# Academic Rules and Regulations

# 2020 (Revision 1.0)

**(Applicable for the students admitted during 2021 – 2022 and 2022 – 2023 only from the upcoming semester from the date of approval)**

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# Undergraduate Programs

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**Choice Based Credit System (CBCS)**

Nadimpalli Satyanarayana Raju Institute of Technology (NSRIT)
Sontyam, Andhra Pradesh 531173
(An Autonomous Institute, Affiliated to JNTU - Gurajada, Vizianagaram, AP)
Accredited by NAAC with 'A' Grade

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|---|---|
| Revision | 1.0 |
| Year of introduction | 2023 |
| Approved | VI Academic Council |
| Date of approval | |

Sign and Seal of the Chairman (ACM)

## The Vision

To promote societal empowerment and become an institution of excellence in the field of engineering education and research

## The Mission

- To develop the students into outstanding professionals through innovative Teaching - Learning process
- To uphold research through long term Academia - Industry interaction
- To inculcate ethical standards and moral values

# Academic Regulations for B. Tech. (Regular, Honors and Minor with Specialization) Program

(For all the candidates admitted from the Academic Year 2020 – 2021 onwards)

B. Tech. (Regular: 160 Credits | Lateral Entry: 121) | B. Tech. (Honors/Minor - Regular: 180 Credits | Lateral Entry: 141)

## 1. Preliminary Definitions and Nomenclature

In this regulation, unless the context otherwise requires:

a. **Degree**:The academic award conferred upon a student on successful completion of a programme designed to achieve the defined attributes. It is referred to as Under-Graduate (UG) Degree, that is B.Tech. degree

b. **Program**: The cohesive arrangement of courses, co-curricular and extracurricular activities to accomplish predetermined objectives leading to the awarding of a degree. It also means specialization or discipline of B.Tech.

c. **Course**:Theory, Practical or Theory-cum-Practical subject studied in a semester, like Engineering Mathematics, Physics, etc.

d. "**University**" means Jawaharla Nehru Technological University – Gurajada, Vizianagaram (JNTU – GV)

e. "**Institute**" means Nadimpalli Satyanarayana Raju Insitutute of Technology (NSRIT)

## 2. Eligibility for Admission

2.1. Admission to the B. Tech. (Regular, Honors and Minor with Specialization) shall be made subject to the eligibility and qualifications as prescribed by Andhra Pradesh State Council for Higher Education (APSCHE), Government of Andhra Pradesh. The total number of seats as per the approved annual intake is categorized into two categories viz. Convenor Quota (Cat. – A) and Management Quota (Cat. – B) with a ratio of 70:30 (G. O. No. 52). The admission under Cat. – A shall be done based on the merit score secured through state-wise common state commone entrance test i.e., AP Engineering Agricultural, Pharmacy Common Entrance Test (AP – EAPCET). The allotment pertaining to Cat. – B admission, the merit list based on 10+2 shall be taken as a benchmark in compliance with the norms issued by APSCHE

2.2. With regard to the students admitted through Lateral Entry Scheme, the students shall be admitted directly into semester III of the second year of B. Tech. programs. Under this scheme 10% seats of the sanctioned intake will be available in each program of study as supernumerary seats. Admissions to this 3 year B. Tech. lateral entry Programme will be through Andhra Pradesh Engineering Common Eligibility Test (ECET). The maximum period to complete B. Tech. under lateral entry scheme is 6 consecutive academic years from the date of joining

## 3. Duration and Medium of Instruction of the Program

The program duration for the award of degree in B. Tech. (Regular, Honors and Minor with specialization) will be of 4 academic years and each academic year will have two semesters. In case, if the student is unable to complete the program in the above said stipulated duration, he/she shall be permitted to complete the program of study within 8 consecutive academic years from the year of admission into B. Tech. program. For the students admitted through lateral entry scheme the duration of the program is 3 years and 6 years if the student fails to complete the program of study in the

stiupulated duration of 3 years. The student who fails to meet the requirements for the award of B. Tech. program during the above said extended duration shall forfeit the degree in B. Tech. program of study. The medium of instruction during the program of study is English.

**Academic Calendar:** As already mentioned, each academic year will have two semesters. Each academic year, an academic calendar will be issued by the Office of the Controller of Examinations (CoE) indicating the duration of instruction period, mid-term tests, semester-end examinations, practical examinations and eventually evaluation. Normally each semester will have fifteen weeks of instruction, one week of practical examinations and two to three weeks for descriptive examinations. In total, each semester will span for a maximum duration of 15 – 19 weeks.

## 4. Programs of Study

NSRIT offers seven programs of four year duration leading to Bachelor's Degree in Engineering and Technology (B. Tech.) as follows

i. Civil Engineering
ii. Computer Science and Engineering (CSE)
iii. Computer Science and Engineering (Artificial Intelligence and Machine Learning)
iv. Computer Science and Engineering (Data Science)
v. Electronics and Communication Engineering (ECE)
vi. Electrical and Electronics Engineering (EEE)
vii. Mechanical Engineering

## 5. Structure of Programs

### 5.1. Categorization of Courses

Each program shall have a common curriculum framework with well defined educational objectives, program outcomes and courses outcomes as per the philosophy of Outcome Based Education (OBE) in line with the Vision and Mission of the department offering the program and in turn in accordance with the Vision and Mission of the Institute. The program structure comprise of theoretical courses, practical courses, theory-cum-practical courses, MOOCs, summer and full semester internship, skill oriented courses, project work, seminars and other relevant courses meeting industry requirements. As the curriculum is framed with Choice Based Credit System (CBCS), the students have the flexibility in opting the courses of their choice under the category of electives. The courses of a particular program are categorized as follows

a. Foundation Courses
    i. Humanities and Social Science including Management (