop** the strategies to apply the concepts of magnetism in engineering field.

CO 5: **Examine** the various applications of semiconductors in engineering field.

UNIT– I

Interference & Diffraction: Introduction -Interference in thin films by reflection – Newton's rings, introduction to diffraction – difference between Fresnel's and Fraunhofer diffraction - Fraunhofer diffraction at single slit (qualitative) - Diffraction grating.

Polarization: Introduction – Types of Polarization – Double refraction – Nicol's prism-Quarter wave plate and Half Wave plate

UNIT–II

Lasers: Introduction – Characteristics of lasers – Spontaneous and Stimulated emission of radiation – Population inversion – Ruby laser – Helium Neon laser-Applications.

Fiber Optics: Introduction- Principle of optical fiber - Acceptance angle – cone - Numerical Aperture-Applications.

UNIT–III

Crystallography : Introduction – Space lattice – Basis – Unit Cell – Lattice parameters – Bravais lattices – Crystal systems – Structures and packing fractions of SC,BCC and FCC.

X-Ray Diffraction: Directions and planes in crystals – Miller indices – Separation between successive (h k l) planes – Bragg's law.

UNIT-IV

Electromagnetic Fields: Gauss and stokes theorems (qualitative) – Fundamental laws of electromagnetism – Maxwell's Electromagnetic Equations.

Magnetic materials: Magnetic Susceptibility- Magnetic permeability –Classification of Magnetic materials – Dia, Para, Ferro – Soft and Hard magnetic materials - Applications

UNIT-V

Quantum Mechanics: Introduction –de-Broglie's concept of Matter waves – Physical significance of wave function - Schrodinger Time Independent wave equations – Particle in a one dimensional potential box.

Semiconductor Physics: Origin of energy band formation in solids- classification of materials into conductors, semiconductors and insulators, Intrinsic and Extrinsic semiconductor- Hall Effect.

TEXT BOOKS:

1. A.J. Dekker, "Solid state Physics", ISBN 10: 0333918339 / ISBN 13: 9780333918333, Mc Millan India Ltd, First edition, 2000.
2. M.N. Avadhanulu & P.G. Kshirasagar, "A text book of Engineering Physics", ISBN 81-219-0817-5, S. Chand publications, First Edition, 2011.
3. P. K. Palanisamy, "Engineering Physics", ISBN: 9788183714464, Scitech Publishers, 4th Edition, 2014
4. M.R. Srinivasan, "Engineering Physics", ISBN978-81-224-3636-5, New Age international publishers, 2nd Edition,2014

REFERENCE BOOKS:

1. Charles Kittle, "Introduction to solid state physics" ISBN: 9788126578436, Willey India Pvt.Ltd, 5TH edition, 2012.
2. M.Arumugam, "Applied Physics", ISBN: 81-89638-01-7, Anuradha Agencies, 4th edition, 2013.
3. D.K.Bhattacharya, "Engineering Physics", ISBN: 0198065426, 9780198065425, Oxford University press, 2nd edition, 2010.
4. Sanjay D Jain and Girish G Sahasrabudhe "Engineering Physics", University Press ISBN: 8173716781,1st edition, 2010.
5. B.K.Pandey & S. Chaturvedi "Engineering Physics" ISBN: 8131517616, Cengage Learning, 1st edition, 2012.

Web References:

1. http://link.springer.com/physics
2. http://www.thphys.physics.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com

E-Books:

1. http://www.peaceone.net/basic/Feynman
2. http://physicsdatabase.com/free-physics-books
3. http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf
4. http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html

I B.TECH-I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	40	60	100	3
Code:19BCC1TH03	**LINEAR ALGEBRA & CALCULUS (Common to All Branches)**						

COURSE OBJECTIVES:

- Understanding basic concepts of linear algebra (systems of linear equations, matrix calculus).
- To become proficiency in solving computational problems of linear algebra.
- To acquire knowledge on mean value theorems in calculus.
- Familiarization about the techniques in calculus and multivariate analysis.

COURSE OUTCOMES:

Upon successful completion of the course, the students should be able to

CO 1: **Solve** the system of linear equations.

CO 2: **Analyze** the applications of matrices in various fields and obtain Eigen values and Eigenvectors.

CO 3: **Relate** the results of mean value theorems in calculus to Engineering problems.

CO 4: **Apply** the functions of several variables to evaluate the rates of change with respect to time and space variables in engineering.

CO 5: **Compute** the area and volume by interlinking them to appropriate double and triple integrals.

UNIT-I: LINEAR SYSTEMS OF EQUATIONS:

Rank of a matrix - Echelon form, Normal form, Solution of linear systems, Direct Methods, Gauss elimination, Gauss Jordon and Gauss Seidal Methods. Solutions of linear simultaneous equations: LU decomposition.

Application: Finding the current in a electrical circuit

UNIT – II: EIGENVALUES AND EIGENVECTORS

Eigenvalues, Eigenvectors, Properties, Cayley - Hamilton Theorem, Quadratic forms, Reduction of quadratic form to canonical form, Rank, Positive definite, negative definite, semi definite, index, signature.

Application: Finding powers and inverse of a square matrix using Cayley Hamilton's Theorem.

UNIT – III: MEAN VALUE THEOREMS

Review on limits and continuity, Mean Value theorems (without proofs): Rolle's theorem, Lagrange's theorem, Cauchy's theorem, Taylor's (Generalized mean value) theorem, increasing and decreasing functions, Maxima and minima of function of single variable.

UNIT- IV: PARTIAL DIFFERENTION:

Function of two or more variables, Partial derivatives, Total derivatives, change of variables, Jacobian - functional dependence, Taylor's theorem for Two variables. Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.

UNIT-V: APPLICATION OF INTEGRATION AND MULTIPLE INTEGRALS:

Applications of Integration to Lengths, Volumes and Surface areas of revolution in Cartesian and Polar Coordinates. Multiple Integrals- double and triple integrals, Change of Variables, Change of order of Integration.

TEXT BOOK :

1. Dr. B.S. Grewal, "*Higher Engineering Mathematics*", 43rd Edition, Khanna Publishers, 2012.

REFERENCES:

1. N.P. Bali, Bhavanari Satyanarayana, Indrani Promod Kelkar, "*Engineering Mathematics*", University Science Press, (An Imprint of Lakshmi Publications Pvt., Ltd) New Delhi, 2012.
2. Kreyszig E, "*Advanced Engineering Mathematics*", 8th Edition, John Wiley, Singapore, 2001.
3. Greenberg M D, "*Advanced Engineering Mathematics*", 2nd Edition, Pearson Education, Singapore, Indian Print, 2003.
4. Peter V. O'Neil, *"Advanced Engineering Mathematics"*, 7th Edition, Cengage Learning, 2011.
5. Bhavanari Satyanarayana, Pradeep Kumar T.V. & Srinivasulu D, "Linear Algebra and Vector Calculus", Studera Press, New Delhi, 2017.

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	1	-	4	40	60	100	3
Code: 19BCC1TH04	**ENGINEERING DRAWING (COMMON TO CIVIL & MECH)**						

COURCE OBJECTIVES:

- The students to use drawing instruments and to draw polygons, engineering Curves & engineering scales.
- The students use to make orthographic projections, projections of points, simple lines & projections of the lines inclined to both the lines.
- The students use to draw the projections of the planes inclined to both the plane.
- The students use to draw the projections of solids & development of surfaces.
- The students use to draw conversion of isometric views to orthographic views vice versa and to learn basic drawing commands in auto cad.

COURSE OUTCOMES:

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

CO 1: **Construct** the geometrical shapes of regular polygons, Engineering Curves, and scales.
CO 2: **Develop** the orthographic projections, projections of points, and lines inclined to both the planes.
CO 3: **Construct** the projection of planes inclined to both the planes.
CO 4: **Develop** the projection of regular solids and surfaces.
CO 5: **Interpret** the conversion of isometric views to orthographic views vice versa.

UNIT– I

THE BASIC CONCEPTS IN ENGINEERING DRAWING: Introduction to engineering drawing instruments, lettering and dimensioning practice. Geometrical constructions**-** Constructing regular polygons by general methods.

CURVES USED IN ENGINEERING PRACTICE: Introduction to conic sections, construction of ellipse, parabola, hyperbola by eccentricity method. Construction of ellipse by - Arcs of circles Method, Concentric Circles Method and Oblong Method, & parallelogram methods.

ENGINEERING SCALES: Introduction scales on drawings Representation fraction: Construction of plain, diagonal and vernier scale.

UNIT–II

ORTHOGRAPHIC PROJECTIONS: Introduction to type of projections, first angle and third angle projections.

PROJECTION OF POINTS: Principles of orthographic projection – Convention – First angle projections, projections of points.

PROJECTIONS OF STRAIGHT LINES:

Projections of straight lines parallel to both the planes, parallel to one plane and inclined to the other plane. Lines inclined to both the planes - Projections of straight lines inclined to both the planes- determination of true lengths, angle of inclination and traces.

UNIT–III

PROJECTIONS OF PLANES: regular planes perpendicular **/** parallel to one plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT-IV

PROJECTIONS OF SOLIDS: introduction to projections of solids, types of solids: prisms, pyramids, cones and cylinders –simple positions and the axis inclined to one of the plane.

DEVELOPMENT OF SURFACES: Development of surfaces of right regular solids- Prisms, Cylinder, Pyramids, Cone and their sectional parts

.

UNIT-V

ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS: Introduction of isometric views, isometric projections & orthographic projections. Conversion of isometric views to orthographic views and orthographic views to isometric views.

INTRODUCTION TO AUTO CAD: Practice on Draw, Edit & Modify commands using auto CAD.

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications.
2. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers.
3. Engineering Drawing & Graphics by K.Venu gopal, New age international Publishers.

REFERENCE BOOKS:

1. Engineering Graphics for Degree by K.C. John, PHI Publishers.
2. Engineering Drawing by Basant Agarwal & CM. Agarwal, Tata McGraw Hill Publishers.

Web References:

1. URL: https://www.youtube.com/watch?v=ohhdNRtDpCY,

E-Books:

1. https://www3.nd.edu/~cpoellab/teaching/cse40814/Lecture1-Handouts.pdf

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
CODE: 19BCC1TH10	**C PROGRAMMING**						

COURSE OBJECTIVE:

- To know the basic problem solving process using Flow Charts and algorithms.
- To understand the basic concepts of control structures in C.
- To learn concepts of arrays, functions, pointers and Dynamic memory allocation in C.
- To use the concepts of structures, unions, files and command line arguments in C.

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO 1: **Develop** algorithms and flow charts for simple problems.
CO 2: **Utilize** suitable control structures for developing code in C.
CO 3: **Make use of** functions and arrays in developing modular programs.
CO 4: **Make use of** structures and pointers to write well-structured programs.
CO 5: **Make use of** file Operations in C programming for a given application.

UNIT I

Introduction to Algorithms and Programming Languages: Algorithm – Key features of Algorithms – Some more Algorithms – Flow Charts – Pseudo code – Programming Languages – Generation of Programming Languages – Structured Programming Language **Introduction to C:** Introduction – Structure of C Program – Writing the first C Program -Compiling and Executing C Programs - Using Comments – Keywords – Identifiers – Basic Data Types in C – Variables – Constants – I/O Statements in C - Operators in C -Programming Examples – Type Conversion and Type Casting.

UNIT II

Decision Control and Looping Statements: Introduction to Decision Control Statements – Conditional Branching Statements – Iterative Statements – Nested Loops – Break and Continue Statement – Goto Statement.

Functions: Introduction – using functions – Function declaration/ prototype – Function Definition – function call – return statement – Passing parameters – Scope of variables –Storage Classes – Recursive functions – Recursion vs Iteration.

UNIT III

Arrays: Introduction – Declaration of Arrays – Accessing elements of the Array – Storing Values in Array – Calculating the length of the Array – Operations on Array — Two Dimensional Arrays –Operations on Two Dimensional Arrays.

Strings: Introduction – Reading Strings – Writing Strings – String Manipulation functions -Array of Strings.

UNIT IV

Pointers: Introduction to Pointers – declaring Pointer Variables – Pointer Expressions and Pointer Arithmetic – Null Pointers – Passing Arguments to Functions using Pointer, Dynamic Memory Allocation.

Structure, Union, and Enumerated Data Types: Introduction – Nested Structures –Arrays of Structures – Structures and Functions – Self-referential Structures – Union –Enumerated Data Types.

UNIT V

Files: Introduction to Files – Using Files in C – Reading Data from Files – Writing Data To Files – Detecting the End-of-file – Error Handling during File Operations – Accepting Command Line Arguments – Functions for Selecting a Record Randomly - Remove () –Renaming a File – Creating a Temporary File

TEXT BOOKS:

1. Reema Thareja**, "**Programming in C**"**, First **edition,** OXFORD University Press 2018.

REFERENCE BOOKS:

1. REEMA THAREJA, "Introduction to C programming" OXFORD UNIVERSITY PRESS
2. Rachhpal Singh, "Programming in C", kalyani publishers
3. E Balagurusamy, "computing fundamentals & c programming", isbn 978-0-07- 066909-3, Tata McGraw-Hill, Second Reprint, 2008,
4. Ashok N Kamthane, "Programming with ANSI and Turbo C", Pearson Edition Publications, 2002.
5. Dennis Richie and Brian Kernighan, "The C programming Language", 2nd edition.

WEB REFERENCES:

1. http://cprogramminglanguage.net/
2. http://lectures-c.blogspot.com/
3. http://www.coronadoenterprises.com/tutorials/c/c_intro.htm
4. http://vfu.bg/en/e-Learning/Computer-Basics--computer_basics2.pdf

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: 19BCC1LB01	**ENGLISH COMMUNICATION SKILLS LAB-I (Common to All Branches)**						

COURSE OBJECTIVES:

- To build confidence in the students to communicate effectively in English.
- To strengthen the oral communication skills to enable them to interact with the people in various social situations.
- To enable the learners improve pronunciation through emphasis on word accent, intonation and rhythm

COURSE OUTCOMES:

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

CO 1: **Develop** various conversations skills /discourses using formal and informal expressions.
CO 2: **Apply** phonological knowledge to speak English with good pronunciation, overcoming mother tongue influence.
CO 3: **Identify** and comprehend several accents of English Language by listening to audio clips.
CO 4: **Utilize** basic communication skills in JAMS and Role plays.

UNIT– I

a. Greeting, Introducing and Taking leave
b. Pure Vowels
c. Listening - TEDx Talks (https://www.ted.com/talks/ashweetha_shetty_how-education-helped-me-rewrite-my-life?language-en#t-623369)
d. Self-Introduction

UNIT–II

a. Giving information and Asking for information
b. Diphthongs
c. Listening -TEDx Talks(https://www.youtube.com/watch?v=Dk20-E0yx_s)
d. Role Play

UNIT–III

a. Inviting, Accepting and Declining Invitations
b. Consonants
c. Listening - TEDx Talks (https://www.youtube.com/watch?v=IgAnj6r1O48)
d. JAM

UNIT-IV

a. Commands, Instructions and Requests
b. Accent and Rhythm
c. Listening -TEDx Talks(https://youtu.be/SKvMxZ284AA)
d. Tables Turned

UNIT-V

a. Suggestions and Opinions
b. Intonation
c. Listening -TEDx Talks(https://youtu.be/ov6pEGXRYZo)
d. Impromptu

TEXT BOOKS:

1. *"Strengthen Your Communication Skills",* Maruthi Publications, 2013.

REFERENCE BOOKS:

1. Meenakshi Raman, Sangeeta Sharma, *Technical Communication: Principles and Practice*, Oxford University Press, 2015
2. J.D.O Conner, *Better English Pronunciation,* Cambridge University Press 1980.
3. T.Balasubramanian, "*A Text Book of English Phonetics for Indian Students"*, Macmillan,1981
4. Penny ur *Grammar Practice Activities,* Cambridge University Press, 2010.
5. Mark Hancock, *Pronunciation in Use,* Oxford University Press 2007.

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	20	30	50	1.5
Code:19BCC1LB02	**ENGINEERING PHYSICS LAB(Common to All branches)**						

COURSE OBJECTIVES:

To impart physical measurement skills and make the students understand coherence between theoretical and practical knowledge.

COURSE OUTCOMES:

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

CO 1: **Explain** the principle of physics and interpret them in engineering field and compares the results with theoretical calculations.
CO 2: **Utilize** modern engineering physics techniques and tools in real time applications in engineering studies.
CO 3: **Identify** the characteristics and the behavior of materials in a practical manner and gain knowledge and its usage.
CO 4: **Apply** the analytical techniques and graphical analysis to the experimental data.

LIST OF EXPERIMENTS:

1. Rigidity modulus of material by wire-dynamic method (torsional pendulum)
2. Determination of wavelength of a source-Diffraction Grating-Normal incidence
3. Newton's rings –Radius of Curvature of Plano Convex Lens.
4. Determination of thickness of thin wire- Air wedge method
5. Determination of wavelength of Laser Source-single slit diffraction.
6. Determine the Numerical aperture of an optical fiber.
7. Melde's experiment – Transverse and Longitudinal modes.
8. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.
9. Verification of laws of stretched string by using Sonometer.
10. Calculate the energy loss in a given ferromagnetic material by plotting B-H Curve.
11. Energy Band gap of a Semiconductor p - n junction.
12. Characteristics of Thermistor – temperature coefficient

TEXT BOOKS:

1. Engineering Physics Lab Manual by Dr.Y. Aparna & Dr.K.Venkateswarao (V.G.S.Book links).
2.Physics Practical Manual, Lorven Publications
3. S. Balasubramanian , M.N. Srinivasan " A Text book of Practical Physics"- S Chand Publishers, 2017.

Web References:

1. https://www.youtube.com/watch?v=NDsSPtL9dyQ
2. https://www.youtube.com/watch?v=9agoJRCnu4w
3. https://www.youtube.com/watch?v=bv-lLJreyCU
4. http://vlab.amrita.edu/index.php

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: 19BCC1LB07	**C PROGRAMMING LAB**						

COURSE OBJECTIVE:

The purpose of this course is to introduce to students to the field of language. The students will be able to enhance their analyzing and problem solving skills and use the same for writing programs in C.

COURSE OUTCOMES:

After completion of this C Programming Lab, students should be able to:

CO 1: **Analyze** logical structure of computer programming and different constructs to develop programs in C Language.

CO 2: **Compare** and contrast various data types and operator precedence.

CO 3: **Analyze** the use of conditional and looping statements to solve problems associated with conditions and repetitions.

CO4: **Analyze** simple data structures, use of pointers and dynamic memory allocation techniques.

CO 4: **Make use of** functions and file I/O operations in developing C Programs.

Exercise l

Construct Flowcharts for the following through Raptor:

i) Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.

ii) Calculate simple and compound interest for various parameters specified by the user.

iii) Calculate the average of n numbers.

Exercise 2

a) Write a C Program to calculate the area of triangle using the formula Area $=(s*(s-a)*(s-b)*(s-c))^{1/2}$ where s= (a+b+c)/2.

b) Write a C Program to find the largest of three numbers using ternary operator.

c) Write a C Program to swap two numbers without using a temporary variable.

Exercise 3

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

b) Write a C program, which takes two integer operands and one operator form the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

Exercise 4

a) Write a C program to find the sum of individual digits of a positive integer and find the reverse of the given number.

b) Draw a flow chart using Raptor and write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Exercise 5

a) Draw a flow chart using Raptor and write a C Program to print the multiplication table of a given number n up to a given value, where n is entered by the user.

b) Write a C Program to enter a decimal number, and calculate and display the binary equivalent of that number.

c) Write a C Program to check whether the given number is Armstrong number or not.

Exercise 6

a) Write a C program to interchange the largest and smallest numbers in the array.
b) Write a C program to input two m x n matrices, check the compatibility and perform addition and multiplication of them.

Exercise 7

a) Draw a flow chart using Raptor and write a C Program to find both the largest and smallest number of an array of integers
b) Write a C Program to find transpose of a matrix.

Exercise 8

Draw a flow chart using Raptor and write C programs that use both recursive and non-recursive Functions for the following

i) To find the factorial of a given integer.
ii)To find the GCD (greatest common divisor) of two given integers.

Exercise 9

a) Draw a flow chart using Raptor and write a C Program for the following To find Fibonacci sequence
b) Write C programs illustrating call by value and call by reference concepts.

Exercise 10

Write C Programs for the following string operations without using the built in functions - to concatenate two strings

a) To append a string to another string
b) To compare two strings

Exercise 11

Write C Programs for the following string operations without using the built in functions

a) To find whether a given string is palindrome or not

Exercise 12

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

i. To insert a sub-string in to given main string from a given position.
ii.To delete n Characters from a given position in a given string.
iii. To replace a character of string either from beginning or ending or at a specified location

Exercise 13

a) Write a C Program to Implement Taylor series method
b) Write a C Program to Implement Euler's method
c) Write a C Program to Implement Runge Kutta method

Exercise 14

a) Draw a flow chart using Raptor and write a C program to implement a linear search.
b) Draw a flow chart using Raptor and write a C program to implement binary search
c) Write a C program to implement sorting of an array of elements.

Exercise 15

a) Write C Program to reverse a string using pointers
b) Write a C Program to compare two arrays using pointers
c) Write a C program to swap two numbers using pointers

Exercise 16

Examples which explores the use of structures, union and other user defined variables

Exercise 17

a) Write a C program which copies one file to another.
b) Write a C program to count the number of characters and number of lines in a file.
c) Write a C Program to merge two files into a third file. The names of the files must be entered using command line arguments.

Exercise 18

Virtual Lab: http://cse02-iiith.vlabs.ac.in/ /

Any three programs must be submitted with result from the above link

*** At the end of the semester the student has to submit a Mini-Project on Computer Programming. The list of Mini-Projects is available in the department.**

TEXT BOOKS:

1. Reema Thareja, " Programming in C", OXFORD .
2. The C programming Language by Dennis Richie and Brian Kernighan 2nd ed..

REFERENCE BOOKS:

1. Dr.E.Balaguruswamy, "Programming in ANSI C", Tata McGraw-Hill Education.
2. Hanly, "Problem Solving and Program Design in C", Koffman, 7th ed, PEARSON.
3. Forouzan, Gilberg, Prasad ,"C Programming, A Problem Solving Approach", CENGAGE.
4. Programming in C, Second Edition by Ashok N.Kamthane, Pearson.

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code:19BCC1LB04	**ENGINEERING WORKSHOP PRACTICE (COMMON TO CIVIL,MECH & EEE)**						

COURSE OBJECTIVES:

- To impart knowledge to students to develop their technical skill sets for creating entities from raw material.
- To give hands on training and practice to students for use of various tools, devices, machines.
- To develop ability of students to understand, plan and implement various processes and operations to be performed on the raw material to create object of desired shape and size.

COURSE OUTCOMES:

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

CO 1: **Make Use of** the various carpentry tools, machines, devices used in engineering practice for preparing different carpentry joints.

CO 2: **Make Use of** the various fitting tools, machines, devices used in engineering practice for preparing different Fits.

CO 3: **Develop** funnel and square box thorough knowledge of various Tin Smithy tools.

CO 4: **Demonstrate** the various house wiring connections for different house wiring connections.

- **CARPENTARY:**
  1. Preparation of T-Joint
  2. Preparation of dovetail Joint

- **FITTING:**
  1. Preparation of v-fit
  2. Preparation of square-fit

- **TIN SMITHY:**
  1. Preparation of funnel
  2. Preparation of square box

- **HOUSE WIRING:**
  1. Series bulbs connection
  2. Parallel bulbs connection
  3. Stair case connection
  4. Florescent lamp connection

IB.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	-	-	0	MC(0)
Code :19BCC1MC01	**ENVIRONMENTAL STUDIES (Common to all Branches)**						

COURSE OBJECTIVES:

- To make the students aware about the environment and it's inter–disciplinary, to familiarize the concept of ecosystem and their importance, basic understanding of the ecosystem and its diversity.
- Overall understanding of the natural resources.
- To bring the awareness among students about the importance of biodiversity and the need for its conservation.
- To make the students understand the adverse effects of environmental pollution, its causes and measures to control it.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities. Awareness on the social issues, environmental legislation and global treaties understanding the environmental policies and regulations.

COURSE OUTCOMES:

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

CO 1: **Explain** the concepts of the ecosystem and its function in the environment. The need for protecting the producers and consumers in various ecosystems and their role in the food web.

CO 2: **Analyze** the natural resources and their importance for the sustenance of the life and recognize the need to conserve the natural resources.

CO 3: **Explain** the biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity.

CO 4: **Distinguish** various attributes of the pollution, their impacts and measures to reduce or control the pollution along with waste management practices.

CO 5: **Define** Environmental policy, legislation, environmental assessment and the stages involved in EIA Environmental audit.

UNIT – I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Need for Public Awareness. Institutions and people in Environment.

Ecosystems:

Definitions and concepts – Characteristics of ecosystem – Structural and functional features – Producers, consumers and decomposers and food webs – Types of ecosystems – Forests, grassland, desert, crop land, pond, lake, river and marine ecosystems – Energy flow in the ecosystem – Ecological pyramids – Ecological successions.

UNIT – II

Natural Resources: Water resources–Use and over utilization of surface and natural resourced ground water–Floods, drought, conflicts over water, dams–benefits and problems on tribal population & Environment.

Forest resources: Use and over–exploitation, deforestation.

Mineral resources: Use and exploitation, tribal & environmental effects of extracting and using mineral resources.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer–pesticide problems, water logging, salinity–concept of sustainable agricultural methods.

Energy Resources: Renewable (wind energy, tidal energy) and non renewable energy resources (Fossil fuels, coal).

UNIT – III

Biodiversity: Definition: genetic, species and ecosystem diversity- classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity

Conservation of biodiversity: Threats to biodiversity: habitat loss, man wildlife conflicts - Endangered and endemic species of India – Conservation of biodiversity: In-Situ conservation and Ex- situ conservation.

UNIT – IV

Environmental Pollution and Control Technologies: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, and nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Good Agricultural Practices – Drip irrigation, soil erosion and desertification

Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.

UNIT – V

Environmental Policy, Legislation and Environmental Management: Environmental ethics: Issues and possible solutions. Environmental Protection Act, Legal aspects -Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act - Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation.

Impact Assessment and its significance - various stages of EIA, preparation of EMP and EIS, Environmental audit, Ecotourism.

Visit to some local Polluted Site: Study of an industrially Polluted area.

TEXT BOOKS:

1. AnubhaKaushik& C. P. Kaushik, Environmental Studies, New Age International (P) Ltd., New Delhi. Fourth edition, 2014.
2. P. N. Palanisamy, P. Manikandan, A. Geetha, and K. Manjula Rani,Environmental Studies, Pearson Education, Chennai.ISBN 978-93-325-2052-3,Second edition-2014.

REFERENCE BOOKS:

1. Deekshita Dave & P. Udaya Bhaskar, Text Book of Environmental Studies Cengage Learning.
2. Shaashi Chawla, a Textbook of Environmental Studies, TMH, New Delhi.
3. Benny Joseph Environmental Studies, Tata McGraw Hill Co, New Delhi.
4. Dr.K.V.S.G. Murali Krishna, Environmental Studies VGS Publishers, Vijayawada, First Edition 2016.
5. Bharucha, E. Text book of Environmental Studies, First edition, Universities Press (India) Pvt., Ltd., Hyderabad, 2005.

Web References:

1. URL:https://www.youtube.com/watch?v=7G3eXI_DPn8
2. URL: https://www.eolss.net/sample-chapters/C09/E6-70-05-01.pdf
3. URL: https://www.youtube.com/watch?v=QuRL6NbyvEQ
4. URL: https://google/ Introduction to Environmental Studies 5JM1G2
5.URL:http://www.teacherspayteachers.com/Product/Food-Chains-Trophic-Levels-and-Ecological- Pyramids-PowerPoint Click the above
6. URL:http://iadc-dredging.com/en/371/environment/ecosystem-services/ this webinar will focus on the concept of ecosystem services
7. URL: http://mocomi.com/ presents: What is Air Pollution? Air pollution is the introduction of foreign products into the atmosphere.
8. URL: https://en.wikipedia.org/wiki/green_impact_assessment

E-books:

1. .https://faculty.psau.edu.sa/.../doc-5-pdf-d78456fce3bebc84d9320fa2f9cf9e2a-original
2. https://www.researchgate.net/.../273775623_Introduction_to_Environmental_Sciences

I B.TECH – II SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Communicative English -II	19BCC2TH01	HS	40	60	100	2	-	-	2
2	Differential Equations & Vector Calculus	19BCC2TH02	BS	40	60	100	3	-	-	3
3	Engineering Mechanics	19BCC2TH11	ES	40	60	100	2	1	-	3
4	Engineering Chemistry	19BCC2TH03	BS	40	60	100	3	-	-	3
5	Elements of Electrical & Electronics Engineering	19BCC2TH14	ES	40	60	100	3	-	-	3
6	Mechanical Workshop Practice	19BME2LB01	ES	20	30	50	-	-	3	1.5
7	Elements of Electrical & Electronics Engineering Lab	19BCC2LB02	ES	20	30	50	-	-	3	1.5
8	Engineering Chemistry Lab	19BCC2LB03	ES	20	30	50	-	-	3	1.5
9	IT workshop	19BCC2LB07	BS	20	30	50	-	-	3	1.5
10	Constitution of INDIA(MC)	19BCC2MC01	MC	-	-	-	3	-	-	0
	Total									**20**

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	0	0	40	60	100	2
Code: 19BCC2TH01	**COMMUNICATIVE ENGLISH - II (Common to All Branches)**						

COURSE OBJECTIVES:

- To enable the engineering students develop their basic communication skills in English for academic and social purposes.
- To equip the students with appropriate oral and written communication skills.
- To enhance the skills of listening, reading and critical thinking.

COURSE OUTCOMES:

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

CO 1: **Infer** explicit and implicit meaning of a text, recognize key passages; raise questions and summarize it.

CO 2: **Compose** paragraphs, essays as creative writing.

CO 3: **Build** grammatically correct sentences using a variety of sentence structures.

CO 4: **Enhance** word power and usage of lexicons.

CO 5: **Compile** emails, letters, reports, resume and information transfer.

UNIT– I

a. **Reading**: Rahul Bajaj
b. **Communication Skills -**Role and significance of communication, Features of Human Communication-
c. **Writing:** Emails and Letters
d. **Vocabulary**: Homonyms, Homophone and Homographs.

UNIT–II

a. **Reading:** Ratan Tata
b. **Communication Skills -**Process of Communication & types of Communication, barriers to communication
c. **Writing:** General Essay
d. **Vocabulary:** Words often confused, Suffixes & Prefixes

UNIT–III

a. **Reading:** Sabeer Bhatia
b. **Communication Skills -**Importance of Listening for effective communication, Interpersonal communication-
c. **Writing:** Note making
d. **Vocabulary:** Synonyms and Antonyms (100)

UNIT-IV

a) **Reading:** Steve Jobs
b) **Communication Skills -**Persuasion techniques
c) **Writing:** Resume
d) **Vocabulary:** One word substitutes (100)

UNIT-V

a. **Reading:** Sudha Murthy
b. **Communication Skills -**Telephone and Cell phone etiquette-
c. **Writing:** Report writing; types, format, style, sample reports
d. **Vocabulary:** Frequently used Idioms (100)

TEXT BOOKS:

1**. "**Modern Trail Blazers" , Orient Black Swan Pvt.Ltd.Publisher, 1ST edition. 2013
2. E Suresh Kumar," *Engineering English",* Orient Black Swan Pvt. Ltd. Publishers.

REFERENCE BOOKS:

1. Raman, Meenakshi and Sangeetha Sharma, "*Technical Communication: Principles and Practice",* Oxford University Press, New Delhi. 2015.
2. Rutherford, Andrea. J *Basic Communication Skills for Technology*. Pearson, New Delhi. 2001
3. Raymong Murphy, "*Murphy's English Grammar",* Cambridge University Press 2004.
   Sanjay Kumar, Pushpa Latha, "*Language and Communication Skills for Engineerers",* Oxford University Press, 2018.

I B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	40	60	100	3
Code: 19BCC2TH02	**DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS (Common to Civil, EEE, ME and ECE)**						

COURSE OBJECTIVES:

- To formulate and solve first order ordinary differential equations.
- To solve second order differential equations of various kinds.
- To find the solution of first order linear and non-linear partial differential equations.
- The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.

COURSE OUTCOMES:

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

CO 1: **Apply** first order ordinary differential equations to real life situations.

CO 2: **Identify** and apply suitable methods in solving the higher order differential equations.

CO 3: **Solve** the partial differentiation equations.

CO 4: **Interpret** the physical meaning of different operators as gradient, curl and divergence.

CO 5: **Estimate** the work done against a field, circulation and flux using vector calculus.

UNIT I: DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE:

Linear-Bernoulli's-Exact equations and equations reducible to exact form.

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

UNIT-II: LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER:

Finding the complementary functions, Inverse operator, Rules for finding the particular integrals, Method of variation of parameters. Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients.

Application: L-C-R Circuit problems.

UNIT – III: FIRST ORDER PARTIAL DIFFERENTIAL EQUATIONS:

Formation of partial differential equation by elimination of arbitrary constants and arbitrary functions, solutions of first order linear (Lagrange's) equations.

UNIT- IV: 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.

UNIT- V: 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).

TEXT BOOK :

1. Dr. B.S. Grewal, "*Higher Engineering Mathematics*", 43rd Edition, Khanna Publishers, 2012.
2. Bhavanari Satyanarayana, Pradeep Kumar T.V. & Srinivasulu D, "Linear Algebra and Vector Calculus", Studera Press, New Delhi, 2017.

REFERENCES:

1. Kreyszig E, "*Advanced Engineering Mathematics*", 8th Edition, John Wiley, Singapore, 2001.
2. Greenberg M D, "*Advanced Engineering Mathematics*", 2nd Edition, Pearson Education, Singapore, Indian Print, 2003.
3. Peter V. O'Neil, *"Advanced Engineering Mathematics"*, 7th Edition, Cengage Learning, 2011.
4. N.P. Bali, Bhavanari Satyanarayana, Indrani Promod Kelkar, "*Engineering Mathematics*", University Science Press, (An Imprint of Lakshmi Publications Pvt., Ltd) New Delhi, 2012.

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BCC2TH11	**ENGINEERING MECHANICS (COMMON TO CIVIL & MECH)**						

COURSE OBJECTIVES:

- Learn and understanding the basic principles of mechanics of rigid bodies, various types of force systems and to analyze problems in a simple and logical manner.
- Study and calculate the concepts of wedge friction, and to analyze simple trusses using method of joints and method of sections.
- Study and determine centroids and center of gravity of various standard geometrical shapes as well as composite areas and bodies.
- Learn the concept of moment of inertia and the mathematical calculations involved in finding moments of inertia of two dimensional areas.
- The students are to be exposed to concepts of work, energy and particle motion.

COURSE OUTCOMES:

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

CO 1: **Apply** the principles of mechanics to determine the resultant of several concurrent forces acting on a particle.

CO 2: **Analyze** the trusses using method of joints and method of sections; apply the basic concepts of dry friction and wedges.

CO 3: **Illustrate** the centroid and center of gravity bodies and composite sections.

CO 4: **Determine** the Area Moment of Inertia and Mass Moment of Inertia of areas bodies and composite sections.

CO 5: **Apply** the work-energy principle to particles and connected systems for engineering applications.

UNIT– I

INTRODUCTION TO ENGINEERING MECHANICS: Basic Concepts**,** Characteristics of a Force, Force system classification, Resultant of Force Systems, parallelogram law of forces, Triangle of forces.

SYSTEMS OF FORCES: Resolution of forces, Coplanar Concurrent forces, Moment of Force and its Application – Couples, Varignon's theorem.

EQUILIBRIUM OF SYSTEMS OF FORCES: Equations of Equilibrium of Coplanar concurrent, Lami's Theorem, support reactions, free body diagrams.

UNIT–II

ANALYSIS OF PLANE TRUSSES: Definition, Assumptions made in the analysis of plane trusses-methods of joints and method of sections.

FRICTION: Introduction, Classification of friction, Laws of Friction, Coefficient of Friction, Angle of Friction, Angle of Repose, Motion of a body on an Inclined Plane, Ladder friction, Wedge friction.

UNIT–III

CENTROID: Centroids of simple figures (from basic principles)-Centroids of composite figures.

CENTRE OF GRAVITY: Centre of Gravity of simple body (from basic principles), Centre of gravity of composite bodies, pappu's theorem.

UNIT-IV

AREA MOMENTS OF INERTIA: Definition, Radius of gyration, Parallel axis theorem, perpendicular axis theorem, Moments of Inertia of composite figures, polar moment of Inertia.

MASS MOMENT OF INERTIA: Moment of Inertia of Rigid body-Moment of Inertia from basic principles-Slender bar, Rectangular Plate, Circular Plate, Moment of Inertia of 3D Bodies-Cone, Solid Cylinder.

UNIT-V

KINETICS: Analysis as a particle, Newton's laws of motion, D'Alembert's principle –simple applications- analysis as a rigid body in translation-fixed axis rotation-Simple applications.

WORK-ENERGY METHOD: Equations for Translation, work-Energy applications to particle motion, connected system-Impulse momentum method-simple applications.

TEXT BOOKS:

1. Engineering Mechanics by S.Timoshenko & D.H.Young., 4th Edn - ,Mc Graw Hill publications.
2. Engineering Mechanics by S.S. Bhavikatti-New age publications
3. Engineering Mechanics Statics and Dynamics A.K.TAYAL Umesh publications.

REFERENCE BOOKS:

1. Engineering Mechanics by Fedinand . L. Singer , Harper – Collins.
2. Mechanics of Materials (In Si Units) by Beer and Johnson, Tata McGraw-Hil.
3. Strength of Materials (Mechanics of Materials) by James M.Gere and Barry J.Goodno, PWS-KENT Publishing Company, 1990
4. Strength of Materials (Mechanics of Solids) by R.K. Rajput , S.Chand Publications.

Web References:

1. https://nptel.ac.in/courses/112103109/14
2. https://nptel.ac.in/courses/112103109/11
3. https://nptel.ac.in/courses/122104014/4

E-Books:

1. https://easyengineering.net/engineeringmechanicsbooks/

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	40	60	100	3
Code: 19BCC2TH03	**ENGINEERING CHEMISTRY (COMMON TO ALL BRANCHES)**						

COURSE OBJECTIVES:

- To analyze water for its various parameters and its significance in industrial and domestic allocations.
- To acquire the knowledge on types of polymers, fuels and their applications.
- To provide information on exciting advanced materials available in engineering.
- To apply the electrochemical principles, understand the fundamentals of corrosion and development of different techniques in corrosion control.
- To learn the importance of engineering materials used in daily life and industry.

COURSE OUTCOMES:

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

CO 1: **Analyze** the suitable method of water treatment depending on the quality treatment.
CO 2: **Compare** different types of polymers, fuels and their importance-Analyzing
CO 3: **Utilize** the advanced materials as engineering materials and apply them in domestic and industrial life-Applying
CO 4: **Distinguish** electrical energy sources and importance of corrosion science-Analyzing
CO 5: **Identify** different types of engineering materials and applications in engineering.

UNIT-I: WATER CHEMISTRY

Characteristics of water: Sources, Impurities–Hardness & its units–Industrial water characteristics–Softening of water by external treatment methods (Lime soda process, Zeolite and Ion exchange process)–Numerical problems on lime soda process–Desalination of brackish water (Reverse osmosis and Electrodialysis).

Water analysis techniques: Alkalinity–hardness (Complexo-metric)–Break point chlorination–Free chlorine–DO–BOD and COD.

UNIT-II: POLYMERS AND FUEL CHEMISTRY

Polymers: Introduction to polymers–Chain growth (free radical, ionic)–Step growth polymerization–Coordination polymerization–Copolymerization with specific examples–Thermoplastics and thermosets–Plastic moulding methods (Compression & Injection moulding)–Rubbers–Natural rubber–Processing–Vulcanization.

Fuels-Types of fuels–Calorific value–Numerical problems based on calorific value–Analysis of coal–Liquid fuels–Refining of petroleum–Cracking of heavy oil–Knocking and anti knocking agents–Octane and cetane values.

UNIT-III: CHEMISTRY OF ADVANCED MATERIALS

Nano materials: Introduction–Sol-gel method & Chemical reduction method of preparation – Characterization by BET method and TEM methods–Carbon nano tubes and fullerenes: Types–Preparation–Properties and Applications.

Liquid crystals: Introduction–Types–Applications.

Composite materials: Introduction–Definition–Types–Applications–Cermets.

UNIT-IV: ELECTROCHEMISTRY AND CORROSION

Electrochemistry: Galvanic cells–Single electrode potential–Reference electrodes–Electrochemical series–Batteries (primary, secondary and fuel cells)–Applications of secondary batteries in E-vehicles.

Corrosion: Causes and effects of corrosion–Theories of corrosion (chemical and electrochemical corrosion)–Factors effecting corrosion–Corrosion control methods–Cathode protection–Sacrificial anodic, Impressed current methods–Surface coatings–Methods of application on metals (Hot dipping, Galvanizing, Tinning, Cladding, Electroplating, Electroless plating)–Organic surface coatings–Paints–Constituents and their functions–Pigment Volume Concentration.

UNIT-V: CHEMISTRY OF ENGINEERING MATERIALS

Lubricants: Introduction–Mechanism of lubrication–Classification of lubricants–Properties and testing of lubricating oils.

Cement & Refractories: Manufacture–Setting and hardening of cement–Failures of cement–Slag cement–Refractory: Introduction–Classification and properties of refractories.

TEXT BOOKS:

1. Shikha Agarwal, "**Engineering Chemistry**", ISBN 1107476410, 2nd Edition, Cambridge University Press, New Delhi, (2019).
2. O.G. Palana, "**Engineering Chemistry**", ISBN 0070146101, Tata McGraw Hill Education Private Limited, New Delhi, (2009).
3. B. Rama Devi, Ch. Venkata Ramana Reddy, Prashantharath, "**Text Book of Engineering Chemistry**", ISBN 9789353500511, Cenage Learning India Pvt. Ltd, (2016).

REFERENCE BOOKS:

1. P.C. Jain and M. Jain "**Engineering Chemistry**", ISBN 8187433175, 15/e, Dhanpat Rai & Sons, Delhi, (2015).
2. B.S Murthy and P. Shankar, "**A Text Book of NanoScience and NanoTechnology"**, University Press (2013).
3. K. Sesha Maheshwaramma and Mridula Chugh, "**Engineering Chemistry"**, Pearson India Edn services, (2016).
4. S.S. Dara, "**A Textbook of Engineering Chemistry"**, ISBN 8121932645, S.Chand Publisher, (2010)

Web References:

1. URL: https://www.youtube.com/watch?v=CWOJW4357Bg
2. URL: https://www.youtube.com/watch?v=H1Y1oxQ5eUA&t=627s
3. URL: https://www.youtube.com/watch?v=1xWBPZnEJk8
4. URL: https://www.youtube.com/watch?v=p9yPXdT0k48&t=225s
5. URL: https://www.youtube.com/watch?v=xb_xndPe4n0&t=390s

E-Books:

"**Engineering Chemistry**" (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	40	60	100	3
Code: 19BCC2TH14	**ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING (Common To Mech and Civil)**						

Course Objectives

- To familiarize with the basic DC network.
- To explain the concepts of electrical machines and their characteristics.
- To identify the importance of transformers and induction motor.
- To impart knowledge about the characteristics of semi conductor devices.
- To expose basic concepts and applications of Transistor

Course Outcomes

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

CO 1: **Analyze** the behavior of an electrical circuit.
CO 2: **Measure** the performance quantities such as losses, efficiency of DC machines
CO 3: **Create** the construct of transformer and Induction motor
CO 4: **Classify** the importance and applications of p-n junction diode.
CO 5: **Evaluate** the configurations and applications of Transistor.

Unit I: Basic laws and Circuits

Active and passive elements-voltage-current-power-power factor-energy-Ohms law-Kirchhoff's Laws-series and parallel circuits-source transformations-delta-wye conversion.

Unit II: DC Machines

Principle Operation-Constructional features-induced EMF-Types of DC generators-Working of DC motor-Torque expression-3point starter-Speed controls-Losses and Efficiency by direct loading.

Unit III: Transformers

Constructional details-working principle-EMF equation-voltage regulation-losses and efficiency-open/short circuit tests.

Induction Motors:3-Phase Induction motor Construction-working principle-Types-slip-Performance characteristics-1-phase Induction motor working principle-starting methods-applications

Unit IV: Semiconductor Devices

Introduction-Bonds-extrinsic-intrinsic-p-n Junction diode-current and voltage characteristics-rectifier circuits-half wave-full wave-bridge rectifier-Zener diode as Voltage Regulator.

Unit V: **Transistor Configurations**

Construction-working-Transistor as amplifier-Transistor as switch -Analysis of CE, CB and CC Characteristic's-Comparison of CE, CB and CC configurations.

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.
4. V.K. Mehta, "Principle of Electrical and Electronics Engg." S.Chand publishing, New Delhi,2006.

References:

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.

Web References:

URL: https://www.youtube.com/watch?v=ohhdNRtDpCY

E-Books:

https://www3.nd.edu/~cpoellab/teaching/eee40814/Lecture1-Handouts.pdf

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: 19BME2LB01	**MECHANICAL WORKSHOP PRACTICE**						

COURSE OBJECTIVES:

- To impart knowledge to students to develop their technical skill sets for creating entities from raw material.
- To give hands on training and practice to students for use of various tools, devices, machines.
- To develop ability of students to understand, plan and implement various processes and operations to be performed on the raw material to create object of desired shape and size.

COURSE OUTCOMES:

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

CO 1: **Make use of** the various black smithy tools, machines, devices used in engineering practice for preparing different Black smithy shapes. .

CO 2: **Make the use** various welding tools, machines, devices used in engineering practice for preparing the different welding joints.

CO 3: **Demonstrate** the various machines and engines used in engineering practice.

CO 4: **Develop** different types of wooden patterns thorough knowledge of various foundry tools.

- **BLACK SMITHY:**
  - Preparation of square bar from round rod
  - Preparation of L-shape
- **WELDING:**
  - Preparation of Butt Joint using electrical arc welding
  - Preparation of T-Joint using electrical arc welding
- **MACHINE SHOP:**
  - Preparation of hole using bench drilling machine
  - Dismantling and assembling of Maruti car engine
  - Making internal thread cutting
  - Making external thread cutting
- **FOUNDRY:**
  - Preparation of split piece wooden pattern on wood lathe
  - Preparation of single piece wooden pattern on wood lathe

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	20	30	50	1.5
Code: 19BCC2LB02	**ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY (Common to Mech and Civil)**						

COURSE OBJECTIVES:

To expose the students to the operation of DC motor, Transformer and rectifiers give them Experimental skill.

COURSE OUTCOMES:

At the end of the course, the student will able to

- **CO 1:** **Determine** the efficiency and regulation of 1-phase transformer
- **CO 2:** **Compute** the performance characteristics of transformers and DC machines through Suitable tests.
- **CO 3:** **Calculate** the ripple factor of half-wave&full-wave rectifiers.
- **CO 4:** **Gain** practical experience related to electronics circuits; stimulate more interest and Motivation for further studies of electrical circuits.

Any 5 of the following experiments to be conducted from each PART:

PART-A: Electrical Experiments:

1. Verification of Kirchhoff's law.
2. Swinburne's test and Predetermination of efficiencies as Generator and Motor
3. Brake test on DC shunt motor. Determination of performance curves
4. Speed control of D.C shunt motor by a) Armature voltage control b) Field flux control method.
5. OC & SC tests on single phase transformer (predetermination of efficiency and regulation).
6. Load test on three-phase induction motor.

PART-B: Electronics Experiments:

7. PN junction diode characteristics a) Forward bias b) Reverse bias
8. Transistor CE characteristics (input and output).
9. Half wave rectifier characteristics with and without filter
10. Full wave rectifier characteristics with and without filter
11. Characteristics of CE Amplifier.
12. Characteristics of CC Amplifier.

I B.TECH II SEMESTERS	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: 19BCC2LB03	**ENGINEERING CHEMISTRY LAB (COMMON TO ALL BRANCHES)**						

COURSE OBJECTIVES:

- To provide the students with a solid foundation in chemistry laboratory required to solve the engineering problems.
- To expose the students in practical aspects of the theoretical concepts.
- To train the students on how to handle the instruments.

COURSE OUTCOMES:

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

CO 1: **Develop** and perform analytical chemistry techniques to address the water related problems (hardness, alkalinity, Chlorine, DO).
CO 2: **Explain** the functioning of different analytical instruments.
CO 3: **Compare** viscosity and surface tension of different oils.
CO 4: **Measure** molecular/system properties such as strength of solutions, conductance of solutions and acid number of lubricating oils, etc.

List of Experiments

Introduction to chemistry laboratory–Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Qualitative analysis etc.

1. Estimation of NaOH using standard HCl solution
2. Determination of hardness of water sample by EDTA method
3. Determination of alkalinity of water sample
4. Determination of Dissolved Oxygen content of water sample by Winkler's method
5. Determination of Dissolved Chlorine by Mohr's method
6. Estimation of Fe^{+2} by using $KMnO_4$
7. Preparation of phenol formaldehyde resin/Urea formaldehyde
8. Conductometric titration between strong acid and strong base
9. Determination of viscosity of a liquid by Ostwald's viscometer
10. Determination of surface tension of a liquid by Stalagnometer
11. Determination of moisture content present in given coal sample
12. Determination of acid value of an oil

TEXT BOOKS:

1. N.K Bhasin and Sudha Rani "**Laboratory Manual on Engineering Chemistry**" 3/e, Dhanpat Rai Publishing Company (2007).
2. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B "**Vogel's Quantitative Chemical Analysis**" 6/e, Pearson publishers (2000).
3. Sudharani, "**Lab manual on Engineering Chemistry**" Dhanpat Rai Publications, Co., New Delhi. (2009).

I B.TECH II SEMESTERS	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code:19BCC2LB07	**IT WORKSHOP**						

COURSE OBJECTIVES:

Enabling the student to understand basic hardware and software tools through practical exposure.

COURSE OUTCOME:

After completion of this course, the student should be able to :

- **CO 1:** **Demonstrate** the need of PC hardware components, applications and softwares.
- **CO 2:** **Explain** the knowledge of networks, internet and World Wide Web, Search engines, Netiquette.
- **CO 3:** **Experiment with** the installation and use of different software like Windows XP, Linux.
- **CO 4:** **Identify** and fix the defective PC and software related issues.
- **CO 5:** **Make use of** various options in Microsoft word, Excel and Power point.

PC Hardware:

Identification of basic peripherals, assembling a PC, installation of system software like MS Windows, device drivers. Trouble shooting Hardware and Software some tips and tricks.

Internet & World Wide Web:

Different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet, web browsers, email, newsgroups and discussion forums. Awareness of cyber hygiene (protecting the personal computer from getting infected with the viruses), worms and other cyber-attacks.

Productivity tools: Crafting professional word documents; excel spread sheets, power point presentations and personal websites using the Microsoft suite of office tools.

PC Hardware

Task 1: Identification of the peripherals of a computer. To prepare a report containing the block diagram of the CPU along with the configuration of each peripheral and its functions. Description of various I/O Devices.

Task 2: (Optional): A Practice on disassembling the components of a PC and assembling them to back to working condition.

Task 3: Examples of Operating Systems- DOS, MS Windows, Installation of MS windows on a PC

Task 4: Introduction to Memory and Storage Devices, I/O Port, Device Drivers, Assemblers, Compilers, Interpreters, Linkers, Loaders.

Task 5: Hardware Troubleshooting (Demonstration): Identification of a problem and fixing a defective PC (improper assembly or defective peripherals).

Software Troubleshooting (Demonstration): Identification of problem and fixing the PC for any software issues.

Internet & Networking Infrastructure

Task 6: Demonstrating Importance of Networking, Transmission Media, Networking Devices-Gateway, Routers, Hub, Bridge, NIC, Bluetooth technology, Wireless Technology, Modem, DSL, and Dialup Connection.

Orientation & Connectivity Boot Camp and Web Browsing: Students are trained to configure the network settings to connect to the Internet. They are trained to demonstrate the same through web browsing (including all tool bar options) and email access.

Task 7: Search Engines & Netiquette:

Students are enabled to use search engines for simple search, academic search and any other context based search (Bing, Google etc).Students are acquainted to the principles of micro-blogging, wiki, collaboration using social networks, participating in online technology forums.

Task 8: Cyber Hygiene (Demonstration) : Awareness of various threats on the internet. Importance of Security patch updates and Anti-Virus solution Ethical Hacking, Firewalls, Multi-factors authentication techniques including Smart card Biometrics and also practiced

WORD

Task 9: MS Word Orientation: Accessing, overview of toolbars, saving files, Using help and resources, rulers, formatting, Drop Cap, Applying Text effects, Using Character Spacing, OLE in Word, using templates, Borders and Colors, Inserting Header and Footer, Using Date and Time option, security features in word, converting documents while saving.

Task 10 : Creating Project : Abstract Features to be covered:-Formatting Styles, Inserting Table, Bullets and Numbering, Changing Text Direction, Cell alignment, footnote, Hyperlink, Symbols, Spell Check, Track Changes, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs.

EXCEL

Task 11: Using spread sheet features of EXCEL including the macros, formulae, pivot tables, graphical representations.

Creating Scheduler - Features to be covered:-Gridlines, Format Cells, Summation, auto fill, Formatting Text.

LOOKUP/VLOOKUP

Task 12: Performance Analysis: Features to be covered:-Split cells, freeze panes, group and outline, Sorting, Boolean and Logical operators, Conditional Formatting.

POWER POINT

Task 13: Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered during this week includes:- PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting –Images, Clip Art, Tables and Charts in PowerPoint.

Task 14: Focusing on the power and potential of Microsoft power point Helps them learn best practices in designing and preparing power point presentation. Topic covered during this week includes:- Master Layouts (slide, template and notes), Types of views (basic, presentation, slide slotter, notes etc), Inserting – Background , textures, Design Templates, Hidden slides, OLE in PPT.

TEXT BOOKS:

Faculty to consolidate the workshop manuals using the following references.

1. Anita Goel , Computer Fundamentals, Pearson
2. Scott. Mueller QUE , Scott Mueller's Upgrading and Repairing PCs, 18/e, Pearson, 2008

REFERENCE BOOKS:

1. Dr.N.B.Venkateswarlu, Essential Computer and IT Fundamentals for Engineering and Science Students.
2. G Praveen Babu, M V Narayana, "Information Technology Workshop", BS Publications, 3e
3. Vikas Gupta, "Comdex Information Technology", Dreamtech.

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	-	-	-	-
Code: 19BCC2MC01	**CONSTITUTION OF INDIA**						

COURSE OUTCOMES:

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

- **CO 1:** **Examine** salient features of Indian Constitution and live accordingly in society & interpret the meaning of Fundamental Rights of State Policy
- **CO 2:** **Discover** various aspects of Union Government legislation and live up to the expectations of the rules.
- **CO 3:** **Examine** State Government legislation and improve your living standards by following the rules strictly
- **CO 4:** **Examine** powers and functions of local bodies such as Municipalities and Panchayats and, take advantage of available resources for better living
- **CO 5:** **Analyze** the powers and functions of Election Commission and The Union Public Service Commission and decide upon it for safe and secured life.

UNIT-I: INTRODUCTION TO INDIAN CONSTITUTION & FUNDAMENTAL RIGHTS

Meaning of the term Indian Constitution –Preamble- Constituent Assembly- Salient Features of Indian Constitution. Fundamental Rights -Fundamental Duties -The Directive Principles of State Policy.

UNIT-II: UNION GOVERNMENT

Union Government -Union Legislature (Parliament) -Lok Sabha and Rajya Sabha (with Powers and Functions) -Union Executive -President of India (with Powers and Functions) -Prime Minister of India (with Powers and Functions) -Union Judiciary (Supreme Court) -Jurisdiction of the Supreme Court

UNIT-III: STATE GOVERNMENT

State Government -State Legislature (Legislative Assembly / Vidhan Sabha, Legislative Council / Vidhan Parishad) -Powers and Functions of the State Legislature -State Executive-Governor of the State (with Powers and Functions) -The Chief Minister of the State (with Powers and Functions) -State Judiciary (High Courts)

UNIT-IV: LOCAL SELF GOVERNANCE

Powers and functions of Municipalities, Panchyats, ZP's and Co – Operative Societies

UNIT-V: SOVEREIGN BODIES

Election Commission of India (with Powers and Functions) -The Union Public Service Commission (with Powers and Functions)

BOOKS:

1. Introduction to constitution of India, Durga Das Basu, Lexis Nexis Publications
2. Constitution of India by PRFESSIONAL BOOK PUBLISHERS
3. The Constitution of India by Arun K Tiru vengadam, Blooms bury publishers.
4. The constitution of India by PM Bakshi, Universal law publishing co
5. The Constitution of India by S.R. Bhansali, Universal law publishing co

II B.TECH – I SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Fluid Mechanics & Hydraulic Machinery	19BME3TH02	PC	40	60	100	2	1	-	3
2	Materials Science and Metallurgy	19BME3TH04	PC	40	60	100	3	-	-	3
3	Thermodynamics	19BME3TH05	PC	40	60	100	2	1	-	3
4	Mechanics of Solids	19BME3TH06	PC	40	60	100	2	1	-	3
5	Numerical Methods & Transformations	19BCC3TH01	BS	40	60	100	2	1	-	3
6	Machine Drawing & Basic Design Engg. Soft. Lab.	19BME3TH03	ES	40	60	100	1	-	4	3
7	Fluid Mechanics & Hydraulic Machinery Lab	19BME3LB01	PC	20	30	50	-	-	3	1.5
8	Mechanics of Solids & Metallurgy Lab	19BME3LB02	PC	20	30	50	-	-	3	1.5
9	Quantitative Aptitude & Reasoning	19BCC3MC01	MC	-	-	-	3	-	-	0
10	Community Service	19BCC3MC02	MC	-	-	-	-	-	-	0
Total										**21**

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME3TH02	**FLUID MECHANICS AND HYDRAULIC MACHINERY**						

COURSE OBJECTIVES:

- To understand the concept of fluid statics and properties of fluids.
- To understand the fluid kinematics and dynamics.
- Get the knowledge of boundary layer theory to solve the problems.
- To understand velocity diagrams on different vanes.
- Learn the working of different kinds of turbines and pumps.

COURSE OUTCOMES:

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

CO 1: **Explain** about Fluid Properties and hydrostatic forces acting on different surfaces

CO 2: **Apply** conversation laws to fluid flow problems in engineering applications

CO 3: **Compute** theory of Boundary layer flows, Identifies dimensionless parameters

CO 4: **Illustrate** the force required to move the vane using by Jet

CO 5: **Demonstrate** the turbines and its functions & Operating conditions of Centrifugal and Reciprocating pumps.

UNIT - I

PROPERTIES OF FLUIDS AND FLUID STATICS: Fluid properties: Mass density, specific weight, specific volume, specific gravity, viscosity, vapour pressure, compressibility, surface tension and capillarity.

FLUID STATICS: fluid pressure at a point, variation of pressure within a static fluid, hydrostatic law - Pressure head, Pascal's law, Measurement of pressure, U-Tube manometer, Differential U-Tube manometer.

UNIT - II:

FLUID KINEMATICS: Lagrangian and Eulerian description of fluid flow: velocity and acceleration of fluid particles, different types of fluid flow, description of flow pattern: Stream line, streak line, path line. Principle of conservation of mass: Continuity equation, applications of continuity equation.

FLUID DYNAMICS: Euler's equation of motion along a stream line - Bernoulli's equation, Practical applications of Bernoulli's equation in flow measurement devices like venturimeter, orifice meter and Pitot tube.

UNIT – III:

BOUNDARY LAYER THEORY: Boundary layer development on a flat plate and its characteristics - Boundary layer thickness, displacement thickness, momentum thickness, energy thickness.

DIMENSIONAL AND MODEL ANALYSIS: Dimensional analysis: dimensions, dimensional homogeneity, methods of dimensional analysis-Buckingham Pi theorem, Raleigh's method Model analysis. Similitude, derivations of important dimensionless numbers.

UNIT – IV:

BASICS OF TURBO MACHINERY: Hydrodynamic force or jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes

HYDRAULIC TURBINES: Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies.

UNIT - V:

HYDRAULIC PUMPS: Classification, working, work done - manometric head losses and efficiencies, specific speed- pumps in series and parallel-performance characteristic curves, NSPH; Reciprocating pump Working.

TEXT BOOKS:

1. Fluid Mechanics and Hydraulics Machines by R.K.Bansal, Laxmi publications
2. Fluid Mechanics and Hydraulic Machines by R.K.Rajput, S. Chand Publications

REFERENCE BOOKS:

1. Fluid Mechanics by White.F.M, Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
2. Hydraulics and Fluid Mechanics by P.N.Modi and S.M.Sethi, Standard Book House, New Delhi.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105101082/ Fluid Mechanics by Prof S K Som, Department of Mechanical Engineering

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
Code: 19BME3TH04	**MATERIAL SCIENCE & METALLURGY**						

COURSE OBJECTIVES:

- To learn the principles of materials science and engineering though lab investigation
- To learn to organize the lab results into a logic, concise and accurate report
- To review physics and chemistry in the context of materials science & engineering
- To give an introduction to metals, ceramics, composites powder metallurgy

COURSE OUTCOMES:

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

CO 1: **Illustrate** the knowledge related to the structure and properties of materials, crystal Systems and phase diagrams of alloys.

CO 2: **Examine** properties of ferrous materials and their engineering applications

CO 3: **Explain** the basic concepts of Heat treatment processes and their applications

CO 4: **Examine** nonferrous materials properties and their engineering applications.

CO 5: **Choose** the various types of ceramics, composite materials and basic steps involved in the Powder Metallurgy process.

UNIT– I

STRUCTURE OF METALS AND CONSTITUTION OF ALLOYS: Ionic, Covalent and Metallic bonds; Amorphous and Crystalline solids. Crystal structure - BCC, FCC, HCP. Crystallization of metals– Nuclei formation and Crystal growth, grain and grain boundaries, Grain size; Necessity of alloying, substitutional solid solutions and Hume Rothery rules of solid solubility, interstitial solid solutions.

EQUILIBRIUM DIAGRAMS: Introduction to Phase and Phase diagrams with its Importance and types-Unary, Binary and Ternary phase diagrams; Binary phase diagrams of Fe-Fe3C and Cu-Ni. Micro constituents in steels- Austenite, Ferrite, Cementite, Pearlite, Bainite, Martenite; eutectic, peritectic, eutectoid and peritectoid reactions. Cooling curve of pure iron, Lever Rule, Gibbs Phase Rule.

UNIT –II

FERROUS METALS AND ALLOYS:

STEELS: Introduction, Classification and Influence of constituents on steel; Structure, properties and applications of plain carbon steels; Alloy steels-Purpose and effect of alloying elements; Properties of Stainless steels and tool steels.

CAST IRON: Introduction, comparison with steels and Classification-Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, S.G. cast iron.

UNIT – III

HEAT TREATMENT OF ALLOYS: Purpose of heat treatment; Process and applications of Annealing, normalizing, Hardening and tempering; Effect of cooling on austenite transformation, TTT diagrams, Hardenability and factors affect hardening; Surface Hardening of Steels- Carburizing, Nitriding, Cyaniding.

UNIT – IV

NON-FERROUS METALS AND ALLOYS: Introduction, Structure and properties of copper Aluminium, Titanium and their alloys.

UNIT – V

CERAMICS: Introduction; Glasses, Ceramets, Abrasive materials.

COMPOSITE MATERIALS: Introduction, types-particle reinforced, fiber reinforced and structural composites.

POWDER METALLURGY: Introduction, preparation, industrial applications, advantages and limitations.

TEXT BOOKS:

1. Introduction to Physical Metallurgy by Sidney H. Avener, TataMcGraw Hill
2. Material Science and Metallurgy by V.D.Kodgire, Everest Publishing House

REFERENCES:

1. Materials Science and engineering by Callister and Baalasubrahmanyam, Wiley India
2. Material science and Engineering by V. Rahghavan, P.H.I Publications
3. Material Science and Metallurgy by A V K Suryanarayana, B S Publications
4. Material Science and Metallurgy by U. C. Jindal by Pearson Publications

WEB REFERENCES:

1. http://nptel.ac.in/courses/Webcourse-contents/IIScBANG/Material%20Science/pdf/Lecture Notes/ MLN_02.pdf
2. http://nptel.ac.in/courses/113105023/Lecture7.pdf
3. http://nptel.ac.in/courses/Webcourse-contents/IIScBANG/Material%20Science/pdf/PPTs/ MTS_07_m.pdf
4. http://nptel.ac.in/courses/IITMADRAS/Design_Steel_Structures_I/1_introduction/3_properties _of_steel.pdf
5. http://nptel.ac.in/courses/112108150/pdf/Lecture_Notes/MLN_10.pdf

E-Books:

1. https://www.ebooks.com/en-us/subjects/technology-metallurgy-ebooks/1211/
2. http://www.digitalbookindex.org/_search/search010mmetallurgya.asp
3. https://www.pdfdrive.com/metallurgy-books.html
4. https://www.elsevier.com/books/fundamentals-of-metallurgy/seetharaman/978-1-85573-927-7
5. https://ebooks.benthamscience.com/book/9781681085708/

II B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME3TH05	THERMODYNAMICS						

COURSE OBJECTIVES:

- To acquire the knowledge of first law of thermodynamics and its analysis.
- To learn the second law of thermodynamics and significance of entropy principles.
- To learn the concepts of reactant, non-reactant gas mixtures and pure substance.
- To understand the significance of various thermal cycles.

COURSE OUTCOMES:

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

CO 1: **Illustrate** the concepts of heat, work, and forms of energy

CO 2: **Classify** various thermal systems using thermodynamic laws and principles.

CO 3: **Apply** the laws of thermodynamics for various thermodynamic systems.

CO 4: **Evaluate** the performance parameters of pure substances and gas mixtures.

CO 5: **Analyze** different thermodynamic cycles and estimate work done and performance

UNIT - I

BASIC CONCEPTS AND DEFINITIONS: Thermodynamic fundamentals, Thermodynamic equilibrium and Quasi-static Process, thermodynamic path, cycle, Work and Heat, work done in various non-flow processes.

ZEROTH LAW OF THERMODYNAMICS: Temperature Scales, Temperature measurement, Constant Volume Gas Thermometer, Advantages of gas thermometers over liquid thermometers

UNIT-II

FIRST LAW: First law of thermodynamics for a system undergoing a cycle and for a change in state. First Law Analysis of Closed System, Thermodynamic processes, Different forms of stored energy, Energy-Forms of Energy, PMM-I.

FIRST LAW FOR FLOW SYSTEMS: Steady flow energy equation and applications, limitations of first law of thermodynamics

UNIT - III

SECOND LAW OF THERMODYNAMICS: Introduction, Thermal Energy Reservoirs, Heat Engines, Refrigerators, Heat Pumps, Kelvin-Planck & Clausius Statements of Second law of Thermodynamics, , Equivalence of Kelvin-Plank and Clausius Statements, PMM II, Differences between reversible and Irreversible Process, Carnot Cycle, Carnot Theorem.

ENTROPY: Introduction, temperature-entropy Plot, Principle of increase of entropy, Entropy Change for Ideal gases, Applications of Entropy.

UNIT - IV:

PURE SUBSTANCES: Pure substance, vapour-liquid-solid phase equilibrium in a pure substance, Independent properties of a pure substance, Equations of state for vapour phase of a simple compressible substance, Tables of thermodynamic properties, thermodynamic surfaces.

MIXTURES OF PERFECT GASES– Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive.

UNIT - V:

POWER CYCLES: Carnot, Otto, Diesel, Dual cycles– Description and representation on P-V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles, Brayton and Rankine cycles.

REFRIGERATION CYCLES: Reversed Carnot cycle - Performance Evaluation, VCR system, Bell-Coleman cycle.

TEXT BOOKS:

1. Thermodynamics Engineering Approach by Yunus A. Cengel M. and Michael A. Boles, Seventh edition, McGraw Hill Education (India) Private Limited, 2011.
2. Engineering Thermodynamics by P.K.Nag, Fifth edition, Tata McGraw Hill Education Private Limited, 2012.

REFERENCES:

1. Fundamentals of Classical Thermodynamics by G.J.Van Wylen& Sonntag, 4th Edition, 1994 Wiley publication 2005.
3. Thermal Engineering by R.K. Rajput, 8th Edition, Lakshmi Publications
4. Engineering Thermodynamics by P.Chattopadhyay, Oxford Higher Edn Publications
5. Thermodynamics by J.P.Holman, McGrawHill.

WEB REFERENCES

1. https://nptel.ac.in/courses/112/105/112105123/
2. https://www.coursera.org/learn/thermodynamics-intro
3. http://www.phys.ens.fr/~ebrunet/Thermo-en.pdf

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME3TH06	**MECHANICS OF SOLIDS**						

COURSE OBJECTIVES:

- To Understand stresses and deformation in a member due to an axial loading. Also to estimate the thermal stresses, strains and strain energy in members subjected to axial loading.
- Understand the concept of shear force and bending moment with respect to beams and to draw the shear force and bending moment diagrams.
- Understand bending and shear stresses in beams of various cross sections under different loading conditions.
- Understand and analyze beam deflections using various methods like double integration approach, Macaulay's method.
- Study the pressure vessels, their classification and to estimate various stresses such as radial, circumferential, longitudinal and shrinkage induced in them, concepts of torsion.

COURSE OUTCOMES:

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

CO 1 **Illustrate** the concepts of stress and strain and thermal stress in members, strain energy due gradually, suddenly applied loads.

CO 2 **Analyze** shear force diagrams and bending moment diagrams to the different loads for the different support arrangements.

CO 3 **Determine** shear stresses induced in the beams which are made with different cross sections like rectangular, circular, I, T sections.

CO 4 **Solve** the equations of slope and deflection for different support arrangements by double integration method, Macaulay's method.

CO 5 **Determine** stresses induced in cylinders subjected to internal, external pressures. Know how a cylinder fails.

UNIT– I

SIMPLE STRESSES & STRAINS: Concept of stress and strain- Types of stresses & strains-tensile ,compressive, shear –Hooke's law – stress – strain diagram for mild steel – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars. Elastic moduli and the relationship between them. Temperature stresses.

STRAIN ENERGY & IMPACT LOADING: Strain energy - Resilience – Stress due to various types of axial loads- Gradually applied suddenly applied and impact loadings.

UNIT–II

SHEAR FORCE AND BENDING MOMENT: Definition of beam – Types of beams-cantilever beam, simply supported beam, overhanging beam– Concept of shear force and bending moment–S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, Uniform Distributed Load (U.D.L), uniformly varying loads and combination of these loads–Point of contra flexure–Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT–III

FLEXURAL STRESSES: Theories of simple bending– Neutral axis, Moment of resistance-derivation of bending equation: M/I = f/y = E/R, Assumptions in the theory of bending. Section modulus, Bending stresses of rectangular, circular, I and T section.

SHEAR STRESSES: Shear stress distribution across various beams sections- rectangular, circular, I and T sections.

UNIT-IV

DEFLECTION OF BEAMS: Member bending into a circular arc –slope, deflection and radius of curvature. Determination of slope and deflection for cantilever and simply supported beams subjected to point loads and U.D.L by Double integration method- Macaulay's method.

UNIT-V

THIN CYLINDERS: Thin cylinders **-** longitudinal and circumferential stresses Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder subjected to internal pressures.

THICK CYLINDERS: Derivation of formulae for radial and hoop stresses- lame's equation– cylinders subjected to inside & outside pressures – compound cylinders.

TORSION OF SHAFTS: Theory of pure torsion- Torsional moment of resistance-derivation of Torsion equation: $T/J = \tau/r = G\theta/L$ - assumptions in the theory of pure torsion, polar modulus, power transmitted by a circular shafts.

TEXT BOOKS:

1. Mechanics of Materials by Dr . B.C. Punmia, Er. Ashok Kumar Jain, Dr. Arun\ Kumar,
2. Strength of materials by S. Ramamrutham , Dhanpat Rai Publications.
3. Strength of materials by R. K. Bansal, Lakshmi publications

REFERENCE BOOKS:

1. Introduction to solid mechanics by Irving H. Shames, James M. Pitarresi, Pearson Publications.
2. Mechanics of Materials (In Si Units) by Beer and Johnson, Tata McGraw-Hil.
3. Strength of Materials (Mechanics of Materials) by James M.Gere and Barry J.Goodno, PWS-KENT Publishing Company, 1990
4. Strength of Materials (Mechanics of Solids) by R.K. Rajput , S.Chand Publications.

WEB REFERENCES:

1. URL: https://nptel.ac.in/courses/112107146/23
2. https://nptel.ac.in/courses/105105108/19
3. https://nptel.ac.in/courses/112105125/pdf/module-9%20lesson-2.pdf
5. https://nptel.ac.in/courses/112105164/36

E-BOOKS:

1. https://easyengineering.net/a-textbook-of-strength-of-materials/

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	40	60	100	3
Code: 19BCC3TH01	**NUMERICAL METHODS AND TRANSFORMATIONS** (CIVIL, EEE, ME)						

COURSE OBJECTIVES:

- To elucidate the different numerical methods to solve nonlinear algebraic equations.
- To propagate the use of different numerical techniques for carrying out numerical integration.
- Explore the use of Laplace transform method to solve with initial value problems of ODE.
- To acquire fundamental Knowledge of Fourier series and Fourier Transform and able to give Fourier expansions of a given function.

COURSE OUTCOMES:

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

CO 1: **Evaluate** approximating roots of polynomials and transcendental equations by different algorithms.

CO 2: **Apply** Newton's forward backward and Lagrange's interpolation for equal and unequal intervals.

CO 3: **Apply** different algorithms for approximating solutions of ordinary differential equation to its analytical computations.

CO 4: **Select** the technique of Laplace transform and apply it to solve differential equations.

CO 5: **Relate** Fourier series, integral, transforms and they are provided with practice in their application and interpretation in a range of situations.

UNIT –I: SOLUTIONS TO ALGEBRAIC EQUATIONS AND INTERPOLATION:

Solution of polynomial and transcendental equations: bisection method, Regula-Falsi method and Newton-Raphson method. Finite differences, relation between operators, interpolation using Newton's, Gauss's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

UNIT –II: NUMERICAL SOLUTIONS OF ODE AND INTEGRATION:

Numerical Differentiation, Ordinary differential equations-Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations. Numerical integration- trapezoidal rule and Simpson's 1/3rd and $3/8^{th}$ rules.

UNIT-III: LAPLACE TRANSFORMATIONS:

Laplace transform and its properties, Transform of derivatives and integrals, Multiplication by t^n, division by t, Unit step function and unit impulse function. Transform of periodic functions, Evolutions of integrals by Laplace Transforms. Finding inverse transforms by the method of partial fractions, other methods of finding inverse Laplace Transforms, Convolution theorem(without proof), Solutions of Initial and Boundary Value Problems.

UNIT – IV: FOURIER SERIES:

Introduction, Euler's formulae, Periodic functions, Dirichlet's conditions, conditions for a Fourier expansion, functions of any period, functions having points of discontinuity, odd and even functions - half range series.

UNIT – V: FOURIER TRANSFORMS:

Fourier integral theorem (without proof), Fourier cosine and sine integrals, Fourier transform, Fourier sine and cosine transforms, properties of Fourier Transforms, convolution theorem (without proof).

TEXT BOOK:

1. B.S.Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publisher.

REFERENCES:

1. N.P. Bali, Bhavanari Satyanarayana, Indrani Promod Kelkar, "Engineering Mathematics", University Science Press, (An Imprint of Lakshmi Publications Pvt., Ltd) New Delhi, 2012.
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGrawhill.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEditiwiley-India.
4. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning, 2011.

II B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	1	-	4	40	60	100	3
Code: 19BME3TH03	MACHINE DRAWING & BASIC DESIGN ENGINEERING SOFTWARE LAB						

COURSE OBJECTIVES:

This course will give the insight into the design, creation of assembly and get the detailed drawing of machine components. To enhance the student's knowledge and skills in engineering drawing and to introduce drafting packages and commands for computer aided drawing and modelling

COURSE OUTCOMES:

At the end of the course, students will be able to identify and classify

- **CO 1:** **Explain** about sectional views, limits, fits and tolerances
- **CO 2:** **Construct** screw fasteners, Keys, Cotters and Pin joints joints, and assembly machine parts.
- **CO 3:** **Create** a model machine parts by using software packages such as. CATIA

A.MACHINE DRAWING:

1. Introduction: Full and half sectional views, limits, fits and tolerances.
2. Screwed fasteners: Screw thread nomenclature - types & classification of screw threads, Square & Hexagonal headed bolted joints.
3. Keys, Cotters and Pin joints: Saddle & Sunk Keys, Cotter Joint with sleeve, Knuckle Joint.
4. Assembly Drawings: Screw Jack, Tail Stock, Eccentric, Pipe vice, Plummer block.

B.COMPUTER AIDED DRAFTING (CAD): using CATIA

1. Introduction to CATIA: Sketcher, part design & drafting.
2. Sketcher: profile tools, operation tools, constraint tools, sketch tools.
3. Part Design: sketcher, sketch based features, dress up features.

Any Three Figures:

- **A)** BASE PLATE
- **B)** DOVETAIL STOP
- **C)** GUIDE PLATE
- **D)** SLOTTED LINK
- **E)** GLAND BLANK

Text Books:

1. Machine Drawing by K.L.Narayana, P.Kannaiah & K.Venkata Reddy, New Age International, and 3rd Edition.
2. CATIA V5-6R2015 for Engineers and Designers, 13ed Kindle Edition, Prof.sham.tickoo.

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Reference Books:

1. Machine Drawing by K.R.Gopala Krishnan, Subhas Publications, 20th Edition, 2007.
2. CATIA V5-6R2018 for Engineers and Designers, Prof.sham.tickoo, BPB Publications (2019)
3. CATIA V5 Tutorials Mechanism Design & Animation Release 20

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: 19BME3LB01	**FLUID MECHANICS AND HYDRAULIC MACHINERY LAB**						

COURSE OBJECTIVE:

To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

COURSE OUTCOMES:

After completion of the course students are able to:

CO 1: **Experiment with** the flow discharge measuring devices used in pipes, channels and tanks.

CO 2: **Solve** the flow equations to estimate performance of the pump

LIST OF EXPERIMENTS:

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

VIRTUAL LAB:

1. Verification of Bernoulli's theorem
2. Reynolds experiment for determination of different regimes of flow.

II B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code:19BME3LB02	**MECHANICS OF SOLIDS & METALLURGY LAB**						

COURSE OBJECTIVES:

In this laboratory students will have the opportunity to apply loads to various materials under different equilibrium conditions. The student will perform tests on materials in tension, compression, torsion, and impact.

To impart practical exposure on the microstructures of various materials and their hardness evaluation. Also to impart practical knowledge on the evaluation of material properties through various destructive testing procedures

COURSE OUTCOMES:

After completion of the course students are able to:

CO 1: **Experiment with** different materials for the evaluation of material properties through various destructive testing procedures.

CO 2: **Examine** the microstructures of different materials and also identify the hardness values.

NOTE: Any 6 experiments from each section A and B.

(A) MECHNICS OF SOLIDS LAB:

1. Direct tension test-brittle and ductile materials
2. Fatigue Test
3. 3-point bend test
4. Unsymmetrical bend test
5. Specimen preparation and characterization
6. Torsion test
7. Vickers hardness Test
8. Test on springs
9. Compression test on cube
10. Impact test
11. Punch shear test
12. Brinell's and Rockwell's hardness test
13. Simply Supported beam

Virtual Lab:

1. To obtain strain measurement for Aluminium specimen by conducting creep test

(B) METALLURGY LAB:

I. Preparation and study of the Micro Structure of Ferrous materials-

a) Cast Iron

1. Grey cast iron
2. Nodular cast iron
3. White cast iron

b) Steel

4. Mild steel
5. Low carbon steel
6. High carbon Steel

II. Preparation and study of the Micro Structure of Non-Ferrous materials-

7. Brass
8. Aluminium
9. Copper
10. Hardenability of steels by Jominy End Quench Test.
11. Die penetration Test.

Virtual Lab:

1. Investigate Mechanical properties of Nano material by conducting Nano indentation test.

II B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	-	-	-	0
Code: 19BCC3MC01	**QUANTITATIVE APTITUDE AND REASONING**						

COURSE OBJECTIVES:

- To train students in analyzing real life scenarios considering all factors
- To educate the students on principles of mathematical problems and problem solving methods
- To train students for campus placements
- To make students adept in applying appropriate logic and shortcuts to solve the problems in the least possible time.

COURSE OUTCOMES:

After thorough learning of Quantitative Aptitude and Reasoning, a student:

CO 1: **Prepare** well for clearing Quantitative Aptitude and Reasoning tests for campus Placements

CO 2: **Critically** evaluate various real life situations by resorting to Analysis of key issues and factors.

CO 3: **Demonstrate** various principles involved in solving mathematical problems and There by reducing the time taken for performing job functions.

APTITUD:

Unit I: Simple equations, Ratio, Proportion, Variation

1. Simple equations

a. Definition of Linear Equations
b. Formation of simple equations
c. Problems on Ages, Fractions and Digits
d. Indeterminate system of equations
e. Special cases in indeterminate system of equations

2. Ratio and proportion

a) Definition of Ratio
b) Properties of Ratios
c) Comparison of Ratios
d) Problems on Ratios
e) Compound Ratio
f) Problems on Proportion, Mean proportional and Continued Proportion

3. Variation

a) Direct variation
b) Inverse variation
c) Joint variation
d)

e) Problems on Variations

Unit II: Percentages, Partnership.

1. Percentages

a) Introduction
b) Converting a percentage into decimals
c) Converting a Decimal into a percentage
d) Percentage equivalent of fractions
e) Problems on percentages

2. Partnership

a) Introduction
b) Relation between capitals, Period of investments and Shares

Unit III: Profit And Loss

a) Problems on Profit and Loss percentage
b) Relation between Cost Price and Selling price
c) Discount and Marked Price
d) Two different articles sold at same Cost Price
e) Two different articles sold at same Selling Price
f) Gain% / Loss% on Selling Price

REASONING :

UNIT IV: Deductions & Connectives

1. Deductions

a) Finding the conclusions using Venn diagram method
b) Finding the conclusions using syllogism method

2. Connectives

a) Definition of a simple statement
b) Definition of compound statement
c) Finding the Implications for compound statements
d) Finding the Negations for compound statements

UNIT V: Analytical Reasoning puzzles

a) Problems on Linear arrangement
b) Problems on Circular arrangement
c) Problems on Double line-up
d) Problems on Selections
e) Problems on Comparisons

UNIT VI: Clocks, Calendars & Blood relations

1. **Clocks**
   a) Finding the angle when the time is given
   b) Finding the time when the angle is known
   c) Relation between Angle, Minutes and Hours
   d) Exceptional cases in clocks

2. **Calendars**
   a) Definition of a Leap Year
   b) Finding the number of Odd days
   c) Framing the year code for centuries
   d) Finding the day of any random calendar date

3. **Blood relations**
   a) Defining the various relations among the members of a family
   b) Solving Blood Relation puzzles
   c) Solving the problems on Blood Relations using symbols and notations

TEXT BOOKS:

1. GL Barrons, Mc Graw Hills, Thorpe's verbal reasoning, LSAT Materials
2. R S Agarwal, S.Chand , 'A modern approach to Logical reasoning'
3. R S Agarwal, S Chand, 'Quantitative Aptitude'
4. Quantitative Aptitude - G. L BARRONS
5. Quantitative Aptitude - Abhijit Guha Mc Graw Hills

REFERENCES:

1. www.careerbless.com/**aptitude**/qa/home.php
2. www.affairscloud.com/**quantitative-aptitude**-questions
3. www.careerafter.com/rs-aggarwal-**quantitative-aptitude**-pdf/
4. www.amazon.in/**Quantitative-Aptitude**-Competitive-Examinations.../8121924987
5. www.indiabix.com

   www.practice**aptitude**tests.com/numerical-**reasoning**-tests

II B.TECH– II SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Kinematics of Machinery	19BME4TH01	PC	40	60	100	2	1	-	3
2	Manufacturing Technology	19BME4TH02	PC	40	60	100	3	-	-	3
3	Metrology & Instrumentation	19BME4TH03	PC	40	60	100	3	-	-	3
4	Applied Thermo Dynamics	19BME4TH04	PC	40	60	100	2	1	-	3
5	**Open Elective-1**		OE	40	60	100	3	-	-	3
6	Applied Thermo Dynamics Lab	19BME4LB01	PC	20	30	50	-	-	3	1.5
7	Metrology & Instrumentation Lab	19BME4LB02	PC	20	30	50	-	-	3	1.5
8	Manufacturing Technology Lab	19BME4LB03	PC	20	30	50	-	-	3	1.5
9	English Communication Skills Lab - II	19BCC4LB01	HS	20	30	50	-	-	3	1.5
	Total									**21**

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME4TH01	**KINEMATICS OF MACHINERY**						

COURSE OBJECTIVES:

- To make student understand the purpose of kinematics, Kinematic joint and mechanism and to study the relative motion of parts in a machine without taking into consideration the forces involved.
- To make student understand various mechanisms for straight line motion and their applications including steering mechanism.
- To make student understand the velocity and acceleration concepts and the methodology using graphical methods and principles and application of four bar chain.
- To make student understand the theories involved in cams.
- To make student understand gears, gear trains.

COURSE OUTCOMES:

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

CO 1: **Illustrate** the various types of kinematic links, kinematic joints & mechanisms.
CO 2: **Interpret** the various types of lower pair mechanisms.
CO 3: **Construct** the velocity and acceleration diagram of different mechanisms.
CO 4: **Construct** the different CAM profiles.
CO 5: **Demonstrate** the Gears and Gear Trains.

UNIT– I

MECHANISMS: Elements or Links – Classification of Links – Types of kinematic pairs –Types of constrained motion. Gubralrs criteria, Grashoff's law, Degrees of freedom, Kutzbach criterion for planar mechanisms

MECHANISM AND MACHINES – Classification of machines – kinematic chain – inversion of mechanism– inversions of quadric cycle, chain – single and double slider crank chains.

UNIT–II

LOWER PAIR MECHANISM: Exact and approximate copiers and generated types - Peaucellier, Hart and Scott Russul - Grasshopper - Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph. Conditions for correct steering - Davis Steering gear, Ackermans steering gear - velocity ratio; Hooke's Joint: Single and double - Universal coupling- application-problems.

UNIT–III

KINEMATICS: Velocity and acceleration – Motion of a link in machine –Determination of Velocity and acceleration diagrams – Graphical method –Application of relative velocity method four bar chain. Velocity and acceleration analysis of a given mechanism, Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration. Plane motion of body.

INSTANTANEOUS CENTER OF ROTATION: centroids and axodes– relative motion between two bodies – Three centres in line theorem –Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

UNIT-IV

CAMS: Definitions of cam and followers – their uses – Types of followers and cams– Terminology – Types of follower motion: Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above three cases. Analysis of motion of Roller follower

UNIT-V

GEAR: Higher pairs, friction wheels and toothed gears–types – law of gearing, condition for constant velocity ratio for transmission of motion, velocity of sliding –phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact.

GEAR TRAINS: Introduction to gear Trains, Train value, Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio –Epicyclic gear trains.

TEXT BOOKS:

1. S.S.Ratan, Theory of Machines, Mc. Graw Hill Publ.
2. Thomas Bevan,Theory of Machines ,CBS Publishers & Distributors

REFERENCE BOOKS:

1. Sadhu Singh ,Theory of Machines , Pearsons Education
2. Khurmi,Theory of machines ,S.Chand publications
3. Ashok G. Ambedkar ,Mechanism and machine theory , PHI Publications.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112104121/
2. https://www.slideshare.net/senthilkumar1311/kinematics-of-machinery

E-BOOKS:

1. https://www.amazon.in/Kinematics-Machinery-Ramachandran-S ebook/dp/B01N6P33YT#reader_B01N6P33YT

II B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
Code: 19BME4TH02	MANUFACTURING TECHNOLOGY						

COURSE OBJECTIVES:

- To emphasize the importance manufacturing sciences in the day-to-day life, and to study the basic manufacturing processes
- To understand the conventional manufacturing processes like casting, metal forming, and welding process.

COURSE OUTCOMES:

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

CO 1: **Explain** various manufacturing processes and fundamentals of casting process
CO 2: **Outline** different types of welding process for fabrication of metals
CO 3: **Demonstrate** advanced welding processes by make use of sketches
CO 4: **Compare** the characteristics of cold and hot working processes of Forming, forging and Rolling
CO 5: **Explain** principles of Extrusion and Drawing processes by make use of sketches

UNIT-I

INTRODUCTION TO MANUFACTURING PROCESSES: Difference between Production and Manufacturing.

FOUNDRY: Introduction to casting process, steps involved in making a casting, Advantages of casting and its applications, Types of patterns, Materials used for patterns, Pattern allowances, Gating elements and moulding procedure, Moulding materials, Cores, Types of Sand moulding-CO2 Moulding and Shell Moulding.

SPECIAL CASTING METHODS: Permanent Mould Casting, Die Casting, Centrifugal Casting, Investment Casting, Continuous Casting, Fettling of Castings, Casting Defects: causes and remedies.

UNIT-II

WELDING: Classification of welding processes, Types of welds and types of joints.

GAS WELDING: Equipment, Oxy-Acetylene flame, types, Gas welding procedure, Gas cutting.

ARC WELDING: Principle of Arc welding, Equipment, Electrodes, Electrode coatings, AC and DC Welding, Arc Blow, Arc Length Characteristics, Related Simple Problems. Welding defects – Causes and Remedies.

UNIT-III

RESISTANCE WELDING: Principle, Butt welding, spot welding and seam welding. Simple problems on resistance welding.

OTHER WELDING PROCESSES: Thermit welding, Inert gas welding - TIG and MIG welding, Submerged arc welding, plasma arc welding, soldering and brazing.

UNIT-IV

FORMING: Introduction, Elastic & Plastic deformation; Recovery, Recrystallization & grain growth; Hot working & Cold working.

FORGING: Introduction, Hot forging & Cold forging, Open & Closed die forging, Forging defects & remedies.

ROLLING: Introduction, Hot & Cold rolling process, Angle of bite, Rolling stand arrangements.

UNIT-V

EXTRUSION & DRAWING: Extrusion fundamentals, Classification of Extrusion- Forward Extrusion, Backward Extrusion, Impact extrusion, Hydrostatic extrusion. Types of drawing: Wire drawing, Tube drawing.

TEXT BOOKS:

1. Manufacturing Technology Vol-I by P.N. Rao, Tata McGraw Hill Publications.
2. Production Technology by P. C. Sharma, S. Chand Publications.

REFERENCES:

1. Welding Technology by Little byTata McGraw Hill Publications.
2. Manufacturing Engineering and Technology by Kalpak Jain, Pearson Education/PHI.

Web References:

1. https://nptel.ac.in/courses/112107144/1
2. https://nptel.ac.in/courses/112107144/2
3. https://nptel.ac.in/courses/112107144/10
4. https://nptel.ac.in/courses/112107144/13
5. https://nptel.ac.in/courses/112107144/14

E-Books:

1. https://easyengineering.net/manufacturingbooks/
2. https://easyengineering.net/manufacturingbooks/
3. https://books.google.com/books/about/Manufacturing_Technology.html?id=fSHZAgAAQBAJ
4. https://www.researchgate.net/publication/259800841_Manufacturing_Technology_Vol_1_Foundry_Forming_and_Welding

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
Code: 19BME4TH03	**METROLOGY & INSTRUMENTATION**						

COURSE OBJECTIVES:

- Inspection of engineering parts with various precision instruments.
- Design of part, tolerances and fits.
- Principles of measuring instruments and gauges and their uses.
- Imparting the principles of measurement which includes the working mechanism of various displacement transducers, measurement of temperature and pressure gauges.

COURSE OUTCOMES:

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

CO 1: **Explain** the design tolerances and fits for selected product quality.
CO 2: **Illustrate** the standards of length, angle measurement.
CO 3: **Demonstrate** the concepts of limit gauges and optical measurements.
CO 4: **Explain** of various transducers to measure displacement
CO 5: **Analyze** various Temperature and pressure transducers for engineering applications

UNIT– I

SYSTEMS OF LIMITS AND FITS: Introduction, nominal size, tolerance, limits, deviations, fits - Unilateral and bilateral tolerance system, hole and shaft basis systems- interchangeability and selective assembly. International standard system of tolerances, selection of limits and tolerances for correct functioning.

UNIT–II

LINEAR MEASUREMENT: Length standards, end standards, slip gauges- calibration of the slip gauges, dial indicators, micrometres.

MEASUREMENT OF ANGLES AND TAPERS: Different methods – bevel protractor, angle slip gauges- spirit levels- sine bar, rollers and spheres used to measure angles and tapers.

UNIT–III

LIMIT GAUGES: Taylor's principles-design of GO and NO GO gauges; plug, ring, snap, gap, taper, profile and position gauges**.**

OPTICAL MEASURING INSTRUMENTS: Tools maker's microscope and uses, autocollimators, optical projector, optical flats and their uses.

UNIT-IV

BASIC PRINCIPLES OF INSTRUMENTATION: Units and standards – Static measurements – Scale and pointer type instruments – Definition of range, sensitivity, hysteresis, accuracy, precision, reliability, repeatability, linearity, drift, Static and dynamic response, reproducibility, calibration procedure, errors in measuring instruments, source of errors.

MEASUREMENT OF DISPLACEMENT: Theory and construction of various transducers to measure displacement - LVDT, piezo electric, inductive, capacitance, resistance.

UNIT-V

MEASUREMENT OF TEMPERATURE: Classification, ranges, various principles of measurement, expansion, electrical resistance, thermistor, thermocouple.

MEASUREMENT OF PRESSURE: Units - classification – different principles used. Manometers, piston, bourdon pressure gauges, bellows - diaphragm gauges. Low pressure measurement, McLeod pressure gauge.

TEXT BOOKS:

1. Engineering Metrology, Mahajan, Dhanpat Rai Publishers.
2. Measurement Systems Applications & design by D.S Kumar, Khanna Publishers.

REFERENCE BOOKS:

1. Engineering Metrology, R.K.Jain, Khanna Publishers.
2. Engineering Metrology by I.C.Gupta, DhanpatRai Publishers.
3. Mechanical and Industrial Measurements, R.K. Jain, Khanna Publishers.

WEB REFERENCES:

1. https://www.youtube.com/watch?v=HpIEeBtJupY&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=1

E-BOOKS:

1. http://www.gvpce.ac.in/syllabi/Engineering%20Metrology.pdf

II B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: **19BME4TH04**	**APPLIED THERMODYNAMICS**						

COURSE OBJECTIVES:

- To understand the engine terminology and working principles of I.C Engines.
- To learn analytical techniques to the engineering problems and performance analysis of internal combustion engines.
- To learn the design and operating characteristics of modern internal combustion engines.

COURSE OUTCOMES:

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

CO 1: **Illustrate** the reasons and effects of various losses that occur in the actual engine operation.
CO 2: **Analyze** the combustion phenomenon and knocking in SI and CI Engines
CO 3: **Explain** the performance and emission parameters of SI and CI engines
CO 4: **Analyze** the working of rotary compressors.
CO 5: **Analyze** the working of axial compressors.

UNIT - I:

ANALYSIS OF IC ENGINE CYCLES: Air standard cycle, fuel air cycle and actual cycle. Comparison of air-standard and fuel air cycle, fuel air cycle and actual cycle. Different types of losses.

WORKING OF I.C ENGINES: Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems -Carburettor, Fuel Injection System, Ignition, Cooling and Lubrication, principle of Wankle engine, principles of supercharging and turbocharging.

UNIT - II:

COMBUSTION IN S.I. ENGINES: Normal Combustion and abnormal combustion - Importance of flame speed and effect of engine variables - Type of Abnormal combustion, pre-ignition and knocking - Fuel requirements and fuel rating, anti knock additives -combustion chamber- requirements, types.

COMBUSTION IN C.I. ENGINES: Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

UNIT - III:

MEASUREMENT, TESTING AND PERFORMANCE: Parameters of performance -measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power - Performance test – Heat balance Sheet.

UNIT - IV:

COMPRESSORS: Classification - positive displacement and roto-dynamic machinery - power producing and power absorbing machines, fan, blower and compressor-positive displacement and dynamic types-reciprocating and rotary types.

ROTARY (POSITIVE DISPLACEMENT TYPE): Roots Blower, Vane sealed compressor, Lysholm compressor - mechanical details and principle of working - efficiency considerations.

UNIT-V:

ROTARY COMPRESSORS: Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

AXIAL FLOW COMPRESSORS: Mechanical details and principle of operation –velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency- pressure rise calculations – Polytrophic efficiency.

TEXT BOOKS:

1. Internal Combustion Engines by V.Ganesan, Tata McGraw Hills Publications
2. A treatise on heat power engineering by Vasandani & D.S.Kumar, Metropolitan Book Co. Ltd.

REFERENCES:

1. Internal Combustion Engine by M.L.Mathur and R.P.Sharma, DhanpatRai Publications
2. Thermal Engineering by R.S.Khurmi and J.K.Guptha, S.Chand Publications

WEB REFERENCES

1. https://nptel.ac.in/courses/112/104/112104033/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/
4. https://www.vssut.ac.in/lecture_notes/lecture1429900545.pdf
5. https://d6s74no67skb0.cloudfront.net/course-material/ME925-Fundamentals-of-Gas-Turbine-Engines.pdf

II B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: **19BME4LB01**	**APPLIED THERMODYNAMICS LAB**						

COURSE OBJECTIVES:

- To learn the construction and working principle of I.C.Engines practically.
- To understand the working principle and performance of air compressor practically.
- To learn the heat balance test of an I.C. Engine.

COURSE OUTCOME:

After the completion of the course, students should be able to

CO1: **Estimate** various fuel characteristics using Internal Combustion Engines

CO2: **Evaluate** the performance parameters of refrigeration system & air compressors

LIST OF EXPERIMENTS:

1. Determination of flash point, fire point.
2. Determination of calorific value of fuel using Bomb Calorimeter.
3. Determination of viscosity of fluid.
4. I.C. Engine Valve Timing Diagram
5. I.C. Engine Port Timing Diagram
6. Determination of performance characteristics of 2-Stroke Petrol Engine.
7. I.C. Engine Performance Test on Single Cylinder 4 Stroke Diesel Engine
8. Evaluation of Engine Friction by Conducting Morse Test on 4 - Stroke Petrol Engine.
9. Evaluation of Engine Friction by Conducting Motoring/Retardation Test on Single Cylinder 4 Stroke Diesel Engine
10. Heat Balance Test on Single Cylinder 4 Stroke Diesel Engine
11. Performance Test on Variable Compression Ratio
12. Volumetric Efficiency of a Reciprocating Air Compressor

VIRTUAL LABS

1. http://vlabs.iitkgp.ernet.in/rtvlas/
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/refigeration/labs/exp1/index.php

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: **19BME4LB02**	**METROLOGY & INSTRUMENTATION LAB**						

COURSE OBJECTIVES:

The Metrology and instrumentation Laboratory course is designed for measuring and gauging instruments for inspection of precision linear, geometric forms, angular and surface finish measurements. The student can learn the measurements with and calibration of instruments. Instrumentation lab introduces the students with the theory and methods for conducting experimental work in the laboratory and calibration of various instruments for measuring pressure, temperature, displacement, speed, etc.

COURSE OUTCOMES:

CO1: **Examine** different instruments that are available for linear, angular and roughness measurements and select and use the appropriate measuring instrument according to a specific requirement.

CO2: **Analyze** proper measuring instrument and know the requirement of calibration, errors in measurement etc.

METROLOGY LAB:

1. Measurement of lengths, heights, diameters by Vernier calipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear tooth Vernier caliper for tooth thickness inspection and flange micro meter for checking the chordal thickness of spur gear.
2. Machine tool alignment test on the lathe, drilling & milling machines.
3. Angle and taper measurements with bevel protractor, Sine bars, rollers and balls.
4. Use of spirit level in finding the straightness of a bed and flatness of a surface.
5. Thread inspection with two wires/ three wire method & tool maker's microscope.
6. Surface roughness measurement with roughness measuring instrument.

INSTRUMENTATION LAB:

1. Calibration of pressure gauge.
2. Calibration of thermocouple for temperature measurement.
3. Calibration of Resistance Temperature Detector for temperature measurement.
4. Study and calibration of LVDT transducer for displacement measurement.
5. Calibration of strain gauge.
6. Calibration of thermistor for temperature measurement.
7. Calibration of capacitive transducer.
8. Study and calibration of photo and magnetic speed pickups.
9. Calibration of resistance temperature detector.

II B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: **19BME4LB03**	**MANUFACTURING TECHNOLOGY LAB**						

COURSE OBJECTIVES:

- To apply the class room knowledge to do the experiments in the lab
- To identify and solve the problems while doing the experiments of casting, metal forming & casting and welding processes.

COURSE OUTCOMES:

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

CO 1: **Experimentation** with the sand molds & welding practice.

CO 2: **Prepare** plastic molding parts, rod bends, washers and aluminum casting.

LIST OF EXPERIMENTS:

I. MOLDING PRACTICE:

1. Preparation of a green sand mould using single piece pattern.
2. Preparation of a green sand mould using multi piece pattern.
3. Sand testing: green strength, dry strength, grain fineness number, permeability etc.

II. WELDING PRACTICE:

1. Preparation of a T joint using electric arc welding.
2. Preparation of a Butt Joint using gas welding.
3. Preparation of a lap joint using spot welding.

III. PLASTIC MOLDING:

Injection Molding:

1. Preparation of a key chain by using two plate mold.

Blow Molding:

1. Preparation of a bottle by using blow molding technique.

IV. MECHANICAL PRESSES:

1. Preparation of a rod bends using hydraulic press.
2. Preparation of a washer using hydraulic press.

V. DEMONSTRATION OF STIR CASTING MACHINE:

1. Preparation of Aluminum casting with stir casting machine

VI. VIRTUAL LAB:

Metal Forming Virtual Simulation Lab (http://msvs-dei.vlabs.ac.in/)

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: 19BCC4LB01	**ENGLISH COMMUNICATION SKILLS LAB-II (Common to All Branches)**						

COURSE OBJECTIVES:

- To train the students to use language effectively in various professional interactions like Group Discussions, Public Speaking, Presentations and Interviews.
- To make the students understand the importance of body language.
- To provide exposure to students to soft skills like Goal Setting, Assertiveness, Time Management, Positive Attitude and Stress Management
- To expose the students to variety of a self-instructional, learner friendly, electronic media and stimulate intellectual faculties/resources

COURSE OUTCOMES:

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

CO 1: **Utilize** Non-verbal cues and interpret nonverbal symbols.
CO 2: **Develop** presentation Skills and make formal presentations using strategies.
CO 3: **Analyze** problem solving skills effectively to participate in Group Discussions.
CO 4: **Build** interview skills for employability.

UNIT– I

Body Language

UNIT–II

Presentation Skills

UNIT–III

Group Discussions

UNIT-IV

Interviews and Telephonic Interviews

UNIT-V

Debates

TEXT BOOKS:

1. *"Strengthen Your Communication Skills",* Maruthi Publications, 2013.

REFERENCE BOOKS:

1. "*Personality Development and Soft Skills"*, Oxford University Press, New Delhi.
2. M Ashraf Rizvi, "*Effective Technical Communication skills"*, McGraw-Hill, 2005.
3. Barun K Mitra, "*Personality Development and Soft Skills",* Oxford University Press, 2011.
4. Konar N, "*Communication Skills for Professionals",* PHI Learning Private Limited, 2011.

III B.TECH– I SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Business Management Concepts for Engineers	19BME5TH02	HS	40	60	100	3	-	-	3
2	Metal Cutting & Machine Tools	19BME5TH03	PC	40	60	100	3	-	-	3
3	Heat Power Engineering	19BME5TH04	PC	40	60	100	2	1	-	3
4	Design of Machine Elements -I	19BME5TH05	PC	40	60	100	2	1	-	3
5	Entrepreneurship and Innovation	19BCC5TH01	HS	40	60	100	2	-	-	2
6	**Open Elective-2**		OE	40	60	100	3	-	-	3
7	Engineering Skills Lab	19BME5LB01	PR	20	30	50	-	-	3	1.5
8	Metal Cutting & Machine Tools Lab	19BME5LB02	PC	20	30	50	-	-	3	1.5
9	Heat Power Engineering Lab	19BME5LB03	PC	20	30	50	-	-	3	1.5
Total										**21.5**

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	30
Code: 19BME5TH02	**BUSINESS MANAGEMENT CONCEPTS FOR ENGINEERS**						

COURSE OBJECTIVE:

The course content enables students to:

- Provide an insight into the various economic concepts which are necessary for taking decisions related to economic aspects of the organization.
- Provide familiarity with the accounting concepts which will help in preparation of various accounting records
- Equip the student with the basic management concepts and functions and to provide knowledge relating to recruitment, selection, training, and motivation of employees in the organization

COURSE OUTCOMES:

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

CO1: Summarize fundamentals of Managerial economics for decision making
CO2: Apply concepts of Financial Accounting and BEP for business decisions
CO3: Evaluate fundamental concepts and principles of management
CO4: Discuss functional areas of management like HR, marketing and finance
CO5: Apply project management techniques for project planning and evaluation

UNIT-I: INTRODUCTION TO MANAGERIAL ECONOMICS

Definitions, - Nature And Scope- Relation With Other Subjects- Demand Definition- Determinants- Law of Demand and Its Exceptions- Concept of Elasticity of Demand- Cost Concepts- CVP Analysis (With Simple Problems), Significance- Limitations.

UNIT-II: MARKET STRUCTURES AND FINANCIAL ACCOUNTING

Introduction to Markets – Features of various markets-Perfect competition, Monopoly and Oligopoly. Definition – Importance, limitations and basic books of financial accounting, Preparation of basic books of accounting: journal, ledger and trail balance.

UNIT-III: INTRODUCTION TO MANAGEMENT

Concept, Nature, Importance- Functions of Management- Henry Fayols Principles of Management- F.W.Taylors Scientific Management- Douglas Mc Gregors Theory X and Y.

UNIT-IV: FUNCTIONAL AREAS OF MANAGEMENT

Concept of HRM, Functions of HR Manager- Marketing Management- Functions of Marketing Manager- Production Management-Functions of Production Management – Financial Management and functions of Financial Management.

UNIT-V: PROJECT MANAGEMENT: (PERT/CPM)

Development of Network – Difference between PERT and CPM- Problems on Critical Path- Problems on PERT Analysis.

TEXT BOOKS

1. Dr. N. APPARAO Dr. P. Vijay Kumar: "Managerial economics and financial analysis" Cengage publication's, New Delhi-2011.
2. Dr. A. R. Aryasri- Managerial Economics and Financial Analysis, TMH2011.
3. V. Maheswari: Managerial Economies, Sultan Chand.
4. Suma Damodaran: Managerial Economics, Oxford 2011.
5. Koontz & Weihrich: Essentials of Management" TMH 2011.

REFERENCES:

1. Managerial economics theory & applications, DM Mithani, Himalaya Publishing House, 2013
2. Accounting For Managers, G. Prasad, Jaibharath Publishers, 2016.
3. Dr. P. Vijaya Kumar & Dr. N. Appa Rao Management Science" cengage. Delhi, 2012
4. Project Planning & Control with PERT & CPM, BC Punmia & KK Khandelwal, Lakshmi Publications, New Delhi, 4th Edition – 2016.

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	30
Code: 19BME5TH03	**METAL CUTTING & MACHINE TOOLS**						

COURSE OBJECTIVES:

The course content enables students to

- Impart the fundamental aspects of the metal cutting principles and their applications studying the behavior of various machining processes
- Train in knowing the fundamental parts of various machine tools
- Discuss the various principles of jigs and fixtures which will be used to hold the work pieces in various machine tools

COURSE OUTCOMES:

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

CO1 Identify different cutting tool materials, tool nomenclature and calculate cutting parameters to enhance tool life.

CO2 Explain the construction & specification of various machine tools and **apply** machining economics.

CO3 Explain the working of Shaping, slotting, planning, drilling, boring machines and **apply** machining economics.

CO4 Distinguish the working of grinding, lapping, honing and broaching processes.

CO5 Illustrate the working of milling machines and **apply** machining economics.

UNIT – I: FUNDAMENTALS OF MACHINING

Basic elements of machining, Orthogonal and oblique cutting. Classification of cutting tools: single, and multipoint; tool signature for single point cutting tool. Mechanics of orthogonal cutting; chip formation, shear angle and its significance, Merchant circle diagram. Numerical problems. Cutting tool materials and applications, tool life equations, effect of process parameters on tool life, machinability. Cutting fluid-types and applications.

UNIT – II: LATHE MACHINES

Lathe- Parts of lathe machine, accessories of lathe machine, and various operations carried out on lathe. Turret and Capstan lathe, taper turning methods. Principal features of automatic lathes – classification – single spindle and multi-spindle automatic lathes, lathe attachments, Machining time calculations.

UNIT – III:

DRILLING: Types of drilling machines, Difference between drilling, boring & reaming, boring operations & boring machines.

SHAPING, PLANNING AND SLOTTING MACHINES- working principle, constructional features- shaper, planner, slotter, machining operations and operating parameters.

UNIT – IV:

MILLING: Various Milling operations, classification of milling machines, Vertical & Horizontal milling, up milling & down milling. Indexing: need of indexing, simple, compound & differential indexing.

JIGS & FIXTURES: Principles of jigs and fixtures, uses, classification of jigs & fixtures

UNIT – 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.

TEXT BOOKS:

1. Manufacturing technology II, P.N Rao, Tata Mcgraw hill publishers
2. Workshop Technology, B.S.RaghuVamshi–Vol II, DhanpatRai& Co

REFERENCES:

1. Production Technology by H.M.T., Tata McGraw-Hill Education
2. Production Engineering, K.C Jain & A.K Chitaley, PHI Publishers
3. Production Technology, R.K. Jain and S.C. Gupta, Khanna Publisher

Web resources:

1. https://nptel.ac.in/courses/112/105/112105233/
2. http://home.iitk.ac.in/~vkjain/Lecture2-Metalcutting.pdf

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME5TH04	**HEAT POWER ENGINEERING**						

COURSE OBJECTIVES:

The course content enables students to:

- Inculcate the fundamental knowledge of the thermal power generation using steam and gas turbines
- Discuss various types of rockets and its applications and preparation of rocket fuels and propellants

COURSE OUTCOMES:

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

CO1: Illustrate the various types of efficiency improvements of Rankine cycle

CO2: Describe the various boilers, mountings and accessories.

CO3: Identify different types of nozzles used in steam turbines.

CO4: Classify different turbines based on utility and applications.

CO5: Discuss gas turbines, jet propulsion and rocket propulsion.

Course Prerequisites: Thermodynamics

UNIT – I: RANKINE CYCLE: Schematic layout, thermodynamic analysis, methods to improve cycle performance, regeneration & reheating.

COMBUSTION: Fuels and combustion, concepts of heat reaction, adiabatic flame temperature, flue gas analysis.

UNIT - II: BOILERS: Classification, working principles of L.P & H.P boilers, mountings and accessories, working principles, boiler horsepower, equivalent evaporation, efficiency.

DRAUGHT: Classification, Natural and Artificial draught, induced and forced draught, height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney.

UNIT – III: STEAM NOZZLES: Function of a nozzle, applications, types, flow through nozzles, thermodynamic analysis, assumptions, velocity of fluid at nozzle exit, Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, nozzle design, Super saturated flow, degree of super saturation and degree of under cooling, Wilson line.

UNIT - IV: STEAM TURBINES: Construction & working of steam turbines, Impulse & reaction principles, and inlet & outlet velocity diagrams. Work output & efficiencies. Pressure & velocity compounding, regenerative feed water heating, reheat cycles, reheat factor.

UNIT -V: GAS TURBINES: Simple gas turbine plant, ideal cycle, essential components, parameters of performance, actual cycle, regeneration, inter-cooling and reheating, closed and semi-closed cycles-merits and demerits.

JET PROPULSION: Working principle thrust power, propulsive force and efficiency. Theory of operation of Rockets and its applications, propellant and types.

TEXT BOOKS:

1. Thermodynamics and Heat Engines, Volume 2, R.Yadav, Central book depot.
2. Heat Engineering, V.P Vasandani and D.S Kumar, Metropolitan Book Company, New Delhi.

REFERENCES:

1. Gas Turbines and Propulsive Systems, P.Khajuria & S.P.Dubey, Dhanpatrai
2. Gas Turbines, Cohen, Rogers and Saravana Muttoo, Addison Wesley, Longman, John wiley& sons
3. Thermal Engineering, R.S Khurmi, JS Gupta, S.Chand, Mechanical Engineering

Web References:

1. http://home.iitk.ac.in/~suller/lectures/lec29.htm
2. https://nptel.ac.in/courses/112/103/112103277/
3. http://nptelvideos.com/video.php?id=1181
4. http://150.107.117.36/NPTEL_DISK4/NPTEL_Contents/Web_courses/Phase1_web/112104117/machine/ui/Course_home-lec24.htm
5. https://nptel.ac.in/courses/112/106/112106166/

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME5TH05	**DESIGN OF MACHINE ELEMENTS-I**						

COURSE OBJECTIVES:

The course content enables students to:

- To review concepts of statics and strength of materials.
- To introduce fundamental approaches to failure prevention of components.
- To provide knowledge in the design of common machine elements such as fasteners, shafts, springs, cotter joints and couplings.

COURSE OUTCOMES:

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

CO1: Define and understand the design considerations and stresses in machine members.

CO2: Explain and solve the problems related to strength of machine elements.

CO3: Apply the engineering principles for the design of simple engineering machine members such as riveted joints, welded joints.

CO4: Apply the engineering principles for the design of keys, cotters, knuckle joints and power transmission of joints.

CO5: Understand and solve the problems related to shaft coupling.

UNIT – I:

INTRODUCTION: General considerations in the design, engineering materials and their properties selection –Manufacturing consideration in design, Tolerances and Fits –BIS codes of steels.

STRESSES IN MACHINE MEMBERS: Simple stresses combined stresses, torsional and bending stresses, impact stresses, stress-strain relation, various theories of failure, factor of safety, design for strength and rigidity, preferred numbers.

UNIT – II:

STRENGTH OF MACHINE ELEMENTS:

Stress concentration, theoretical stress concentration factor, fatigue stress concentration factor notch sensitivity, design for fluctuating stresses, endurance limit, estimation of endurance strength, Soderberg's line, Goodman's line, modified Goodman's line.

UNIT – III:

RIVETED AND WELDED JOINTS: Riveted joints- types, failure of joints, and efficiency of joint. Welded joints-types of welded joints, strength of butt, parallel fillet and transverse fillet welded joints Stresses, joints subjected to bending and twisting moments.

UNIT – IV:
KEYS & COTTERS: Types of keys, force acting on keys, Design of Keys. Types of Cotter joint-Socket & Spigot joint, Sleeve & Cotter joint.

UNIT – V:
POWER TRANSMISSION SHAFTS: Design of shafts. Shafts subjected to bending, torsion and axial loading. Shafts subjected to Fluctuating loads.
SHAFT COUPLING: Rigid couplings-muff, split muff and flange couplings, flexible couplings-flange coupling (modified).

TEXT BOOKS:
1. Design of Machine Elements, V.B.Bhandari, TMH Publishing Co. Ltd., New Delhi.
2. Mechanical Engineering Design, J.E.Shigley, TMH Publishing Co. Ltd., New Delhi.

REFERENCES:
1. Machine Design, Pandyah and Shah, TMH Publishing Co. Ltd., New Delhi.
2. Design Data hand book. Mahadevan, CBS Publishers.
3. Machine Design, R.S. Khurmi & J.K.Gupta, S. Chand Publications.

WEB REFERENCES:
https://nptel.ac.in/courses/112/105/112105124/
https://nptel.ac.in/courses/112/105/112105125/
https://nptel.ac.in/courses/112/106/112106137/
http://www.nptelvideos.in/2012/12/design-of-machine-elements.html
https://freevideolectures.com/course/2363/design-of-machine-elements-i

III B.TECH-I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	0	0	40	60	100	2
Code: 19BCC5TH01	**ENTREPRENEURSHIP & INNOVATION**						

COURSE OBJECTIVES:

The course content enables students to:

- Creating awareness among the students about the significance of entrepreneurship and its social relevance.
- Imparting knowledge to the students on institutional support available to start a business venture
- To understand the significance of entrepreneurial training in the development of new and existing entrepreneurs

COURSE OUTCOMES:

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

CO1 : Outline the concepts of Entrepreneurship.
CO2 : Create the awareness on creativity and innovation.
CO3 : Adopt the Entrepreneurship Development programs
CO4 : Evaluate the project planning and feasibility studies
CO5 : Analyze the concept of small and micro enterprises.

UNIT –I: ENTREPRENEUR AND ENTREPRENEURSHIP

Entrepreneur – Definitions, concept of entrepreneur, characteristics of entrepreneur, types of entrepreneurs, concept of entrepreneurship, characteristics of entrepreneurship, role of entrepreneurship in economic development, ethics and social responsibilities of an entrepreneur, Financial institutional support to entrepreneurs(IDBI,SISI,DIC,NIESBUD, Commercial banks etc.,

UNIT-II: CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP

Meaning and concept of creativity - Nature and characteristics of creativity -Creativity Process- Factors affecting creativity - Meaning and Importance Innovation - Process -Distinguish the Creativity and Innovation.

UNIT –III: ENTREPRENEURSHIP DEVELOPMENT PROGRAMMES

Designing Appropriate Training Programme to inculcate Entrepreneurial Spirit -Training for Entrepreneurs, Entrepreneurship Development Programme (EDP) – Need and objectives of EDP's - Phases and evolution on EDP's existing and new Entrepreneurs.

UNIT –IV: PROJECT PLANNING AND FEASIBILITY STUDIES

Meaning of a project, Project identification – Sources of new Ideas, Methods of generating ideas, Project selection**,** - Project Feasibility Study -Project evaluation and Techniques (PBP, ARR, NPV, IRR & PI).

UNIT –V: SMALL AND MICRO ENTERPRISES

Importance, definitions, MSME's Development Act 2006 – policies and their support to MSMEs - Growth of Firm and growth strategies, Factors inducing growth – sickness in small business and remedies.

TEXT BOOKS:

1. **1.** "Entrepreneurship", Arya Kumar: Pearson, Publishing House, New Delhi, 2012.
2. **2.** "Entrepreneurship', VSP Rao, Kuratko: Cengage Learning, New Delhi,2012
3. **3.** ShoimoMaital, DVR Seshadri, "Innovation Management", Response Books 2007

REFERENCES:

1. "Entrepreneurship Development" B.Janakiram, M Rizwana: Excel Books, ND, 2011
2. "Entrepreneurship Development", P.C.Shejwalkar Everest Publishing House, ND, 2011
3. Vinnie Jauhari& Sudhanshu Bhushan, "Innovation Management". Oxford University Press, 2014.

III B.TECH-I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code : 19BME5LB01	**ENGINEERING SKILLS LAB**						

CORSE OBJECTIVES:

The course content enables students to:

- The course in intended to provide knowledge of basic 3D printing elements, control and robotics.
- Candidates are trained on the 3D printing software (viz., Thinkercad and CURA) to gain the first-hand experience of 3D printing and manufacturing.

COURSE OUTCOMES:

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

CO1: Model and manufacture mechanical components using 3D printer.

CO2: Operate a robot efficiently.

List of Experiments:

- **This lab has been divided into two streams namely 3D printing lab and Robotics lab. Robotics lab has more exposure towards pick and place operations, and operating a robot effectively and analyse the kinematic mechanisms for position control systems. 3D printing lab will give an overall exposure towards modelling and printing of any structural elements.**

3D Printing Lab

1. Experiments on Thinker Cad.
2. Pre-processing STL file using CURA software.
3. Manufacture Hexagonal Nut by using 3D Printer.
4. Manufacture Connecting rod, Piston by using 3D Printer.
5. Simulation of Delta 3D Printing Machine – Virtual Lab

Robotics Lab

1. Introduction to CProg software
2. Pick and place operation using Electromagnetic Gripper Robot.
3. Pick and place operation using Pneumatic Gripper Robot.
4. Pick and place operation by Electromagnetic Gripper Robot using Teach Pendent.
5. Collaborating Two Robots using PLC.

Virtual labs:

1. http://vlabs.iitkgp.ernet.in/mr/#

Resources:

1. https://www.srmist.edu.in/codepartment-of-mechatronics-engineeringntent/mechatronics-laboratory
2. https://www.tinkercad.com/

III B.TECH-I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: 19BME5LB02	**METAL CUTTING & MACHINE TOOLS LAB**						

COURSE OBJECTIVES:

The course content enables students to:

- To learn the step turning, taper turning and thread cutting on lathe machines
- To the operation of shaping, planning, drilling, milling and surface grinding

COURSE OUTCOMES:

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

CO 1 Illustrate the working of lathe, shaper, planner, drilling, milling and grinding machines.

CO 2 Analyze the forces acting on cutting tools for different machines.

LIST OF EXPERIMENTS:

1. Plain turning and step turning operation on Lathe.
2. Taper turning operation on lathe.
3. Thread cutting and Knurling operation on Lathe.
4. Surface grinding
5. Preparation of hexagonal nut on milling machine
6. Cutting a slot on shaper machine
7. Drilling operation
8. Force measurement using Lathe tool Dynamometer.
9. Planning operation
10. Slotting operation

VIRTUAL LAB:

Metal Cutting & Machine Tools Lab

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/machine_tools/labs/exp1/index.php
2. https://fab-coep.vlabs.ac.in/exp1/Theory.html
3. https://virtlabs.tech/metal-cutting/

III B.TECH-I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: 19BME5LB03	**HEAT POWER ENGINEERING LAB**						

COURSE OBJECTIVES:

The course content enables students to:

- Perform different experiments on engines for determination of performance and emissions
- Estimate the fuel property calorific value using Junkers and bomb calorimeters
- Determination of dryness fraction of given steam sample using throttling calorimeter

COURSE OUTCOMES:

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

CO1: Demonstrate the various horse powers, Calorific values, emissions of IC engines.

CO2: Determine the various efficiencies and energy balance for several types of Internal Combustions Engines and compressors.

LIST OF EXPERIMENTS:

1. Determination of Calorific Value of gaseous Fuel by Junker's Calorimeter.
2. Performance Analysis of Heat Pipe.
3. Engine Performance with Turbo Charger.
4. Emission Studies of IC Engine.
5. Performance Analysis of Vapour Compression Test Rig.
6. Economical Speed Test on Four Stroke Multi-cylinder Petrol Engine.
7. Performance Test on Solar Flat Plate Collector Test Rig.
8. Retardation Test on Single Cylinder Diesel Engine.
9. Study of Boilers.
10. Dryness fraction measurement by separating and throttling calorimeter.

Virtual Lab Experiments:

1. Torque crank angle curve of SI Engine: http://vlabs.iitkgp.ernet.in/rtvlas/#
2. Determination of Cylinder MEP: http://vlabs.iitkgp.ernet.in/rtvlas/#
3. Torsional Vibrations of an Engine: http://vlabs.iitkgp.ernet.in/rtvlas/#

III B.TECH– II SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Design of Machine Elements -II	19BME6TH02	PC	40	60	100	2	1	-	3
2	Heat Transfer	19BME6TH03	PC	40	60	100	2	1	-	3
3	Dynamics of Machinery	19BME6TH04	PC	40	60	100	2	1	-	3
4	Complex Variables, Probability & Statistics	19BME6TH01	BS	40	60	100	2	1	-	3
5	**Professional Elective-1**		PE	40	60	100	2	1	-	3
	Automobile Engineering	19BME6PE05								
	Refrigeration and air conditioning	19BME6PE06								
	Operations Research	19BME6PE07								
	Unconventional Machining Processes	19BME6PE08								
6	**Open Elective-3**		OE	40	60	100	3	-	-	3
7	Heat Transfer Lab	19BME6LB01	PC	20	30	50	-	-	3	1.5
8	Machine Dynamics Lab	19BME6LB02	PC	20	30	50	-	-	3	1.5
9	Mini Project	19BME6MP	PR	20	30	50	-	-	3	1.0
10	Advanced Communication Skills	19BCC6MC01	MC	-	-	-	3	-	-	0
	Total									**22.0**

III B.TECH-II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	40	60	100	3
Code: 19BME6TH02	**DESIGN OF MACHINE ELEMENTS -II (Design Data Book is allowed)**						

COURSE OBJECTIVES:

The course content enables students to:

- To provide basic design methods for clutches, brakes, belt drives, bearings, gears and connecting rod.
- To introduce the design modifications to be considered for ease of manufacturing.

COURSE OUTCOMES:

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

CO1: Apply the design procedure to engineering problems, including the consideration of technical and manufacturing constrains of bearings.

CO2: Identify the loads and stresses while designing the connecting rod and crank shaft.

CO3: Analyze stresses on the piston and cylinder depending upon Design and proportions.

CO4: Identify the loads and machine members subjected and calculate static and dynamic stresses to ensure safe design.

CO5: Compare capacities of power transmission of Belt, Rope and Chain Drives.

UNIT – I:

DESIGN OF BEARINGS: Types of Journal bearings, Lubrication, Bearing Modulus, Full and partial bearings, Clearance ratio, Heat dissipation of bearings, bearing materials, Journal bearing design, Ball and roller bearings, Static loading of ball & roller bearings, Bearing life.

UNIT – II:

DESIGN OF I.C ENGINE COMPONENTS: Connecting Rod, Thrust in connecting rod, Stress due to whipping action on connecting rod ends, Cranks and Crank shafts- strength and proportions of over hung and centre cranks, Crank pins.

UNIT – III: PISTONS AND CYLINDERS

Pistons, Forces acting on piston, Construction, Design and proportions of piston, Cylinder. Cylinder liners.

UNIT – IV:

DESIGN OF CURVED BEAMS: introduction, stresses in curved beams, Expression for radius of neutral axis for rectangular, circular, trapezoidal and T-Section, C – clamps. Design of crane hook.

UNIT – V:

POWER TRANSMISSION SYSTEMS: Transmission of power by Belt and Rope drives, Transmission Efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives, Materials.

TEXT BOOKS:

1. Machine Design, V.B. Bandari, Tata McGraw Hill Publishers .
2. Machine Design, Pandya & Shaw, Charotar publishers.

REFERENCES:

1. Machine Design, R.N. Norton, Pearson Publishers.
2. Design Data hand book. S.Md.Jalaludeen, Anuradha Publishers.
3. Mechanical Engineering Design, JE Shingly, Tata McGraw Hill Publishers.

WEB REFERENCES:

https://www.digimat.in/nptel/courses/video/112105124/L01.html
http://nptel.vtu.ac.in/econtent/courses/ME/06ME61/index.php
http://creativestellars.blogspot.com/p/design.html
https://www.jntumaterials.co.in/2015/04/jntujntuk-design-of-machine-members-i.html
https://lecturenotes.in/subject/549/design-of-machine-members-i

III B.TECH-II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1		40	60	100	3
Code: 19BME6TH03	**HEAT TRANSFER**						

COURSE OBJECTIVES:

The course content enables students to:

- Able to analyze different modes of heat transfer and estimate the heat transfer
- Differentiate the forced and free convection heat transfer and correlate the heat transfer using non dimensional numbers
- Illustrate different heat transfer phenomena like radiation, condensation and boiling methods

COURSE OUTCOMES:

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

CO1: Illustrate various modes of heat transfer
CO2: Analyze various methods of heat transfer using extended surfaces and fins
CO3: Estimate heat loss from the system to the surroundings using convection.
CO4: Determine various methods of design of heat exchangers.
CO5: Estimation of radiation heat transfer between bodies.

UNIT-I

Introduction: Basic Modes of heat transfer, Steady state Heat Conduction- General Conduction equation in Cartesian and Cylindrical coordinates, Initial and Boundary conditions.

One-Dimensional Steady State Heat Conduction: Heat flow through plane wall and cylinder with constant thermal conductivity, Heat flow through composite slab and Cylinders, Thermal resistance, Electrical analogy, critical insulation thickness, uniform heat generation in slabs.

UNIT-II

Fins & Extended Surfaces: Types, Applications, Fin materials, Heat transfer from fins with uniform cross section, Fin efficiency and Effectiveness.

One-Dimensional Unsteady State Heat Conduction: Analytical Solutions for Plane wall, cylinder and sphere, Lumped heat capacity systems, transient temperature charts.

UNIT-III

Forced Convection: External Flows: Introduction, Principles of convection. Hydrodynamic and thermal boundary layers and their thicknesses. Correlations for heat transfer in Laminar and Turbulent flows over a flat plate relation between fluid friction and heat transfer in laminar flows.

Internal Flows: Division of Internal Flow through Concepts of Hydrodynamic and Thermal Entry Lengths-Use of Empirical Relations for Convective Heat Transfer in Horizontal Pipe Flow.

UNIT–IV

Natural Convection: Mechanism of natural convection, Development of Hydrodynamic and thermal boundary layer along a vertical plate- Use of empirical relations for Vertical plates and pipes.

Heat Exchangers: Classification, types of heat exchangers, Flow arrangement, Temperature distribution, Overall heat transfer coefficient, Fouling factor, LMTD and NTU methods of Heat exchanger analysis, correction for LMTD for use with multi pass and cross flow Heat Exchangers, Effectiveness.

UNIT-V

Boiling: Pool boiling–regimes-calculations on nucleate boiling, critical heat flux and film boiling. **Condensation**: Film wise and drop wise condensation.

Radiation heat transfer: Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies -concepts of shape factor – Emissivity – heat exchange between grey bodies.

TEXT BOOKS:

1. Heat and Mass Transfer /Arora and Domkundwar/Dhanpatrai & sons
2. Fundamentals of Engineering Heat and Mass Transfer / R.C. Sachdeva / New Age International

REFERENCE BOOKS:

1. Heat and Mass Transfer /Cengel/McGraw Hill.
2. Heat and Mass Transfer /D.S.Kumar / S.K.Kataria & Sons

WEB REFERENCES:

1. https://www.sciencedirect.com/topics/engineering/conduction-heat-transfer
2. http://thermopedia.com/content/750/
3. https://www.sciencedirect.com/topics/engineering/heat-convection
4. https://www.intechopen.com/books/advances-in-heat-exchangers/use-of-heat-transfer-enhancement-techniques-in-the-design-of-heat-exchangers
5. https://www.engineeringtoolbox.com/radiation-heat-transfer-d_431.html

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME6TH04	**DYNAMICS OF MACHINERY**						

COURSE OBJECTIVES:

The course content enables students to:

- Equip the student with fundamental knowledge of dynamics of machines so that student can appreciate
- Develop understanding of dynamic balancing, gyroscopic forces and moments.
- Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses.

COURSE OUTCOMES:

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

CO1 **Analyze** the effect of precession motion on the stability of aero plane and naval ship, automobile vehicles under gyroscope.

CO2 **Illustrate** friction in clutches, brakes and dynamometers for engineering applications.

CO3 **Analyze** the stability of different types of governors under dynamic analysis.

CO4 **Analyze** balancing of rotating masses by analytical and graphical methods

CO5 **Analyze** balancing of reciprocating masses for primary and secondary forces.

UNIT – I:

GYROSCOPE AND GYROSCOPIC EFFECTS: Introduction, Precessional Angular Motion, Gyroscopic Couple, Effect of precession motion on the stability of moving vehicles such as, Aero plane and Naval ship, Four wheel vehicle moving in a curved path, Two wheel vehicle Taking a Turn.

UNIT – II:

FRICTION CLUTCHES: Friction clutches- single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch.

BRAKES AND DYNAMOMETERS: Types of Brakes, Single Block or Shoe Brake, Simple Band Brake, Differential Band Brake, Internal Expanding Brakes. General description and operation of dynamometers - Prony, Rope brake. Classification of Transmission Dynamometers - Epicyclic, Bevis Gibson flash light and belt transmission,

UNIT – III:

GOVERNERS: Types of Governors, Terms Used in Governors. Watt Governor. Porter Governor, Proell Governor, Hartnell Governor, Hartung Governor, Sensitiveness of Governors, Stability of Governors, Isochronous Governor, Hunting, Effort and Power of a Governor

UNIT – IV

BALANCING OF ROTATING MASSES: Static balancing, dynamic balancing, balancing of a Single Rotating Mass by a Single Mass Rotating in the Same Plane. Balancing of a Single Rotating Mass by Two Masses Rotating in Different Planes, Balancing of Several Masses Rotating in the Same Plane by Analytical and Graphical Methods, Balancing of Several Masses Rotating in Different Planes.

UNIT- V:

BALANCING OF RECIPROCATING MASSES: Unbalanced Force**,** Primary and Secondary Unbalanced Forces of Reciprocating Masses, Partial Balancing of Unbalanced Primary Force in a Reciprocating Engine, Partial Balancing of Locomotives, Variation of Tractive Force, Swaying Couple, Hammer Blow, Balancing of Primary Forces and Secondary Forces of Multi-cylinder Inline Engines, Balancing of Radial Engines, and Balancing of V-engines.

TEXT BOOKS:

1. Theory of Machines, Thomas Bevan, Pearson education publications.
2. Theory of machines, SS Rattan, Tata McGraw Hill publications.

REFERENCES:

1. Theory of Machines, W.G.Green, Blackie publications.
2. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age
3. Theory of Machines / Shigley / MGH2.
4. Theory of Machines, R.S. Khurmi &J.K.Gupta, S. Chand Publications

WEB REFERENCES:

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

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME6TH01	**COMPLEX VARIABLES, PROBABILITY AND STATISTICS**						

COURSE OBJECTIVES:

The course content enables students to:

- Analyze the function of complex variable and its analytic property with a review of elementary complex function.
- Understand the Taylor and Laurent expansion with their use in finding out the residue and improper integral.
- Revise the elementary concepts of probability
- Introduce techniques for carrying out probability calculations and identifying probability distributions.

COURSE OUTCOMES:

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

CO1 Apply the probability concepts in their respective engineering data.
CO2 Apply discrete and continuous probability distributions to solve various engineering problems.
CO3 Analyze the multivariate problems in engineering.
CO4 Apply the method of least squares to estimate the parameters of a regression model.
CO5 Determine the confidence interval for a population parameter for single sample and two sample cases.

UNIT I: FUNCTIONS OF COMPLEX VARIABLES:

Limit and Continuity of f(z), Derivative of f(z), Cauchy-Riemann equations, analytic functions, harmonic functions, Orthogonal system.
Application: Flow problems.

UNIT II: COMPLEX INTEGRATION:

Integration of Complex functions, Cauchy theorem (without proof), Cauchy integral formula (without proof), Series of complex terms, Taylor's series, Laurent's series, zeros and singularities of analytic functions, residues and residue theorem(without proof), Calculation of residues.
Applications: Evaluation of real definite integrals (Integration around the semi-circle and Unit Circle)

UNIT III: PROBABILITY AND RANDOM VARIABLES:

Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous)**,** Binomial - Poisson approximation to the binomial distribution and normal distribution-their properties.

UNIT IV: SAMPLING DISTRIBUTION:

Estimation: Point Estimation, Interval Estimation, Bayesian Estimation.

UNIT V: 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. Student t-distribution (single mean, two means and paired t-test), Testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

TEXT BOOKS:

1. **B.S. Grewal,** Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. **S. C. Gupta and V. K. Kapoor,** Fundamentals of Mathematical Statistics, 11/e (Reprint) 2019, Sultan Chand & Sons Publications.

REFERENCE BOOKS:

1. **Miller and Freund's,** Probability and Statistics for Engineers, 7/e, Pearson, 2008.
2. **T. K. V. Iyenger**, Probability and Statistics, S. Chand & Company Ltd, 2015.
3. **Jay I. Devore,** Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-I	2	1	-	40	60	100	3
Code: 19BME6PE05	**AUTOMOBILE ENGINEERING**						

COURSE OBJECTIVES

The course content enables students to:

- Understand the vehicle structure, engine and its auxiliary systems.
- Develop the knowledge about vehicle transmission system.
- Gain knowledge about vehicle safety and engine services.

COURSE OUTCOMES

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

CO1: Acquisition of sufficient knowledge to classify Engines, Chassis, Fuel Supply Systems.
CO2: Categorize and explain engine auxiliaries.
CO3: Contrast steering, braking and suspension systems
CO4: Estimate suitable conventional and automatic transmission system.
CO5: Repair and maintain some of the engine components.

UNIT – I:

INTRODUCTION TO VEHICLE STRUCTURE AND ENGINE COMPONENTS: Vehicle construction, Chassis, Frame and Body, Engine - types, construction, Lubrication system, Oil pumps, Filters, Cooling system, Water pumps, Radiators, Anti-freezing compounds, Air pollution and Pollution standards.

UNIT – II:

ENGINE AUXILIARY SYSTEMS:

Carburetors, Electronic Fuel Injection Systems – Monopoint, Multipoint and Direct Injection Systems, Electrical Systems – Battery, Generator, Starting Motor, and Ignition- Battery and Electronic Types.

UNIT – III:

TRANSMISSION SYSTEM:

Clutch - Types and Construction, Fluid Flywheel and Torque Converter, Gear Boxes, Manual and Automatic - Overdrives – Propeller Shaft - Differential and Rear Axle**.**

UNIT – IV:

VEHICLE DRIVE SYSTEMS:

Steering Geometry and Types, Types of front axle, Suspension systems, Braking systems, Wheel and Tyres.

UNIT – V:

SAFETY: Introduction, safety systems - seat belt, air bags, bumper, Anti-lock brake system (ABS), wind shield, suspension sensors, traction control, mirrors, central locking and electric windows, speed control

ENGINE SERVICE: Introduction, service details of engine cylinder head, valves and valve mechanism, piston-connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly-precautions.

TEXT BOOKS:

1. Automotive Mechanics, Vol. 1 & Vol. 2, Kirpal Sing, standard publishers.
2. Automobile Engineering- P.S Gill, S.K. Kataria & Sons, New Delhi.

REFERENCE BOOKS:

1. Automotive Engines Theory and Servicing, James D. Haldermanand Chase D. Mitchell Jr., Pearson education inc.
2. Automobile Engineering, William Crouse, Tata McGraw Hill Distributors.

WEB REFERENCES:

1. https://mechathon.com/components-parts-of-automobile/
2. https://www.wartsila.com/marine/build/engines-and-generating-sets/wartsila-engines-auxiliary-systems
3. https://www.britannica.com/technology/automobile/Transmission
4. https://www.qinetiq.com/en/what-we-do/services-and-products/vehicle-drive-technology
5. https://en.wikipedia.org/wiki/Automotive_safety

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-I	2	1	-	40	60	100	3
Code: 19BME6PE06	**REFRIGERATION AND AIR CONDITIONING**						

COURSE OBJECTIVES

The course content enables students to:

- Illustrate basic cycles of refrigeration and analyze the performance of the cycles
- Analyze the concepts of flow of refrigerant in different devices of VCR and VAR
- Design the air conditioning system for comfort requirements using different techniques

COURSE OUTCOMES

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

CO1: Illustrate of concepts of refrigeration and their applications.

CO2: Evaluate the performance parameters of different types of refrigeration systems.

CO3: Identify the desirable properties of refrigerant and its use in various refrigeration systems.

CO4: Examine the special types of refrigeration systems

CO5: Design of Air Conditioning systems for human comfort conditions.

Course Prerequisites: Thermodynamics

UNIT-I

Refrigeration Basics-Types of Refrigeration systems, and Applications**,**

Refrigerants: Classification- Desirable properties- Nomenclature- Commonly used refrigerants-Alternate refrigerants –Greenhouse effect, global warming.

Air Refrigeration Systems: Introduction-Air refrigeration system working on Reversed Carnot cycle-Air refrigeration system working on Bell Coleman cycle- COP- Open and Dense air systems, Applications.

UNIT – II

VAPOUR COMPRESSION REFRIGERATION SYSTEM: Working principle-Simple vapour compression refrigeration cycle-Representation of cycle on T-s and P-h charts- Effect of Sub cooling and Superheating-Actual Vapour compression cycle and its applications.

VCR SYSTEM COMPONENTS: Compressors-Classification-Working-Condensers-Classification-Working-Evaporators–Classification-Working, Expansion devices-Types-Working**.**

UNIT – III

VAPOUR ABSORPTION REFRIGERATION SYSTEM: Description and working of Aqua-Ammonia system- Calculation of maximum COP- Lithium Bromide- Water system-Principle of operation of three fluid absorption systems, Applications.

STEAM JET REFRIGERATION: Principle of working - Analysis - Applications.

NON-CONVENTIONALREFRIGERATION SYSTEMS: Thermo-electric Refrigeration, Vortex tube refrigeration.

UNIT – IV

PSYCHROMETRY: Introduction - Psychrometric properties and relations- Psychrometric chart Psychrometric processes-Sensible, Latent and Total heat–Sensible Heat Factor and Bypass Factor. **HUMAN COMFORT CONDITIONS:** Thermodynamics of Human body-Effective temperature - Comfort chart.

UNIT – V

AIR CONDITIONING SYSTEMS: Introduction-Components of Air conditioning system Classification of Air conditioning systems-Central and Unitary systems- summer, winter and Year round systems- Cooling load estimation.

TEXT BOOKS:

1. Refrigeration and Air conditioning / CP Arora / Mc Graw Hill
2. Refrigeration and Air-Conditioning / RC Aora / PHI

REFERENCE BOOKS:

1. Principles of Refrigeration - Dossat / Pearson
2. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / Mc Graw Hill

WEB REFERENCES:

1. https://home.howstuffworks.com/refrigerator4.htm
2. https://www.ashrae.org/
3. https://en.wikipedia.org/wiki/Air_conditioning

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-I	2	1	-	40	60	100	3
Code: 19BME6PE07	**OPERATIONS RESEARCH**						

COURSE OBJECTIVES:

The course content enables students to:

- To learn the importance of Operations Research in the design, planning, scheduling, manufacturing and business applications
- To use the various techniques of Operations Research in solving such problems.

COURSE OUTCOMES:

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

CO 1 **Illustrate and solve** linear programming problems.
CO 2 **Solve** transportation and assignment problems.
CO 3 **Select** a suitable sequencing and networking models.
CO 4 **Solve** waiting line theory problems.
CO 5 **Analyze** game theory & replacement problems.

UNIT-I

INTRODUCTION: Development-definition, characteristics and phases, types of operation research models, applications.

LINEAR PROGRAMMING PROBLEM: LPP Formulation, graphical method, simplex method, two–phase method, big-M method, duality principle.

UNIT-II

TRANSPORTATION PROBLEM: Formulation, types of initial basic feasible solution using different methods, optimal solution, unbalanced transportation problem, degeneracy.

ASSIGNMENT PROBLEM: Formulation, optimal solution, Unbalanced assignment problem, travelling salesman problem.

UNIT-III

SEQUENCING: Introduction, flow, shop sequencing, *n* jobs through two machines, *n* jobs through three machines, job shop sequencing, and two jobs through 'm' machines.

NETWORKING MODELS: Earliest Completion time of a project and Critical path, Programme Evaluation Review Technique, Total Slack, Free Slack, Probability of achieving completion date, Cost Analysis, Resource Scheduling-Advantages, Limitations, Distinction between PERT and CPM.

UNIT–IV

WAITING LINES: Introduction – single channel – poison arrivals –exponential service times – with infinite population and finite population models– multichannel – poison arrivals – exponential service times with infinite population single channel poison arrivals.

DYNAMIC PROGRAMMING: Introduction, Bellman's principle of optimality, applications of dynamic programming.

UNIT-V

THEORY OF GAMES: Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 &2 x n games -graphical method.

REPLACEMENT: Replacement Model, Replacement of items that deteriorate, Gradually, Fail suddenly, group Replacement policy analysis, Problems.

TEXT BOOKS:

1. Operations Research, S.D.Sharma, KedarNath Ram Nath Publishers
2. Operations Research, A.M.Natarajan, P.Balasubramani and A. Tamilarasi, Pearson Education

REFERENCE BOOKS:
Introduction to O.R, Hiller &Libermann, Tata McGraw Hill

REFERENCE BOOKS:

1. Introduction to O.R, Hiller &Libermann, Tata McGraw Hill
2. Operations Research, R.Pannerselvam, PHI Publications
3. Operations Research, Wagner, PHI Publications

Web Links:

- **http://www.bbau.ac.in/dept/UIET/EME-601%20Operation%20Research.pdf**
- **https://www.cs.toronto.edu/~stacho/public/IEOR4004-notes1.pdf**

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-I	2	1	-	40	60	100	3
Code: 19BME6PE08	**UNCONVENTIONAL MACHINING PROCESSES**						

COURSE OBJECTIVES:

The course content enables students to:

- Identify the classification of unconventional machining processes.
- To understand the principle, mechanism of metal removal of various unconventional machining processes.
- To study the various process parameters and their effect on the component machined on various unconventional machining processes.
- To understand the applications of different processes.

COURSE OUTCOMES:

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

CO1 **Summarize** the needs and classification of unconventional machining process.

CO2 **Illustrate** the concept of machining the hard material using chemical energy and electro-chemical energy.

CO3 **Apply** the knowledge on machining electrically conductive material through electrical energy in non-traditional machining processes.

CO4 **Identify** the process parameters, their effect and applications of different processes.

CO5 **Compare** various thermal energy based non-traditional machining processes.

UNIT– I

INTRODUCTION: Need for non-traditional machining methods classification of modern machining processes – considerations in process selection, applications.

ULTRASONIC MACHINING – Elements of the process, mechanics of material removal, MRR process parameters, applications and limitations.

UNIT–II

MECHANICAL ENERGY BASED PROCESSES

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining (AJM, WJM, AWJM). Working Principles – equipment used – Process parameters – MRR – Applications.

UNIT–III ELECTRIC DISCHARGE MACHINING

Working Principle, Equipment, Process Parameters, Material removal rate, Tool Wear, Dielectric, Flushing, and Wire cut EDM - Applications.

UNIT-IV THERMAL ENERGY BASED PROCESSES

Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM), Principles-Equipment-Process Parameters – Applications.

UNIT-V ELECTRO–CHEMICAL MACHINING: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Surface finish and accuracy, economic aspects of ECM ,advantages and applications.

TEXT BOOKS:

1. Advanced machining processes/ VK Jain/ Allied publishers.
2. Modern Machining Process / Pandey P.C. and Shah H.S./ TMH.

REFERENCE BOOKS:

1. New Technology / Bhattacharya A/ The Institution of Engineers, India 1984.
2. Advanced Methods of Machining by McGeough; Publisher: Chapman and Hall, London.

WEB REFERENCES:

- https://www.youtube.com/watch?v=cxU1zUOpGLk&list=PLtpJfjyaifnmCI-JcNxs6uQgv3b2WYKzS
- http://home.iitk.ac.in/~nsinha/Non-traditional-machining.pdf

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: 19BME6LB01	**HEAT TRANSFER LAB.**						

COURSE OBJECTIVES

The course content enables students to:

- Illustrate different conduction and convection heat transfer modes and estimate the rates of heat transfer
- Analyze the heat transfer in different apparatus like heat exchangers, condensers
- Theorize the method of heat transfer in radiation and other phenomena

COURSE OUTCOMES

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

CO1: Evaluate the amount of heat exchange for plane, cylindrical & spherical geometries

CO2: Compare the performance of extended surfaces and heat exchangers.

LIST OF EXPERIMENTS:

1. Determination of overall heat transfer co-efficient of a composite slab.
2. Determination of heat transfer rate through a lagged pipe.
3. Determination of heat transfer rate through a concentric sphere.
4. Determination of thermal conductivity of a metal rod.
5. Determination of efficiency of a pin-fin.
6. Determination of heat transfer coefficient in forced convection.
7. Determination of heat transfer coefficient in natural convection.
8. Determination of effectiveness of parallel and counter flow heat exchangers.
9. Determination of emissivity of a given surface.
10. Determination of Stefan Boltzmann constant.
11. Determination of heat transfer rate in drop and film wise condensation.
12. Determination of critical heat flux.
13. Study of two-phase flow.

Virtual Lab Experiments:

1. Heat Transfer by Radiation http://htv-au.vlabs.ac.in/
2. Black Body Radiation http://htv-au.vlabs.ac.in/
3. Thermo Couple Seebeck Effect http://htv-au.vlabs.ac.in/

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: 19BME6LB02	**MACHINE DYNAMICS LAB**						

COURSE OBJECTIVES

The course content enables students to:

- To study the behavior of machine elements experimentally when subjected to dynamic forces.
- Develop understanding of dynamic balancing, gyroscopic forces and moments.

COURSE OUTCOMES

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

CO1: Analyze the static and dynamic analysis by balancing

CO2: Determine the natural frequency of vibration of the vibrating system

LIST OF EXPERIMENTS:

1. Determination of the magnitude of gyroscopic couple, angular velocity of precession.
2. Static balancing using steel balls.
3. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
4. An experiment on pin-on-disc apparatus.
5. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils.
6. Determination of steady state amplitude of forced vibratory system without Damping.
7. Determination of steady state amplitude of forced vibratory system with Damping
8. Determination of natural frequency of free longitudinal vibrations
9. Determination of natural frequency of free transverse vibrations
10. Determination of natural frequency of free torsional vibrations

Virtual Labs:

- **https://mdmv-nitk.vlabs.ac.in/#**

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	-	-	-	0
Code: 19BCC6MC01	**ADVANCED COMMUNICATION SKILLS**						

COURSE OBJECTIVES

The course content enables students to:

- To make the students conscious about their Non-Verbal communication
- Train the students to use the language effectively to face interviews and participate in Group Discussions.
- To develop effective written communication skills in academic, technical and professional contexts.
- Develop critical thinking skills necessary to become employable.

COURSE OUTCOMES

At the end of the course students will be able to:

CO 1 Use English language fluently, accurately and appropriately
CO 2 Know how body language is used in communication and interpret non-verbal symbols.
CO 3 Understand the nuances of the written language and write technical reports effectively.
CO 4 Participate in Group discussions and successfully face interviews.

Unit-1: **Non-Verbal Communication**
Unit-2: **Resume Preparation**
Unit-3: **E-mail writing & Professional Letter writing**
Unit-4: **Essay Writing & Paragraph writing**
Unit-5: **Group discussion**
Unit-6: **Interview skills**

References:

1. Rajendra Pal, J S KorlahaHi, *Essentials of Business Communication,* Sultan Chand & Sons
2. Andrea J. Rutherford, *Basic Communication Skills for Technology,* Pearson Education Asia
3. V. Prasad, *Advanced Communication Skills,* Atma Ram Publications
4. Barun K. Mitra, *Personality Development and Soft Skills,* Oxford University Press
5. Sanjay Kumar, Pushp Lata, *Communication Skills,* Oxford University Press
6. Meenakshi Raman, Sangeeta Sharma, *Fundamentals of Technical Communication,* Oxford University Press

IV B.TECH– I SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Mechatronics	19BME7TH01	PC	40	60	100	3	-	-	3
2	Finite Element Methods	19BME7TH02	PC	40	60	100	2	1	-	3
3	Industrial Engineering and Management	19BME7TH03	PC	40	60	100	2	1	-	3
4	**Professional Elective-2**		PE	40	60	100	2	1	-	3
	Advanced Mechanics of Solids	19BME7PE04								
	Nonconventional Source of	19BME7PE05								
	Quality Concepts in	19BME7PE06								
	CAD/CAM	19BME7PE07								
5	**Professional Elective-3**		PE	40	60	100	2	1	-	3
	Design for Manufacturing	19BME7PE08								
	Power Plant Engineering	19BME7PE09								
	Optimization Techniques	19BME7PE10								
	Smart Manufacturing	19BME7PE11								
6	**Open Elective-4**		OE	40	60	100	3	-	-	3
7	Mechatronics & Simulation Lab	19BME7LB01	PC	20	30	50	-	-	3	1.5
8	MOOCS	19BCC5MOOC	PE	-	-	-	-	-	-	1
9	Internship / Practical Training	19BCC7IPT	PR	50	-	50	-	-	-	1
	Total									**21.5**

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
Code: 19BME7TH01	**MECHATRONICS**						

COURSE OBJECTIVES

The course content enables students to:

- Understand key elements of Mechatronics system, representation into block diagram
- Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application

COURSE OUTCOMES

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

CO1 Discuss the elements of a microcontroller as well as the operating principles of motors, sensors, and circuits commonly used in mechatronic devices
CO2 Describe the basics of microcontrollers used in mechatronics.
CO3 Compare actuators for different applications.
CO4 Analyze different logics ad logical controls
CO5 Apply the concepts of mechatronics for various applications

UNIT 1: INTRODUCTION TO MECHATRONICS

Introduction: Multi-disciplinary Scenario, Origins, Evolution of Mechatronics, An overview of Mechatronics, Introduction to Manufacturing, Design.

System Modelling: Introduction, system modelling, mechanical system, translational mechanical system with spring, damper and mass, Rotational mechanical system with spring, damper and mass; electrical system, modelling electric motor, fluid system, thermal systems, modeling pneumatic actuator

UNIT 2: MICROCONTROLLERS

Basics of microcontrollers, Introduction to Microcontroller Technology, history, applications and challenges cum opportunities.

UNIT 3: ACTUATORS

Introduction, actuator types and application areas, mechanical actuation systems, Electrical actuating systems - DC motors, AC motors, stepped motor, solid state switches, solenoids; Fluid power actuators.

UNIT 4: DIGITAL LOGIC & PLC

Digital logic, number systems, logic gates, Boolean algebra, karnaugh maps, application of logic gates, sequential logic, Programmable logic controller (PLC), Digital controllers.

UNIT 5: APPLICATIONS IN MECHATRONICS

Sensors for condition monitoring, mechatronic control in automated manufacturing, artificial intelligence in mechatronics, Fuzzy logic applications in mechatronics, micro sensors in mechatronics, and contemporary issues.

TEXT BOOKS:

1. Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering (2010), W. Bolton, Pearson Education.
2. Mechatronics system design by Devdas Shetty and Richard A. Kolk, PWS publishing company.

REFERENCES:

1. Mechatronics: Principles, concepts and applications by Nitaigour Premchand Mahalik, Tata – McGraw Hill Publishing Company Ltd.
2. Mechatronics: Integrated Mechanical Electronic Systems by K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram, Willey Publication, 2008

WEB RESOURCES:

1. https://nptel.ac.in/courses/112/103/112103174/
2. https://ocw.mit.edu/courses/mechanical-engineering/2-737-mechatronics-fall-2014/
3. https://nptel.ac.in/downloads/112101098/

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME7TH02	**FINITE ELEMENT METHODS**						

COURSE OBJECTIVES

The course content enables students to:

- Enable the mathematical and physical principles essential for the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis
- Introduce theory of elasticity.
- Analyze the various elements in structural and thermal analysis and selection of suitable elements for the problems being solved.
- Introduce various field problems and the discretization of the problem.

COURSE OUTCOMES

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

CO1: **Apply** the knowledge of Differential calculus to solve problems related to the field of structural and thermal engineering by approximate and numerical methods.

CO2: **Design** a new component or improve the existing components using FEA

CO3: **Solve** the problems in solid mechanics and heat transfer using FEM

CO4: **Identify, formulate**, and solve engineering problems

CO5: **Use** the techniques, skills, and modern engineering tools necessary for engineering practice.

UNIT I: FUNDAMENTAL CONCEPTS: Introduction to Theory of Elasticity – Definition of stress and strain – plane stress, plane strain, stress-strain relations in three dimensional elasticity- weighted residual method and variational methods.

UNIT II: DISCRETIZATION OF THE PROBLEM: Concepts of discretization, types of elements, interpolation function, node numbering scheme, assembly and boundary conditions, Convergence requirements – derivation of shape function equations, one dimensional problems.

UNIT III: ANALYSIS OF TRUSS: Truss element, element Stiffness matrices, simple problems on truss

ANALYSIS OF BEAMS: Beam Element, Shape functions and Element stiffness matrix, load vector for concentrated and Uniformly Distributed Load, simple problems on beams.

UNIT IV: TWO DIMENSIONAL PROBLEMS: Finite element modelling of two dimensional Problems - constant strain triangle Element - treatment of boundary conditions 2-D four nodded isoparametric element, numerical integration , Gaussian Quadrature Approach.

UNIT V: HIGHER ORDER PROBLEMS: Higher order 1D and 2D elements; Derivation of shape function equations for Four node quadrilateral elements.

DYNAMIC ANALYSIS: Free Vibrations, Longitudinal Vibrations and Transverse Vibrations, Eigen Values and Eigen Vectors

TEXT BOOKS

1. Introduction to Finite Elements in Engineering, Chandraputla, Ashok and Belegundu, Prentice – Hall.
2. The Finite Element Method in Engineering by S.S.Rao, Elsevier.

REFERENCES

1. Finite Element Procedures by Bathe, K. J. 2nd ed. Klaus-Jürgen Bathe, 2014.
2. Textbook of Finite Element Analysis by P Seshu; PHI publisher.

WEB RESOURCES:

1. http://nptel.ac.in/courses/112/105/112105197
2. https://freevideolectures.com/course/2684/mechanical-vibrations
3. http://www.feaprofessor.com/tutorials.html
4. https://wiki.scilab.org/Finite%20Elements%20in%20Scilab
5. http://ocw2.mit.edu/resources/res-2-002-finite-element-procedures-for-solids-and-structures-spring-2010/linear/
6. https://www.edx.org/course/a-hands-on-introduction-to-engineering-simulations

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME7TH03	**INDUSTRIAL ENGINEERING & MANAGEMENT**						

COURSE OBJECTIVES

The course content enables students to:

- Enhance systematic and comprehensive understanding on various aspects related with industrial engineering and its relevance in the industrial environment.
- Inculcate the organizational structure, plant location and plant layout, production planning and control, scheduling, forecasting, statistical quality control.

COURSE OUTCOMES

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

CO1 **Design** and conduct experiments, analyses, interpret data and synthesize valid conclusions.

CO2 **Design** a system, component, or process, and synthesize solutions to achieve desired needs.

CO3 **Apply** the techniques, skills, and modern engineering tools necessary for engineering practice with appropriate considerations for public health and safety, cultural, societal, and environmental constraints.

CO4 Make **use** of function effectively within multi-disciplinary teams and understand the fundamental precepts of effective project management.

CO5 **Apply** concepts of Resource management for Industrial Applications.

UNIT – I: INTRODUCTION: Definition of industrial engineering (I.E), development, applications, role of an industrial engineer, differences between production management and industrial engineering, quantitative tools of IE and productivity measurement. concepts of management, importance, functions of management, scientific management, Taylor's principles, theory X and theory Y, Fayol's principles of management.

UNIT – II : PLANT LAYOUT: Factors governing plant location, types of production layouts, advantages and disadvantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts, plant maintenance, preventive and breakdown maintenance.

UNIT – III : OPERATIONS MANAGEMENT: Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.

UNIT – IV: STATISTICAL QUALITY CONTROL: Quality control, its importance, SQC, attribute sampling inspection with single and double sampling, Control charts – X and R – charts X AND S charts and their applications, numerical examples.

UNIT – V: RESOURCE MANAGEMENT: Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job-evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, types.

TEXT BOOKS:

1. Industrial Engineering and management by O.P Khanna, Khanna Publishers.
2. Industrial Engineering and Production Management, Martand Telsang, S.Chand & Company Ltd. New Delhi.
3. Statistical Quality Control by Gupta.

REFERENCE BOOKS:

1. Industrial Management by Bhattacharya DK, Vikas publishers.
2. Operations Management by J.G Monks, McGrawHill Publishers.
3. Industrial Engineering by Banga & Sharma.
4. Principles of Management by Koontz O' Donnel, McGraw Hill Publishers.
5. Industrial Engineering and Management by Raju, Cengage Publishers.

WEB LINKS:

- https://nptel.ac.in/courses/112/107/112107292/
- https://nptel.ac.in/courses/112/107/112107142/
- https://core.ac.uk/download/pdf/55638606.pdf
- https://civildatas.com/download/industrial-engineering-and-management-by-khanna

IV B.TECH I SEMESTER Professional Elective-2	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME7PE04	**ADVANCED MECHANICS OF SOLIDS**						

COURSE OBJECTIVES

The course content enables students to:

- Introduce the concept of theories of stress and strain.
- Familiarize with the concepts of stresses and strains in un symmetric bending and torsion using classical methods.

COURSE OUTCOMES

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

CO1 **Illustrate** the theories of stress strain relations for engineering applications.

CO2 **Analyze** bending stresses in beams subjected to unsymmetrical bending.

CO3 **Analyze** the radial stress in curved beams subjected to concentrated and uniform loads.

CO4 **Analyze** stresses induced cylindrical bending of thin rectangular plates by classical methods.

CO5 **Illustrate** the torsion of thin wall torsion members subjected to multiple connected cross sections.

UNIT-I:

THEORIES OF STRESS AND STRAIN: Definition of stress at a point, Stress notation, Three-Dimensional Stress System - Normal and Shearing Stresses, Equilibrium Equations. Principal Stresses -Principal Planes, Principal Strains, Generalized Hooke's Law.

THEORIES OF FAILURE: Graphical Representation for Plane Stress, Derivation of Equations for Failure Theories, Yield Criteria, Tresca's yield Criterion, Von-Mises-Hencky yield criterion.

UNIT-II:

UNSYMMETRICAL BENDING: Bending stresses in Beams subjected to nonsymmetrical bending; deflection of straight beams due to nonsymmetrical bending.

SHEAR CENTER: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections**.**

UNIT-III:

CURVED BEAM THEORY: Winkler Bach formula for circumferential stress –limitations – correction factors–radial stress in curved beams – closed ring subjected to concentrated and uniform loads-stresses in chain links.

UNIT IV:

BENDING OF THIN PLATES: Cylindrical Bending of Thin Rectangular Plates, Plate with Simply Supported Edges Carrying UDL, Uniformly Loaded Rectangular Plate with Clamped Edges, Symmetrical Bending of Circular Plates, Uniformly Loaded Circular Plate, Circular Plate Loaded at the Centre.

UNIT-V:

TORSION: Linear elastic solution, Prandtl elastic membrane (Soap-Film) analogy, narrow rectangular cross section, hollow thin wall torsion members, multiple connected cross sections. Hollow thin wall torsion members, Thin wall torsion members with restrained ends.

TEXT BOOKS:

1. "Advanced Mechanics of materials", Boresi & Sidebottom, Wiley International, 6th edition.
2. "Strength of materials", Sadhu singh, Khanna Publication, 1st edition.

REFERENCE BOOKS:

1. "Theory of elasticity", Timoschenko S.P. and Goodier J.N., McGraw- Hill Publishers, 3rd Edition.
2. "Advanced Mechanics of Solids", L.S Srinath, McGraw Hill Education (India) Pvt. Ltd.3rd edition.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/101/112101095/
2. https://cosmolearning.org/courses/advanced-strength-of-materials/
3.http://www.engineering108.com/Data/Engineering/Mechanical/SM/Strength_Of_Materials_parts_IandII-Timoshenko.pdf

IV B.TECH I SEMESTER Professional Elective-2	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME7PE05	**NON CONVENTIONAL SOURCE OF ENERGY**						

COURSE OBJECTIVES:

The course content enables students to:

- Summarize different sources of energy and its availability
- Analyze the requirements for wind energy and design of wind energy systems
- Illustrate different sources of renewable energy and conversion into useful work output

COURSE OUTCOMES:

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

CO1: Illustrate the concept of Solar Energy, Solar Radiation.
CO2: Analyze the conversion methods using flat plate collector.
CO3: Examine the concepts of energy production from wind
CO4: Examine the concepts of OTEC, Wave energy and Bio Energy sources.
CO5: Elaborate the power generation through DEC systems, Hydrogen energy and storage concepts.

Course Prerequisites: Thermodynamics, Heat Transfer

UNIT-I

INTRODUCTION: Energy Scenario-Survey of Energy Resources-Classification of Energy sources-Need for Non-Conventional Energy Resources.

SOLAR RADIATION: Environmental impact of solar power, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation.

UNIT-II

SOLAR ENERGY APPLICATIONS: Solar water Heating, Space heating, solar driers - Active and Passive heating systems-solar energy storage devices -selective surface - solar stills and solar ponds-solar refrigeration systems and their construction – photovoltaic power generation.

UNIT-III

WIND ENERGY: Wind- characteristics- wind energy conversion systems- types of wind blades-Betz model construction - Interference Factor - Power Coefficient - Torque Coefficient and thrust coefficient.

GEOTHERMAL ENERGY: Structure of Earth - Geothermal Regions - Hot springs - Hot Rocks-Hot Aquifers - Analytical Methods to estimate Thermal Potential - Harnessing Techniques-Electricity Generation Systems from geothermal energy.

UNIT–IV

ENERGY FROM OCEANS: Tidal Energy; Tides - Diurnal and Semi - Diurnal Nature - Power from Tides, tide- basins arrangements- types.

BIO–ENERGY: Biomass Energy Sources-Plant Productivity, Biomass Wastes-Aerobic and Anaerobic bio-conversion processes, biogas digesters and their construction – Raw Materials and properties of Bio-gas.

UNIT-V

DIRECT ENERGY CONVERSION SYSTEMS: Fuel Cells and Solar Cells–Thermionic and Thermoelectric Generation – MHD Generator-Open and Closed Systems.

HYDROGEN ENERGY: Sources of hydrogen, production of hydrogen, electrolysis of water, thermal decomposition of water, thermo chemical production bio-chemical production.

TEXT BOOKS:

1. Renewable Energy Resources, John Twidell &Tony Weir, Routledge Publishers
2. Non-Conventional Energy Sources, G.D Rai, (4th ed.), Khanna Publishers

REFERENCE BOOKS:

1. Renewable Energy Resources, G.N.Tiwari and M.K.Ghosal, Narosa Publication Ltd
2. Non-Conventional Energy, Ashok V Desai, Wiley Eastern

WEB REFERENCES:

1. https://www.energy.gov/eere/solar/solar-radiation-basics
2. https://www.wasp.dk/about-us
3. https://www.toppr.com/guides/physics/sources-of-energy/non-conventional-sources-of-energy/

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-2	2	1	-	40	60	100	3
Code: 19BME7PE06	**QUALITY CONCEPTS IN DESIGN**						

COURSE OBJECTIVES:

The course content enables students to:

- Study about robust design, embodiment principles, various methods in design of experiments, reliability charts and histograms and six sigma techniques.
- It helps the design cum quality engineer to get familiarized with various concepts in design, quality and reliability principles in the design of an engineering product or a service.

COURSE OUTCOMES:

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

CO1: **Apply** the knowledge of Differential calculus to solve problems related to the field of structural and thermal engineering by approximate and numerical methods.

CO2: **Design** a new component or improve the existing components using FEA

CO3: **Solve** the problems in solid mechanics and heat transfer using FEM

CO4: **Identify, formulate**, and solve engineering problems

CO5: **Use** the techniques, skills, and modern engineering tools necessary for engineering practice.

UNIT I: DESIGN FOR QUALITY

Quality Function Deployment -House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design –testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

UNIT II: FAILURE MODE EFFECT ANALYSIS

Basic methods - Refining geometry and layout, general process of product embodiment- Embodiment checklist Advanced methods: systems modeling, mechanical embodiment principles-FMEA method-linking fault states to systems modeling.

UNIT III: DESIGN OF EXPERIMENTS

Basic methods- Two factorial experiments-Extended method- reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional factorial design Statistical analysis of experiments: Degree of freedom, correlation coefficient, standard error of the residual test, ANOVA-ratio test, other indicators-residual plots.

UNIT IV: STATISTICAL CONSIDERATION AND RELIABILITY

Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control–Scatter diagrams – Multivariable charts – Matrix plots and 3-D plots.-Reliability-Survival and Failure-Series and parallel systems-Mean time between failure-Weibull distribution

UNIT V: DESIGN FOR SIX SIGMA

Basis of Six Sigma –Project Selection For Six Sigma- Six Sigma Problem Solving- Six Sigma In Service And Small Organizations - Six Sigma And Lean Production –Lean Six Sigma And Services.

TEXT BOOKS

1. Fundamentals of Quality control and improvement 2nd edition, AMITAVA MITRA, Pearson Education Asia, 2002.
2. Product Design And Development, KARL T. ULRICH, STEVEN D. EPPINGER, TATA Mc GRAW-HILL- 3rd Edition, 2003.

REFERENCES

1. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN OTTO & KRISTIN WOOD, Pearson Education (LPE), 2001.
2. The Management and control of Quality-6th edition-James R. Evens, William M Lindsay.

WEB RESOURCES

- https://prezi.com/zwr6rih5k7tg/quality-concepts-in-design/?fallback=1
- https://www.slideshare.net/kitmechanicalofficial/ed7103-qcdnotes

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-2	2	1	-	40	60	100	3
Code: 19BME7PE07	**CAD/CAM**						

COURSE OBJECTIVES

The course content enables students to:

- Learn 2D & 3D transformations of the basic entities like line, circle, ellipse etc.
- Understand the different geometric modeling techniques like solid modeling, surface modeling, feature based modeling etc. and to visualize how the components look like before its manufacturing or fabrication.
- Learn the part programming, importance of group technology, computer aided process planning, computer aided quality control.

COURSE OUTCOMES

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

CO1: Illustrate the fundamental concepts of the Product cycle and Design process.
CO2: Build the mathematical basis in the technique of representation of geometric entities and the technique of transformation of geometric entities using transformation matrix.
CO3: Develop the 2D and 3D geometries using Modeling packages and NC, CNC and DNC machines and part programming methods
CO4: Describe the use of GT for the product development and also the use of CAPP for the Product development.
CO5: Identify the various elements and their activities in the Computer Integrated Manufacturing Systems

UNIT – I:

INTRODUCTION: Fundamentals of Product cycle- Design process, Computers in design applications, benefits of CAD, Computer configuration for CAD applications, graphics terminal, memory types, input devices, display devices, hard copy devices, and storage devices.
COMPUTER GRAPHICS: Database structure for graphics modelling, 2D and 3D transformations, mathematics of projections, clipping

UNIT – II:

GEOMETRIC MODELING: 3D wire frame modelling, wire frame entities, concept of parametric and non-parametric representation of curves, curve fitting techniques, definitions of cubic spline and Bezier, B-spline.
SURFACE MODELING: Algebraic and geometric form, cylindrical surface, ruled surface, surface of revolution, spherical surface, Composite surface, Bezier surface, B-spline surface.
SOLID MODELING: Sweep representation, constructive solid geometry, boundary representations.

UNIT – III:

CAD SOFTWARE: (Drafting and Modelling)**:** Basic geometric commands, layers, display control commands, editing, dimensioning, sweep representation, solid modeling.

CNC MACHINING AND PART PROGRAMMING: Numerical Control (NC) machine tools, NC Tooling and Automatic Tool Changers – CNC types, constructional details, features of Machining center, turning center, CNC Part Programming - fundamentals, manual part programming methods, Computer Aided Part Programming.

UNIT – IV:

CELLULAR MANUFACTURING: Group Technology(GT), Part Families, Parts Classification and coding, Simple Problems in Opitz Part Coding system, Production flow Analysis, Cellular Manufacturing, Composite part concept, Machine cell design and layout, Quantitative analysis in Cellular Manufacturing, Rank Order, Clustering Method.

UNIT - V:

COMPUTER INTEGRATED MANUFACTURING: Types of manufacturing systems, computer aided process planning (CAPP) and types.

COMPUTER AIDED QUALITY CONTROL: Terminology used in quality control, use of computers in Quality control. Inspection methods contact and noncontact types, computer aided testing, integration of CAQC with CAD/CAM.

TEXT BOOKS:

1. CAD / CAM / CAE, E.Zimmers & M.Groover, Pearson Education.
2. CAD / CAM Theory and Practice, Ibrahim Zeid, TMH.

REFERENCES:

1. Automation, Production systems & Computer integrated Manufacturing, Groover,P.E.
2. Principles of Computer Aided Design and Manufacturing, FaridAmirouche, Pearson.
3. Computer Numerical Control Concepts and programming, Warren S Seames, Thomson.

Web References:

1. https://www.youtube.com/watch?v=vO1lc75jtiM
2.https://books.google.co.in/books/about/CAD_CAM_Computer_Aided_Design_and_Manufa.html?id=18cy2E-o8gIC

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-3	2	1	-	40	60	100	3
Code: 19BME7PE08	**DESIGN FOR MANUFACTURING**						

COURSE OBJECTIVES

The course content enables students to:

- Expose students to a range of manufacturing system constraints to designing various shapes during material and process selection.

COURSE OUTCOMES

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

CO1: Illustrate the impact of manufacturing constraints on product design and process planning.

CO2: Select different materials and parameter for production.

CO3: EMPLOY different machining and manufacturing processes.

CO4: Identify the assembly processes for different systems & applications.

CO5: Analyze Failure modes for different use cases.

UNIT-I INTRODUCTION: Need, Identification and Problem Definition, Concept Generation and Evaluation, Embodiment Design, Concurrent Engineering.

UNIT-II MATERIALS AND SHAPES: Selection, Properties of Engineering Materials, Selection of Materials, Selection of Shapes, Case Studies.

UNIT-III MANUFACTURING PROCESSES: selection, Review of Manufacturing Processes, Design – Casting- Bulk Deformation Processes- Sheet Metal Forming Processes. Design - Powder Metallurgy - Polymer Processing - Additive Manufacturing.

UNIT-IV DESIGN FOR ASSEMBLY: Review of Assembly Processes, Design – Welding- Brazing and Soldering - Adhesive Bonding - Joining of Polymers- Heat Treatment, Case-Studies.

UNIT-V DESIGN FOR RELIABILITY AND QUALITY: Failure Mode and Effect Analysis, Design for Quality, Design for Reliability, Approach to Robust Design, Design for Optimization. Case Studies: Identification of economical design and redesign for manufacture.

TEXT BOOKS:

1. P. Dewhurst, W. Knight, G. Boothroyd, Product Design for Manufacture and Assembly, 3rd edition, CRC Press, 2010.
2. L. C. Schmidt, G. Dieter, Engineering Design, 4th edition, McGraw Hill Education India Private Limited, 2013. ISBN: 978-1259064852

REFERENCES

1. M. F. Ashby, Materials Selection in Mechanical Design, 4 th edition, Elsevier, 2011. ISBN: 978-9380931722.
2. M. F. Ashby, Materials and the Environment: Eco-informed Material Choice, 2 nd edition, Butterworth-Heinemann, 2012.
3. G. Boothroyd, Assembly Automation and Product Design, 2nd edition, CRC Press 2005.

WEB REFERENCES

1. https://nptel.ac.in/courses/112/101/112101005/
2. https://www.edx.org/course/a-hands-on-introduction-to-engineering-simulations

IV B.TECH I SEMESTER **Professional Elective-3**	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME7PE09	**POWER PLANT ENGINEERING**						

COURSE OBJECTIVES

The course content enables students to:

- Identify different types of energy sources and processing of the energy sources
- Summarize the different thermodynamic cycles to be used for power plants
- Differentiate the types of power produced in different plants like solar, petrol, diesel and nuclear plants

COURSE OUTCOMES

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

CO1: Explain the layout, construction and working of the components inside a thermal power plant.

CO2: Illustrate the components inside a Diesel, Gas and Combined cycle power plants.

CO3: Analyze the concepts and flows and processes of different power plants.

CO4: Enumerate the types of power production from renewable energy

CO5: Examine the economics of power plants

Course Prerequisites: Thermodynamics, Heat Transfer

UNIT- I

COAL & GAS BASED THERMAL POWER PLANTS:

Rankine cycle: Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Steam Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants - Fuel and ash handling, Draught system, Feed water treatment.

UNIT- II

DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS:

Otto, Diesel, Dual & Brayton Cycle based power plants, Components. Combined Cycle Power Plant-Integrated Gasifier based Combined Cycle systems.

UNIT- III

NUCLEAR POWER PLANTS

Basics of Nuclear power, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Canadian Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT- IV

POWER FROM RENEWABLE ENERGY

Hydro Electric Power Plants - Classification, Typical Layout and associated components. Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT- V

ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS

Power tariff types, Load distribution parameters, load curve, site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control techniques including Waste Disposal.

TEXT BOOKS

1. Power Plant Engineering- P.K.Nag, Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. Power Plant Engineering – P.C.Sharma / S.K.Kataria Pub

REFERENCE BOOKS

1. A course in Power Plant Engineering –Arora and Domkundwar, Dhanpatrai& Co.
2. An Introduction to Power Plant Technology / G.D. Rai.

WEB REFERENCES:

1. http://indianpowersector.com/home/power-station/thermal-power-plant/
2. https://dieselgasturbine.com/power-plants-of-the-world-3/
3. https://en.wikipedia.org/wiki/Nuclear_power_plant
4. https://www.nrdc.org/stories/renewable-energy-clean-facts
5. https://aip.scitation.org/doi/10.1063/1.3220701

IV B.TECH I SEMESTER **Professional Elective-3**	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: : 19BME7PE10	**OPTIMIZATION TECHNIQUES**						

COURSE OBJECTIVES

The course content enables students to:

- Impart knowledge on various categories of existing engineering problems and solutions to such problems through different optimization techniques and approaches.
- It helps the design engineer to get familiarized with various concepts in design optimization, and reliability principles in the design of an engineering product.
- Provide knowledge on geometric programming.

COURSE OUTCOMES:

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

CO1 **Use** the various techniques of optimization and provide an optimum solution to the problems involving the design of machine elements.

CO2 Discrete the type of problems and **optimize** as per the requirements.

CO3 **Assess** the search methods and provide local and/or global maxima or minima.

CO4 **Analyze** stresses and the deflection of curved flexural members like chain links and crane hooks.

CO5 **Apply** the knowledge of optimization in designing of various machine elements and systems.

UNIT I: INTRODUCTION

General Characteristics of mechanical elements - Adequate and Optimum design - Principles of optimization - Formulation of objective function - Design constraints – Classification of optimization problem.

UNIT II: UNCONSTRAINED OPTIMIZATION

Single variable and Multivariable optimization- Techniques of unconstrained minimization – Golden section, Pattern and Gradient search methods – Interpolation methods.

UNIT III: CONSTRAINED OPTIMIZATION

Optimization with equality and inequality constraints - Indirect methods using penalty functions – Lagrange multipliers - Geometric programming - Constrained, mixed inequality and unconstrained minimization – Genetic algorithms.

UNIT IV: STATIC APPLICATIONS

Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, maximum weight – Design of shafts and torsionally loaded members – Design of springs.

UNIT V: DYNAMIC APPLICATIONS

Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms.

TEXT BOOKS

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers

REFERENCES

1. Engineering Optimization – S.S.Rao, New Age Publishers
2. Johnson Ray, C., "Optimum design of mechanical elements", Wiley, John & Sons, 1990.
3. Goldberg, D.E., "Genetic algorithms in search, optimization and machine", Barnen, Addison-Wesley, New York, 1989

WEB REFERENCES:

1. http://nptel.ac.in/courses/105/108/105108127/
2. https://nptel.ac.in/courses/112/105/112105235/
3. https://nptel.ac.in/courses/111/105/111105039/
4. http://web.mit.edu/16.810/www/16.810_L8_Optimization.pdf
5. http://apmonitor.com/me575/index.php/Main/BookChapters
6. http://www.cs.cmu.edu/~suvrit/teach/aopt.html

IV B.TECH I SEMESTER **Professional Elective-3**	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME7PE11	**SMART MANUFACTURING**						

COURSE OBJECTIVES

The course content enables students to:

- Identifying the global trends that are changing in the society, products, and the manufacturing process.
- Explore and know the concepts of Industry 4.0.
- Explore how smart manufacturing principles have had a real impact in varied applications of sports, technology and medicine.

COURSE OUTCOMES

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

CO1: Illustrate the concepts and learn the tenets of smart manufacturing.
CO2: Interpret agile manufacturing systems and smart manufacturing standards.
CO3: Analyze implemented automated manufacturing systems.
CO4: Compare different concepts for multi-machine systems.
CO5: Choose the opportunities, challenges brought about by Industry 4.0

UNIT I:

INTRODUCTION: Basics of Smart manufacturing and its difference from conventional/legacy manufacturing, Nine pillars of smart manufacturing (Industry 4.0). Smart Manufacturing Processes, manufacturing concerns with compliances, skill gap, energy monitoring, and standards.

UNIT II:

SMART FACTORIES AND PROCESS IMPLEMENTATION: Introduction of smart factories, challenges, smart-predictable manufacturing, Benefits of Smart Factory Implementation, Hardware and Software, Role of Industry 4.0, Automation in factory, agile manufacturing systems.

UNIT III:

SMART COMMUNICATION SYSTEMS: Basics of Communication Technologies for smart manufacturing systems – Cyber Physical Systems, Big Data analytics and Cloud; Industrial Artificial Intelligence – Intelligent Analytics Services.

UNIT IV:

SMART MANUFACTURING ENABLED TECHNOLOGIES: Smart design and Modelling, Monitoring and Intelligent Control of Machining/Manufacturing and Logistics/Supply Chain Processes; Green Manufacturing.

UNIT V:

INDUSTRIAL ENGINEERS AND INTELLIGENT MACHINES: Sizing the Gaps, Man, Machines and Product Flow, The Global Manufacturing Business and the Measure of Productivity, People, Machines and the Workplace, Globalization, Improving Information Capture/Traceability, Improving Intelligent Decision Making under uncertainty Production.

TEXT BOOKS

1. Smart Manufacturing Innovation and Transformation: Interconnection and Intelligence by Zongwei Luo, IGI Global, 2014
2. Industry 4.0: The Industrial Internet of Things by A Gilchrist; Apress; 1st edition 2016.

REFERENCES

1. Smart Manufacturing by Shoukat Ali; LAP LAMBERT Academic Publishing, 2016.
2. Smart Manufacturing: Concepts and Methods by Masoud Soroush, Michael Baldea, Thomas F. Edgar, Elsevier, 2020.

WEB RESOURCES

1. https://www.edx.org/course/industry-40-how-to-revolutionize-your-business
2. https://www.coursera.org/specializations/digital-manufacturing-design-technology
3. https://www.experfy.com/training/courses/smart-manufacturing-the-connected-factory
4. https://nptel.ac.in/courses/106/105/106105195/
5. https://enterpriseiotinsights.com/20170830/smart-factory/three-smart-factory-case-studies-tag23-tag99
6. https://professional.mit.edu/course-catalog/smart-manufacturing-moving-static-dynamic-manufacturing-operations

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	20	30	50	1.5
Code: 19BME7LB01	**MECHATRONICS & SIMULATION LAB**						

COURSE OBJECTIVES

The course content enables students to:

- The course in intended to provide knowledge of basic mechatronics elements, system level integration, control and robotics.
- This lab imparts skill and knowledge on Modular Automation Production Systems by implementing the automation skills achieved from Basics of PLC
- Candidates are trained on the ANSYS and/or 3D Experience SIMULIA Modules to gain the first-hand experience of simulation and analysis of mechanical systems.
- Programmes were developed to enhance the skill set of the students on functions of engineering components and modules.

COURSE OUTCOMES:

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

CO1: Interpret and operate on PLC and mechatronic systems

CO2: Use of various analytical tools like ANSYS, Fusion 360 etc., for engineering simulation

List of Experiments:

This lab has been divided into two streams namely mechatronics lab and simulation lab. Mechatronics lab has more exposure towards PLC, actuator & sensor controls, and modelling & planning for different kinds of mechanisms for position control systems. Simulation lab will give an overall exposure towards structural analysis, thermal analysis and modal analysis.

- **Mechatronics Lab**
  1. Ladder programming on Logic gates ,Timers & counters
  2. Ladder Programming for digital & Analogy sensors
  3. Ladder programming for Traffic Light control, Water level control and Lift control Modules

  DYNA 1750 Transducers Kit
  4. Characteristics of LVDT
  5. Principle & Characteristics of Strain Gauge
  6. Characteristics of Summing Amplifier
  7. Characteristics of Reflective Opto Transducer Open loop control of Mobile robot

  AUTOMATION STUDIO software
  8. Introduction to Automation studio & its control
  9. Draw & Simulate the Hydraulic circuit for series & parallel cylinders connection
  10. Draw & Simulate Meter-in, Meter-out and hydraulic press and clamping

- **Simulation Lab (Fusion 360 Lab)**
    1. To determine the Deflection and Member forces of a given 2D truss.
    2. To find the displacement, maximum, minimum stresses induced in a given cantilever beam with uniformly distributed load and point loads and draw the shear force and bending moment diagrams by using simulation tool, also list the results according to the given loads.
    3. Estimation of natural frequencies and mode shapes Harmonic response of 2D beam.
    4. Determination of deflections component and principal and Von-mises stresses in plane stress, plane strain and Axisymmetric components.
    5. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
    6. Steady state heat transfer Analysis of plane and Axisymmetric components.

WEB RESOURCES:

1. https://www.srmist.edu.in/codepartment-of-mechatronics-engineeringntent/mechatronics-laboratory
2. https://cloud.academy.3ds.com/r2017x/role_smq.html
3. https://ocw.mit.edu/courses/mechanical-engineering/2-737-mechatronics-fall-2014/labs/
4. www.ansys.com

IV-II SEMESTER

S.No.	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	**Professional Elective-4**		PE	40	60	100	2	1	-	3
	Experimental Stress Analysis	19BME8PE01								
	Solar Energy Systems	19BME8PE02								
	Total Quality Management	19BME8PE03								
	Robotics and Applications	19BME8PE04								
2	**Professional Elective-5**		PE	40	60	100	2	1	-	3
	Mechanical Vibrations	19BME8PE05								
	Waste Heat Recovery Systems	19BME8PE06								
	Production Planning and Control	19BME8PE07								
	Automation in Manufacturing	19BME8PE08								
3	PROJECT	19BME8PW	PR	80	120	200	-	-	14	7
	Total									**13**

IV B.TECH II SEMESTER Professional Elective - 4	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME8PE01	**EXPERIMENTAL STRESS ANALYSIS**						

COURSE OBJECTIVES

The course content enables students to:

- Understand the relation between the mechanics theory and experimental stress analysis.
- Highlight the new experimental methods to determine stresses and strains.

COURSE OUTCOMES

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

CO1 **Illustrate** the three-dimensional stress strain relations for engineering applications.

CO2 **Experiment with** recording instruments at different levels of frequencies for static and dynamic recording.

CO3 **Examine** the brittle coating stresses by brittle coating analysis and moiré-fringe analysis.

CO4 **Illustrate** the Photo elasticity materials and Isochromatic fringes for engineering applications.

CO5 **Analyze the** three dimensional Photo elasticity models by Frozen-stress method, the scattered-light method

UNIT-I:

INTRODUCTION: Theory of Elasticity, Plane stress and plane strain conditions, compatibility conditions, problem using plane stress and plane strain conditions, three-dimensional stress strain relations.

STRAIN MEASUREMENT METHODS: various types of strain gauges, electrical resistance strain gauges, semiconductor strain gauge circuits.

UNIT-II:

RECORDING INSTRUMENTS: Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.

UNIT-III:

BRITTLE COATINGS: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

MOIRE METHODS: Introduction, mechanism of formation of Moire fringes, the geometarical approach to moiré-fringe analysis, the displacement field approach to Moire-fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of moiré-fringes, experimental procedure and techniques.

UNIT-IV:

PHOTO ELASTICITY: Photo elasticity, polariscope, plane and circularly polarized light, bright and dark filed setup, photo elasticity materials,, Isochromatic fringes – Isoclinics.

UNIT-V:

THREE DIMENSIONAL PHOTO ELASTICITY: Introduction, locking in model deformation, materials for three dimensional photo elasticity, machining cementing and slicing three dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions, applications of the Frozen-stress method, the scattered-light method

TEXT BOOKS

1. Timoshenke and GoodierJr ,"Theory of Elasticity" McGraw Hill Education (India) Pvt Ltd, 3e
2. Experimental Stress Analysis / Sadhu singh / Khanna Publications.

REFERENCE BOOKS

1. Dally and Riley, "Experimental stress analysis", McGraw-Hil
2. A treatise on Mathematical theory of elasticity / LOVE A.H./ Dover Publications
3. Photo Elasticity / Frocht/ Wiley / 3rd Edition

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/106/112106068/
2. https://www.springer.com/gp/book/9783319060859
3. http://ndl.iitkgp.ac.in/document/TE0xV0RtV09TblREcWpockJFS1IrNUFROExPejg2eXZKcWE4MXpLWENMTFg2d0ErQmV5dm9PdUE4ZHVUQU1Cay9YUkFEMEtMME1QYittSUpNcjJBK3k2WDJobHd5VXpmMHhmVGVqUndEMHgwVTcxT3ZYTXZjc1ZQWjFCM1ZJZVo

IV B.TECH II SEMESTER Professional Elective - 4	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME8PE02	**SOLAR ENERGY SYSTEMS**						

COURSE OBJECTIVES

The course content enables students to:

- Estimate the solar radiation in different zones of irradiation
- Examine the solar photovoltaic conversion systems and the requirements for construction and working

COURSE OUTCOMES

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

CO1 Identity different sources of renewable energy.
CO2 Demonstrate different solar collectors and working.
CO3 Discuss the storage devices and applications of solar energy.
CO4 Evaluate the performance of photovoltaic systems
CO5 Illustrate the advance current technology of the solar energy systems

Course Prerequisites: Thermodynamics, Heat Transfer

UNIT I: SOLAR RADIATION: Role and potential of new and renewable sources, the solar energy option, Environmental impact of solar power, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation-pyranometer, pyrheliometer and sun shine recorder.

UNIT II: SOLAR COLLECTORS: Flat plate and concentrating collectors, classification of concentrating collectors-modified flat plate collector, compound and cylindrical concentrator collectors, fixed mirror solar collector, central tower receiver collector, orientation and thermal analysis, advanced collectors.

UNIT III: SOLAR ENERGY STORAGE AND APPLICATIONS: Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers.

UNIT IV: SOLAR PHOTOVOLTAIC SYSTEMS: Fundamentals of solar cells and PN junction photodiode, Solar cell classification, solar cell structure, solar module and panel and array construction, Photovoltaic conversion - Solar cell characteristics, solar cell efficiency, and fill factor, Applications of solar PV systems.

UNIT V:ECONOMIC ANALYSIS: Initial and annual costs, definition of economic terms for a solar system, Present worth calculation and repayment of loan in equal annual instalments, Annual savings, cumulative savings and life cycle savings, Payback period.

TEXT BOOKS

1. Sukhatme.K, Suhas P. Sukhatme, "Solar energy: Principles of thermal collection and storage", Tata McGraw Hill publishing Co. Ltd, 8th Edition, 2011.
2. Goswami D.Y., Kreith F., Kreider J.F.,"Principles of Solar Engineering", Taylor and Francis, 2nd Edition, Indian reprint, 2003.

REFERENCES

1. B. H. Khan, "Non-Conventional Energy Resources", Tata McGraw Hill, Second edition, 2011.
2. G.D. Rai, "Solar Energy Utilization", Khanna Publishers, 5th Edition, 2014

WEB REFERENCES

1. https://www.sciencedirect.com/topics/engineering/solar-energy-system
2. https://www.elprocus.com/solar-energy-system/
3. https://www.energysage.com/solar/101/
4. https://www.nrel.gov/research/re-solar.html

IV B.TECH II SEMESTER Professional Elective - 4	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: : 19BME8PE03	**TOTAL QUALITY MANAGEMENT**						

COURSE OBJECTIVES

The course content enables students to:

- Understand the concept of Quality.
- Exposure to challenges in Quality Improvement Programs.
- Implement Quality Implementation Programs.

COURSE OUTCOMES

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

CO 1 Interpret Quality Management principles and process.

CO 2 Distinguish different TQM principles of Leadership, Motivation, Team work and supplier relationship

CO 3 Identify and Recommend appropriate type of TQM tools for various industries

CO 4 Choose various Quality charts, Quality functions and TPM concepts

CO 5 Select various quality management systems

UNIT-I INTRODUCTION

Quality – Need, Evolution and Definitions – Dimensions of product and service quality – Basic concepts and elements of TQM - Advantages – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT-II TQM PRINCIPLES

Leadership – Quality Statements, Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT- III TQM TOOLS AND TECHNIQUES I

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II

Control Charts – Process Capability – Concepts of Six Sigma. Quality Circles – Cost of Quality – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.

UNIT V QUALITY MANAGEMENT SYSTEM

Need for ISO 9000 – ISO 9001-2008 - TS16949 quality System – Elements, Documentation, Quality Auditing – QS 9000 – ISO 14000 – ISO 14001 -Concepts, Requirements and Benefits – TQM Implementation in manufacturing and service sectors.

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, ―Total Quality Management, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. ISO9001-2015 standards

Web Links:

1. http://rmkec.ac.in/tmp/mech/Contents/totalqualitymanagement.pdf
2. http://www.ddegjust.ac.in/2017/Uploads/11/POM-324.pdf
3. http://www.velhightech.com/Documents/GE-6757-TOTAL-QUALITY-MANAGEMENMT-IV-YEAR-VII-SEM-NOTES.pdf

IV B.TECH II SEMESTER Professional Elective - 4	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	40	60	100	3
Code: 19BME8PE04	**ROBOTICS AND APPLICATIONS**						

COURSE OBJECTIVES

The course content enables students to:

- Introduce the concepts of Robotic system, its components and control related to robotics.
- Learn about analyzing robot kinematics.

COURSE OUTCOMES

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

CO1 **Distinguish** between automation and robotics and **identify** various components of robot.
CO2 **Select** appropriate type of actuators and sensors for different applications.
CO3 **Analyze** kinematics of a robot
CO4 **Analyze** Dynamics of a robot
CO5 **Illustrate** present and future applications of robots

UNIT 1: FUNDAMENTALS OF ROBOTICS

INTRODUCTION TO ROBOTICS: what is a robot, components of robot, Robot history, robotic controls and systems, classification, challenges and opportunities, The scenarios of industrial robotics and advanced robotics

HOMOGENOUS COORDINATES AND TRANSFORM REPRESENTATIONS: Vector spaces, inner products, vector norms, orthogonality, Linear transformations, matrix multiplication, matrix groups, Coordinate transformations, rigid transformations, rotation matrices

UNIT 2: ACTUATORS AND SENSORS

SENSORS: Basic Elements, General Classification of Sensors, types and working, use of sensors in robotics.

ACTUATORS: Types, working principles, applications and advancements (hydraulic devices, Electric motors such as DC servomotors and stepper motors, Pneumatic devices, as well as other novel actuators)

UNIT 3: ROBOT KINEMATICS

The fundamentals of kinematics, differential kinematics and statics- Kinematic chains, Forward kinematics, The Jacobian and its properties, Inverse kinematics- analytical methods

UNIT 4: ROBOT DYNAMICS

Differential kinematics- Jacobian computation, singular configurations, Configuration space operation, Dynamics- Lagrange, Euler and Newton, Euler formations, Problems.

UNIT 5: ROBOT APPLICATIONS IN MANUFACTURING

Material Transfer, Material handling, loading and unloading, Processing, spot and continuous arc welding & spray painting, Assembly and Inspection. Future applications of robots. Path planning in robotics.

TEXT BOOKS:

1. Industrial Robotics, Groover M P, Pearson Education.
2. Robotics and Control, Mittal R K & Nagrath I J, Tata McGraw Hill.

REFERENCES:

1. Robotics: Fundamental Concepts and Analysis, Ashitava Ghosal, Oxford Publications.
2. Robotic Systems: Applications, Control and Programming; Edited by Ashish Dutta, Intech Open.
3. Robotics, Fu K S, McGraw Hill.
4. Robotic Engineering, Richard D. Klafter, Prentice Hall.

WEB RESOURCES:

1. https://www.intechopen.com/books/robotic-systems-applications-control-and-programming.
2. http://planning.cs.uiuc.edu/node659.html
3. https://www.edx.org/course/robot-mechanics-and-control-part-i
4. https://www.edx.org/course/robotics-foundation-ii-robot-control
5. https://nptel.ac.in/courses/112/105/112105249/
6. http://www.robotictutorials.com/ → for tutorials
7. ARC lab material – in house Dept. of Mechanical Engineering, NEC
8. http://vlabs.iitkgp.ernet.in/rislab/
9. http://www.mind.ilstu.edu/teachers/labs/robot/
10. http://vlab.amrita.edu/?sub=3&brch=271&sim=1642&cnt=3525
11. https://www.virtualroboticstoolkit.com/
12. https://www.robotlab.com/blog/robotlab-is-offering-free-online-virtual-robotics-and-coding-courses-to-those-affected-by-covid-19

IV B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective - 5	2	1	-	40	60	100	3
Code: 19BME8PE05	**MECHANICAL VIBRATIONS**						

COURSE OBJECTIVES

The course content enables students to:

- Understand Formulate mathematical models of problems in vibrations using Newton's second law or energy principles.
- Determine a complete solution to the modeled mechanical vibration problems.
- Correlate results from the mathematical model to physical characteristics of the actual system.
- Design of a mechanical system using fundamental principles developed in the class.

COURSE OUTCOMES

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

CO 1: Illustrate the natural frequency of free longitudinal vibrations of systems by using energy principles.

CO 2: Determine Natural frequency of free transverse vibrations over a shaft under Point loads, uniform distributed load and several loads.

CO 3: Analyze the damped vibrations and forced vibrations to the modeled mechanical vibration problems.

CO 4: Analyze free and forced vibration analysis of a two degree of freedom system under the formulation of equations of motion.

CO 5: Determine natural frequency of free torsional vibrations of one, two and three rotor systems by using energy principles.

UNIT-I:

FUNDAMENTALS OF MECHANICAL VIBRATIONS: Introduction**,** Basic Terminology used in Vibratory Motion, Degrees of freedom, Types of vibrations, Natural frequency of free longitudinal vibrations of systems having single degree of freedom – Equilibrium method, Energy method, Rayleigh's method. Effect of inertia of the constraint in free longitudinal vibrations.

UNIT – II:

TRANSVERSE VIBRATIONS: Natural frequency of free transverse vibrations – Cantilever Shaft due to point load at free end - Simply supported shaft due to a point load, Uniform distributed load - Fixed shaft at both ends due to Uniform distributed load. Natural frequency of free transverse vibrations over a shaft subjected to a number of point loads – Rayleigh's Method, Dunkerley's Method.

UNIT-III:

DAMPED VIBRATIONS: Critical or Whirling speed of a shaft, Viscous damping- Over damping, under damping, critical Damping. Critical damping coefficient, Damping factor, Logarithmic decrement.

FORCED VIBRATIONS: Frequency of under damped forced vibrations – Differential equation method. Magnification factor, Vibration isolation, Transmissibility.

UNIT-IV

TWO DEGREE OF FREEDOM SYSTEM: Free and forced vibration analysis of a two degree of freedom system – different methods for the formulation of equations of motion, natural frequencies, principal modes - physical interpretation and orthogonality; general method, eigen value method

UNIT-V

TORSIONAL VIBRATIONS: Natural Frequency of free torsional vibrations, Effect of inertia of constraint, Torsional vibration of one, two and three rotor systems, Torsionally Equivalent shaft, torsional vibrations of a geared system; coordinate coupling – static and dynamic coupling.

TEXT BOOKS:

1. G.K. Grover & Nigam , "Mechanical Vibrations", Nem Chand and Brothers, 8th edition
2. Theory of machines, SS Rattan, Tata McGraw Hill publications.

REFERENCE BOOKS:

1. Thomson, " Theory of Vibration with Application", pearson India, 5th edition.
2. S.S. Rao , "Mechanical vibration", pearson India, 4th edition.
3. V.P.Singh,"Mechanical vibration" DhanpatRai& Co.
4. Schaum Series," Mechanical vibration" McGraw-Hill, 1st edition.
5. F.S. Tse, Morse &Hinkle,"Mechanical Vibration", CBS Publisher, 2nd edition.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/103/112103111/
2. https://nptel.ac.in/courses/112/103/112103112/#
3. http://ndl.iitkgp.ac.in/document/g_kDps3B9vQMV2-zacLwxKF4JxxfRzInbpuP0Kj_yXn-Y1tJl_y_j6U6A0-B_tE
4. https://www.springer.com/gp/book/9783030450731
5. http://160592857366.free.fr/joe/ebooks/Mechanical%20Engineering%20Books%20Collection/VIBRATIONS/mechVib%20theory%20and%20applications.pdf

IV B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective - 5	2	1	-	40	60	100	3
Code: 19BME8PE06	**WASTE HEAT RECOVERY SYSTEMS**						

COURSE OBJECTIVES

The course content enables students to:

- Estimate the possible waste heat sources and the methods of extraction of heat from the sources
- Illustrate the methodologies used for extraction of waste heat and physical requirements of extraction

COURSE OUTCOMES

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

CO1: Analyze the waste heat recovery technologies developed for various thermal systems.

CO2: Acquire knowledge on waste heat recovery in heat pump, thermoelectric and HVAC systems.

CO3: Apply the economic analysis concepts for the effective implementation of waste heat recovery.

CO4: Examine the concepts of low grade heat utilization

CO5: Identify the need for various energy storage systems in waste heat recovery applications.

Course Prerequisites: Thermodynamics, Heat Transfer

UNIT I

INTRODUCTION: Rankine cycle, Coupled cycles and combined plants energy resources and use, potential for energy conservation, optional utilization of fossil fuels, total energy approach.

UNIT II

WASTE HEAT RECOVERY SYSTEMS SELECTION CRITERIA: Recuperators -regenerators-economizers-plate heat exchangers-thermal fluid heaters.

Waste heat boilers: classification, location, service conditions, design considerations.

Other heat extraction Systems: fluidized bed heat exchangers-heat pipe exchangers-heat pumps-absorption systems.

UNIT III

LOW GRADE HEAT UTILIZATION: Rejection of heat from power plants, Utilization of waste heat in refrigeration, heating, ventilation and air conditioning systems.

UNIT IV

ENERGY STORAGE: Need for energy storage, Thermal, electrical, magnetic and chemical storage systems. Advances in Energy Storage-Applications.

UNIT V

ECONOMIC ANALYSIS: Investment cost-economic concepts-measures of economic performance-procedure for economic analysis-examples-procedure for optimized system selection and design- load curves – sensitivity analysis -regulatory and financial frame work for cogeneration and waste heat recovery system.

TEXT BOOKS:

1. Principles of Waste Heat Recovery; Robert Goldstick, Albert Thumann; Fairmont Press, 1986
2. Heat Recovery Systems: A Directory of Equipment and Techniques; David Anthony Reay; E. & F. N. Spon, 1979

REFERENCE BOOKS:

1. Parker, Colin & Roberts, Energy from Waste-An Evalution of Conversion Technologies Elsevier Applied science.
2. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Prentice Hall of India.

WEB REFERNCES

1. https://glomeep.imo.org/technology/waste-heat-recovery-systems/

IV B.TECH II SEMESTER Professional Elective–5	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	40	60	100	3
Code: 19BME8PE07	**PRODUCTION PLANNING AND CONTROL**						

COURSE OBJECTIVES:

The course content enables students to:

- Understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.

COURSE OUTCOMES:

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

CO1 Apply the systems concept for the design of production and service systems.

CO2 Make use of forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques.

CO3 Understand the principles and techniques of inventory management

CO4 Choose routing procedure and able to prepare bill of material.

CO5 Understand the importance and function of scheduling &Identify dispatching procedure and make use of computer in production planning and control

UNIT-I

INTRODUCTION: Definition, objectives and functions of production planning and control, elements of production control, types of production, organization of production planning and control department, internal organization of department.

UNIT-II

FORECASTING: Forecasting, importance of forecasting, types of forecasting, their uses general principles of forecasting, forecasting techniques, qualitative methods and quantitative methods.

UNIT-III

INVENTORY MANAGEMENT: Inventory control, Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system, Determination of Economic order quantity and economic lot size-ABC analysis-Recorder procedure.

UNIT–IV

ROUTING : Routing, definition, routing procedure, route sheets, bill of material, factors affecting routing procedure, schedule, definition, difference with loading.

UNIT-V

PRODUCTION SCHEDULING: Production Control Systems-Loading and scheduling, Master Scheduling-Scheduling rules, Gantt charts-Basic scheduling problems, Line of balance, Flow production scheduling.

DISPATCHING: Dispatching, activities of dispatcher, dispatching procedure, follow up, applications of computer in production planning and control.

TEXT BOOKS:

1. Elements of Production Planning and Control, Samuel Eilon.
2. Production Planning and Control, Mukhopadyay, PHI.

REFERENCE BOOKS:

1. Production Planning Control and Industrial Management, K.C.Jain& L.N. Aggarwal, Khanna Publishers, 6th Edition, 2008.
2. Theory and Problems in Production & Operations Management, S.N.Chary, Tata McGrawHill, 2003.
3. Production and Operations Management, N.G. Nair,Tata McGraw-Hill, 2004

WEB LINKS:

1. http://www.ddegjust.ac.in/2017/Uploads/11/POM-326.pdf
2. https://mrcet.com/downloads/digital_notes/ME/IV%20year/PPC%20NOTES.pdf
3. https://getmyuni.azureedge.net/assets/main/study-material/notes/mechanical_engineering_industrial-engineering-operation-research_production-planning-and-control_notes.pdf
4. http://www.velhightech.com/wp-content/uploads/2019/04/IE6605-Production-Planning-and-Control-IV-YEAR-VIII-SEM-converted.pdf

IV B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective–5	2	1	0	40	60	100	3
Code: 19BME8PE08	**AUTOMATION IN MANUFACTURING**						

COURSE OBJECTIVES:

The course content enables students to:

- Describe the basic concepts of automation in manufacturing systems.
- Acquire the fundamental concepts of automated flow lines and their analysis.
- Classify automated material handling, automated storage and retrieval systems.
- Illustrate adaptive control systems and automated inspection methods**.**

COURSE OUTCOMES:

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

CO 1. **Illustrate** the basic concepts of automation in machine tools.
CO 2. **Analyze** various automated flow lines, Explain assembly systems and line balancing methods.
CO 3. **Describe** the importance of automated material handling and storage systems.
CO 4. **Interpret** the importance of adaptive control systems and varies parameters.
CO 5. **Describe** the importance of automated inspection systems**.** And machine vision.

UNIT-I

INTRODUCTION: Types and strategies of automation, pneumatic and hydraulic, Components, circuits, automation in machine tools, mechanical feeding and tool, changing and machine tool control.

AUTOMATED FLOW LINES: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations.

UNIT – II

ANALYSIS OF AUTOMATED FLOW LINES: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

ASSEMBLY SYSTEM AND LINE BALANCING: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT – III

AUTOMATED MATERIAL HANDLING and STORAGE SYSTEMS:

Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems. Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing**.**

UNIT – IV

ADAPTIVE CONTROL SYSTEMS: Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations. Consideration of various parameters such as cutting force, temperatures, vibration and acoustic emission in the adaptive controls systems.

UNIT – V

AUTOMATED INSPECTION: Fundamentals, types of inspection methods and equipment, Coordinate Measuring Machines, Machine Vision- Introduction, image acquisition, and image processing applications of machine vision.

TEXT BOOK:

1. Automation, Production Systems and Computer Integrated Manufacturing : M.P. Groover./ PE/PHI.
2. Computer Control of Manufacturing Systems by Yoram Coren.

REFERENCES:

1. CAD / CAM/ CIM by Radhakrishnan.
2. CAD/CAM/CIM, (2nd Edition),by Radhakrishnan and Subramanian, NewAge Publications,

WEB REFERENCES:

1. https://www.youtube.com/watch?v=v-3TmN4HhLc
2. https://www.automationmag.com/4721-ebook

List of open Electives offered by Department

Open Elective-I

S.No.	Open Elective-I Subject Title	Department Offering the Subject	Sub Code	No.of periods per week		No.of Credits
				L	T	C
1	RPT &3D Printing (Other than ME)	ME	19BCC4OE05	3	-	3
2	Operations Research	ME	19BCC4OE06	3	-	3

Open Elective-II

S.No.	Open Elective-II Subject Title	Department Offering the Subject	Sub Code	No.of periods per week		No.of Credits
				L	T	C
1	Work study	ME	19BCC5OE05	3	-	3
2	Mechatronics	ME	19BCC5OE08	3	-	3

Open Elective-III

S.No.	Open Elective-III Subject Title	Department Offering the Subject	Sub Code	No.of periods per week		No.of Credits
				L	T	C
1	Automotive Vehicles	ME	19BCC6OE05	3	-	3
2	Nano Technology	ME	19BCC6OE06	3	-	3

Open Elective-IV

S.No.	Open Elective-IV Subject Title	Department Offering the Subject	Sub Code	No.of periods per week		No.of Credits
				L	T	C
1	Pneumatics & Hydraulic Automation	ME	19BCC7OE05	3	-	3
2	Industrial Robotics	ME	19BCC7OE08	3	-	3

OPEN ELECTIVE – I

Open Elective-I

Open Elective-I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	-	-	40	60	100	3
Code: 19BCC4OE05	**RAPID PROTOTYPING AND 3D PRINTING (Other than MECH)**						

COURSE OBJECTIVES:

- The course aims at the importance of Rapid Prototyping, classifications, models, specifications of various Rapid Prototype Techniques.
- To learn the different tools, soft-wares required and the applications of Rapid Prototyping.
- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies

COURSE OUTCOMES:

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

CO 1: **Identify** the use of Rapid Prototyping Techniques in the manufacturing of complex Components.

CO 2: **Classify** the Stereo lithography Apparatus and its process.

CO 3: **Illustrate** the process of laminated object manufacturing and fused Deposition Modeling.

CO 4: **Explain** the Selective laser sintering process.

CO 5: **Compare** different method and discuss the effects of the Additive Manufacturing Technologies.

UNIT – I:

INTRODUCTION: Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process.

UNIT–II:

LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, layering technology, applications, advantages and disadvantages.

UNIT–III:

SOLID-BASED RAPID PROTOTYPING SYSTEMS: Laminated object manufacturing (LOM) – models and specifications, process, working principle, applications, advantages and disadvantages, Fused deposition modeling (FDM) – models and specifications, process, working principle, applications, advantages and disadvantages.

UNIT – IV:

POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages.

UNIT-V:

3D PRINTING: Overview – History – Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling – Applications. Three dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages.

TEXT BOOKS:

1. Rapid prototyping: Principles and Applications – Chua C.K., Leong K.F. and LIM C.S, World Scientific publications.
2. Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press

REFERENCE BOOKS

1. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer.
2. Wholers Report 2000 – Terry Wohlers, Wohlers Associates.

WEB REFERENCES:

1. URL: https://mosafavi.iut.ac.ir/sites/mosafavi.iut.ac.ir/files//.../rapid_prototyping_1_0.pdf

E-BOOKS:

1. https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf

Open Elective-I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	40	60	100	3
Code: 19BCC4OE06	OPERATIONS RESEARCH						

Course Objectives:

To learn the importance of Operations Research in the design, planning, scheduling, manufacturing and business applications and to use the various techniques of Operations Research in solving such problems.

Course Outcomes:

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

- **CO 1** **Illustrate and solve** linear programming problems.
- **CO 2** **Solve** transportation and assignment problems.
- **CO 3** **Select** a suitable sequencing and networking models.
- **CO 4** **Solve** waiting line theory problems.
- **CO 5** **Analyze** game theory, replacement and simulation problems.

UNIT-I

Development-definition, characteristics and phases, types of operation research models, applications.

LINEAR PROGRAMMING PROBLEM: Formulation, graphical solution, simplex method, artificial variables techniques, two–phase method, big-M method, duality principle.

UNIT-II

TRANSPORTATION PROBLEM: Formulation, types of initial basic feasible solution using different methods, optimal solution, unbalanced transportation problem, degeneracy.

ASSIGNMENT PROBLEM: Formulation, optimal solution, variants of assignment problem, travelling salesman problem.

UNIT-III

SEQUENCING: Introduction, flow, shop sequencing, *n* jobs through two machines, *n* jobs through three machines, job shop sequencing, and two jobs through 'm' machines.

NETWORKING MODELS: Earliest Completion time of a project and Critical path, Programme Evaluation Review Technique, Total Slack, Free Slack, Probability of achieving completion date, Cost Analysis, Crashing the network, Resource Scheduling-Advantages, Limitations, Cost Analysis, Distinction between PERT and CPM, LPP Formulation.

UNIT–IV

WAITING LINES: Introduction – single channel – poison arrivals –exponential service times – with infinite population and finite population models– multichannel – poison arrivals – exponential service times with infinite population single channel poison arrivals.

DYNAMIC PROGRAMMING: Introduction, Bellman's principle of optimality, applications of dynamic programming.

UNIT-V

THEORY OF GAMES: Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 &2 x n games -graphical method.

REPLACEMENT: Replacement Model, Replacement of items that deteriorate, Gradually, Fail suddenly, group Replacement policy analysis, Problems.

SIMULATION: Definition, types of simulation models, phases of simulation, applications of simulation, inventory and queuing problems, advantages and disadvantages, simulation languages

TEXT BOOKS

1. Operations Research, S.D.Sharma, KedarNath Ram Nath Publishers
2. Operations Research, A.M.Natarajan, P.Balasubramani and A. Tamilarasi, Pearson Education

REFERENCE BOOKS

1. Introduction to O.R, Hiller &Libermann, Tata McGraw Hill
2. Operations Research, R.Pannerselvam, PHI Publications
3. Operations Research, Wagner, PHI Publications

WEB LINKS:

- **http://www.bbau.ac.in/dept/UIET/EME-601%20Operation%20Research.pdf**
- **https://www.cs.toronto.edu/~stacho/public/IEOR4004-notes1.pdf**

Open Elective-II

	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Open Elective-II	3	0	0	40	60	100	3
Code: 19BCC5OE05	**WORK STUDY**						

COURSE OBJECTIVES

The course content enables students to:

- Think and explore the ways to make the job easy or have time be productive.
- Explain how to improve productivity through work study.

COURSE OUTCOMES

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

CO1: **Demonstrate** the fundamental concepts of work systems and work study**.**

CO2: **Demonstrate** the fundamental concepts of method study.

CO3: **Analyze** the movements at workplace.

CO4: **Explain** work measurement and time study.

CO5: **Explain** work sampling and predetermined time standards. Predetermined motion time measurement (MTM).

UNIT I:

Productivity: Definition of productivity, individual enterprises, task of management Productivity of materials, and, building, machine and power. Work Study: Definition, objective and scope of work study, advantages. Human factor in work study Work study and management, work study and supervision, work study and worker.

UNIT II:

Introduction to Method Study: Definition, objective and scope of method study, activity recording and exam aids. Charts to record moments in shop operation – process charts, flow process charts, travel chart and multiple activity charts.(With simple problems)

UNIT III:

Micro and Memo Motion Study: Charts to record moment at work place – principles of motion economy, classification of movements, two handed process chart, SIMO chart, and micro motion study. Development, definition and installation of the improved method.

UNIT IV:

Introduction to Work Measurement: Definition, objective and benefit of work measurement. Work measurement techniques. Work sampling: need, confidence levels, sample size determinations, with simple problems. Time Study: Time Study, Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating, Systems of rating.

UNIT V:

Scales of rating, factors affecting rate of working, allowances and standard time determination. Predetermined motion time study – Method time measurement (MTM) Wages and Incentives: introduction, definition, wage differentials ,methods of wage payment, Advantages ,disadvantages, Financial incentives, non-financial incentives.

TEXT BOOKS:

1. ILO -Introduction to work study, ISBN 13:9788120406025 Publisher: India Book House Pvt. Ltd, 4th Revised Edition, 2008.
2. Ralph M Barnes -Motion and Time study, ISBN:13:978981426182 Publisher: John Wiley, 7th edition 2009.

REFERENCES BOOKS:

1. M S Sanders and E J McCormic -Human Factors in Engineering Design, ISBN: 13:9780070549012, Mc Graw Hill, 7th Edition,1992.
2. R.S.Bridger -Introduction to Ergonomics, ISBN:13:9780849373060, Publisher Taylor and and Francis dated 20th Aug 2008, 3rdEdition

WEB LINKS:

1. http://fmcet.in/MECH/ME2027_uw.pdf
2. http://egyankosh.ac.in/bitstream/123456789/31709/1/Unit-6.pdf
3. http://egyankosh.ac.in/bitstream/123456789/31709/1/Unit-6.pdf

Open Elective-II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	40	60	100	3
Code: 19BCC5OE08	**MECHATRONICS (Other than ME)**						

COURSE OBJECTIVES

The course content enables students to:

- Understand key elements of Mechatronics system, representation into block diagram
- Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application.

COURSE OUTCOMES

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

CO1 **Recognize** the elements of a microcontroller as well as the operating principles of motors, sensors, and circuits commonly used in mechatronic devices.

CO2 **Learn** basics of microcontrollers used in mechatronics.

CO3 **Design** and implement different logics ad logical controls

CO4 **Assess** various control systems used in automation.

CO5 **Learn** the concepts of mechatronics for various applications.

UNIT 1: INTRODUCTION TO MECHATRONICS

System modelling: Introduction, system modelling, mechanical system, translational mechanical system with spring, damper and mass, Rotational mechanical system with spring, damper and mass; electrical system, modelling electric motor, fluid system, thermal systems, modeling pneumatic actuator

UNIT 2: OVERVIEW OF MICROCONTROLLERS

Basics of microcontrollers, Introduction to Microcontroller Technology, history, applications and challenges cum opportunities.

UNIT 3: ACTUATORS

Introduction, actuator types and application areas, mechanical actuation systems, Electrical actuating systems - DC motors, AC motors, stepped motor, solid state switches, solenoids; Fluid power actuators, piezoelectric actuators.

UNIT 4: DIGITAL LOGIC

Digital logic, number systems, logic gates, Boolean algebra, karnaugh maps, application of logic gates, sequential logic, PLC, Digital controllers.

UNIT 5: ADVANCED APPLICATIONS IN MECHATRONICS

Sensors for condition monitoring, mechatronic control in automated manufacturing, artificial intelligence in mechatronics, Fuzzy logic applications in mechatronics, micro sensors in mechatronics, and contemporary issues.

TEXT BOOKS

1.W. Bolton, Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering (2010), Pearson Education.
2. Mechatronics system design by Devdas Shetty and Richard A. Kolk, PWS publishing company.

REFERENCES

1. Mechatronics: Principles, concepts and applications by Nitaigour Premchand Mahalik, Tata – McGraw Hill Publishing Company Ltd.
2. Mechatronics: Integrated Mechanical Electronic Systems by K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram,, Willey Publication, 2008

WEB REFERENCES:

1.https://nptel.ac.in/courses/112/103/112103174/
2.https://ocw.mit.edu/courses/mechanical-engineering/2-737-mechatronics-fall-2014/
3.https://nptel.ac.in/downloads/112101098/

Open Elective –III

Open Elective-III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	40	60	100	3
Code: 19BCC6OE05	**AUTOMOTIVE VEHICLES**						

COURSE OBJECTIVES

The course content enables students to:

- Obtain an overview of automotive components, subsystems, design cycles, communication protocols and safety systems employed in today's automotive industry.
- Understand Safety standards, advances in towards autonomous vehicles.

COURSE OUTCOMES

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

CO1 **Illustrate** different types of chassis and body parts.
CO2 **Examine** the transmission systems and accessories used in automobiles.
CO3 **Elaborate** steering mechanisms.
CO4 **Analyze** different braking and suspension mechanisms.
CO5 **Apply** the knowledge of electrical systems in the automotive vehicles.

UNIT-I CHASSIS & BODY

Classification of vehicle, layout with reference to power plant, steering location and drive, chassis, construction and details (frames, sub-frames, defects in frame, frameless vehicles, vehicle dimensions), details of chassis & body materials, Integrated body construction, Vehicle interior system (dash board & seating system), head roofs.

UNIT-II TRANSMISSION & DRIVELINE

Clutches, principle, types, Fluid coupling and torque convertors, problems on performance of automobile such as resistance to motion, tractive efforts, engine speed, power and acceleration requirements. Determination of gear box ratios for different vehicle applications, different types of gear boxes, Automatic transmission, Effect of driving thrust and torque-reaction, Hotchkiss drives, Torque tube drive, radius rods, Propeller shaft, Universal joints, Final drive- different types, two speed rear axle, Rear axle construction: full floating, three quarter floating and semifloating arrangements, Differential: conventional type & Non-slip type, differential locks.

UNIT-III FRONT AXLE & STEERING

Front axle types, rigid axle and split axle, constructional details, materials, front wheel geometry viz., camber, castor, kingpin inclination, toe-in and toe-out, Wheel alignment and balancing, Condition for true rolling motion off-road wheels during steering. Steering geometry. Ackermann and Davis steering. Construction details of steering linkages. Different types of steering gear box. Steering linkages layout for conventional and independent suspensions. Turning radius, instantaneous centre, wheel wobble and shimmy. Over-steer and under-steer. Power and power assisted steering.

UNIT-IV BRAKING & SUSPENSION

Type of brakes, Principles of shoe brakes, Constructional details – materials. Disc brake, drum brake theory, constructional details, advantages, Brake actuating systems. Factors affecting brake performance, Parking & Exhaust brakes, power & power assisted brakes, Antilock Breaking System (ABS), Testing of brakes.

Types of suspension, factors influencing ride comfort, types of suspension springs (leaf & coil springs), independent suspension (front and rear). Rubber, pneumatic, hydro-elastic suspension, Shock absorbers, types of wheels, types of tyres and constructional details, tubeless tyres and aspect ratio of tubed tyres.

UNIT-V ELECTRICAL SYSTEM

Battery, Charging circuit, Alternator, generator, current – voltage regulator – starting systems, mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature, indicator, wiring harness, Trouble shooting.

TEXT BOOKS:

1. Sukhatme S.P. and J.K.Nayak, Solar Energy: Principles of Thermal Collection and Storage, TMH
2. Heinz Heisler, "Advanced Vehicle Technology", second edition, Butterworth – Heinemann, New York, 2002.
3. Automotive Mechanics By William H. Crouse, Donald L. Anglin · 1984.
4. Kirpal Singh, "Automobile Engineering", Standard publishers, Distributors, Delhi, 1999.

REFERENCE:

1. G.B.S.Narang, "Automobile Engineering", Khanna Publishers, Twelfth reprint New Delhi, 2005.
2. R.P.Sharma, "Automobile Engineering", Dhanpat Rai & Sons, New Delhi, 2000.
3. Dr. N. K. Giri, "Automobile Mechanics", Seventh reprint, Khanna Publishers, Delhi, 2005
4. K.K. Ramalingam, "Automobile Engineering ", Scitech Publications (India) PVT.

WEB LINKS:

1. https://web.iitd.ac.in/~achawla/course_pdfs/4.%20MEL736/1-Automobile_introduction.pdf
2. https://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443-2/RAND_RR443-2.pdf
3. http://160592857366.free.fr/joe/ebooks/Automative%20engineering%20books/Automotive%20Engineering%20Powertrain,%20Chassis%20System%20and%20Vehicle%20Body.pdf

Open Elective-III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	40	60	100	3
Code: 19BCC6OE06	**NANO TECHNOLOGY**						

COURSE OBJECTIVES

The course content enables students to:

- Attain foundational knowledge of the Nanoscience and related fields.
- Acquire an understanding the Nanoscience and Applications.

COURSE OUTCOMES

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

CO1: Enumerate basics of nano materials and technology.
CO2: Illustrate the synthesis of nano materials.
CO3: Develop an idea for preparation of nano size materials.
CO4: Summarize the knowledge on tools used in nano technology.
CO5: Compare different nano fabrication methods.

UNIT – I:

INTRODUCTION: Evolution of science and technology, Introduction to Nanotechnology, Nanotechnology - Definition, Significance, Difference between Nanoscience and Nanotechnology, Feynman predictions on Nanotechnology, Moore's law, Bottom up and top down approaches, challenges in Nanotechnology.

UNIT – II:

NANO MATERIALS, SYNTHESIS: History of materials, Nanomaterial Definition, Classification of Nanostructured materials, causes of interest in nanomaterial, some present and future applications of nanomaterial, Carbon nanotubes, Nanocomposites, nano fluids-An overview over preparation, properties, applications.

UNIT – III:

PROCESSING OF NANO MATERIALS: Processes for producing ultrafine powders mechanical grinding, wet chemical synthesis of nanomaterial. Gas phase synthesis of Nanomaterial, gas condensation processes, chemical vapour condensation, laser ablation.

UNIT – IV:

CHARACTERIZATION AND TOOLS: Electron Microscopy Techniques: Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Tunnelling Microscopy, Atomic Force Microscopy, Scanning Probe Microscopy- X ray methods -Fluorescence

UNIT – V:

NANOFABRICATION: Introduction - micro, nanofabrication: Optical lithography, Electron beam lithography, Atomic lithography, Molecular beam epitaxy, MEMS, NEMS -An introduction. Nanotechnology applications in Mechanical Engineering: Nano mechanics, Nano scale heat transfer, nano-machining, molecular dynamic simulation - An introduction

TEXT BOOKS:

1. Nano science and nanotechnology by M.S. Ramachandra Rao, Shubrasingh, Wiley publishers
2. Nano structures & Nano materials by Guozhongcao, Imperial college press.2nd Edition

REFERENCE BOOKS

1. Micro manufacturing and Nano Technology by N.P.Mahalik,.Springer,2006
2. Nano Technology by Mark Ratner &Danier Ratner, Prentice Hall
3. Nano materials by A S Edelstein& R C Cammarata, Institute of physics publishing, Bristol and Philadelphia.

WEB LINKS:

1. https://core.ac.uk/download/pdf/55611506.pdf
2. https://ec.europa.eu/programmes/erasmus-plus/project-result-content/fe710461-5da6-42bd-9351-828558ab56da/Nanotechnology%201%20Fundamentals%20of%20Nanotechnology.pdf
3. https://www.kth.se/social/upload/54062f97f2765416cecdfd74/HT14-IM2655_Lecture%201.pdf

Open Elective IV

Open Elective-IV	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	40	60	100	3
Code: 19BCC7OE05	**PNEUMATICS & HYDRAULIC AUTOMATION**						

COURSE OBJECTIVES

The course content enables students to:

- Equip the student with fundamental knowledge of fluid power systems, pneumatic systems and hydraulic systems.
- Develop knowledge of the performance of hydraulic circuits using various hydraulic elements. Pneumatic circuits using various Pneumatic elements

COURSE OUTCOMES

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

CO 1 **Compare** the Pneumatic and Hydraulic systems working principles and components.
CO 2 **Explain** the performance of hydraulic actuators using cylinders.
CO 3 **Explain** the fluid control valves working and construction.
CO 4 **Analyze** the performance of hydraulic circuits using various hydraulic elements.
CO 5 **Analyze** the performance of Pneumatic circuits using various Pneumatic elements

UNIT – I:

INTRODUCTION TO PNEUMATIC AND HYDRAULICS: Fluid Power and Its Scope, Applications of fluid power. Advantages and disadvantages of fluid power Classification of Fluid Power Systems, Basic Components of a Hydraulic System, Basic Components of a Pneumatic System, Comparison between Hydraulic and Pneumatic Systems, Comparison of different power systems.

UNIT – II:

HYDRAULIC & PNEUMATIC ACTUATORS: Classification of hydraulic & pneumatic actuators, hydraulic & pneumatic cylinders - construction and working of single acting and double-acting cylinders, Graphical symbols of different linear actuators, Cylinder Force, Velocity and Power, Various Methods of Applying Linear Motion Using Hydraulic Cylinders- vertical cylinder, Horizontal cylinder, Inclined cylinder. First, Second and Third Class Lever Systems.

UNIT – III:

FLUID POWER CONTROL VALVES: Different types of valves used in fluid power, Directional control valves (DCV) - classifications - working and construction of various direction control valves - applications, Pressure-control valves (PCV) – classifications - working construction of various pressure control valves – applications. Flow control valves (FCV) - classifications - working construction of various flow control valves - applications. time delay, quick exhaust, twin pressure, shuttle.

UNIT – IV:

HYDRAULIC CIRCUITS: Various hydraulic circuits, Nomenclature, Graphical Symbols, Control of a Single-Acting Hydraulic Cylinder and a Double-Acting Hydraulic Cylinder, Double-pump circuit, sequencing circuit, Circuit for Fast Approach and Slow Die Closing, Performance of hydraulic circuits using various hydraulic elements

UNIT – V:

PNEUMATIC CIRCUITS: Basic pneumatic circuits, Nomenclature, Graphical Symbols, Development of single Actuator Circuits, Development of multiple Actuator Circuits, Cascade method for sequencing, introduction to piping and its software's.

TEXT BOOKS:

1. Basic Pneumatic Systems, Principle and Maintenance by S R Majumdar, McGraw Hill.
2. Hydraulics, Fluid Mechanics and Hydraulic Machinery by P.N. Modi, S.M. Seth, Standard Book House.
3. Fluid Mechanics and Hydraulic Machines by R.K.Rajput, S. Chand *Publishing*
4. Industrial Hydraulics by John Pippenger and Tyler Hicks, McGraw Hill.

REFERENCES:

1. Hydraulic and Pneumatic Controls: Understanding made Easy by K.Shanmuga Sundaram, S.Chand, New Delhi, 2006
2. Fluid Mechanics and Fluid Power Engineering by D.S.Kumar, SK Kataria and Sons.
3. Fluid Power with Applications by Anthony Esposito, Pearson.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/105/112105047/
2. https://nptel.ac.in/courses/112/105/112105046/
3.http://www.just.edu.jo/~haalshraideh/Courses/IE431/Lecture_slides/Hydrolics%20and%20Pneumatics.pdf

Open Elective-IV	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	40	60	100	3
Code: 19BCC7OE08	**Industrial Robotics (Other than ME)**						

COURSE OBJECTIVES

The course content enables students to:

- Introduce the concepts of Robotic system, its components and control related to robotics.
- Learn about analyzing robot kinematics.

COURSE OUTCOMES

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

CO1: Identify Robot terminology and importance

CO2: Select appropriate type of actuators for different applications

CO3: Choose appropriate sensors for different applications

CO4: Analyse the kinematics of robot related to transformations

CO5: Illustrate present and future applications for robots

UNIT 1: FUNDAMENTALS OF ROBOTICS

Introduction to Robotics: Robot and industrial robots, advantages, components of robot, Robot history, robotic controls and systems, classification, challenges and opportunities, the scenarios of industrial robotics and advanced robotics

UNIT 2: ACTUATORS

Actuators – Types, working principles, applications and advancements (hydraulic devices, Electric motors such as DC servomotors and stepper motors, Pneumatic devices, as well as other novel actuators)

UNIT 3: SENSORS

Sensors – Basic Elements, General Classification of Sensors, types and working, use of sensors in robotics.

UNIT 4: ROBOT KINEMATICS

The fundamentals of kinematics, differential kinematics and statics: Kinematic chains, Forward kinematics, The Jacobian and its properties**,** Inverse kinematics: analytical methods

UNIT 5: APPLICATIONS

Robot Application in Manufacturing: Material Transfer, Material handling, loading and unloading, Processing, spot and continuous arc welding & spray painting, Assembly and Inspection. Future applications of robots. Path planning in robotics.

TEXT BOOKS:

1.Industrial Robotics, Groover M P, Pearson Education.
2.Robotics: Fundamental Concepts and Analysis, Ashitava Ghosal, Oxford Publications.

REFERENCES:

1.Robotics and Control, Mittal R K & Nagrath I J, Tata McGraw Hill.
2. Robotic Engineering, Richard D. Klafter, Prentice Hall.

WEB REFERENCES:

1. http://planning.cs.uiuc.edu/node659.html
2. https://www.edx.org/course/robot-mechanics-and-control-part-i
3. https://www.edx.org/course/robotics-foundation-ii-robot-control
4. https://nptel.ac.in/courses/112/105/112105249/
5. http://www.robotictutorials.com/ → for tutorials
6. ARC lab material – in house Dept. of Mechanical Engineering, NEC

VIRTUAL LAB RESOURCES FOR PRACTICE AND TUTORIALS:

1. http://vlabs.iitkgp.ernet.in/rislab/
2. http://www.mind.ilstu.edu/teachers/labs/robot/
3. http://vlab.amrita.edu/?sub=3&brch=271&sim=1642&cnt=3525
4. https://www.virtualroboticstoolkit.com/
5. https://www.robotlab.com/blog/robotlab-is-offering-free-online-virtual-robotics-and-coding-courses-to-those-affected-by-covid-19

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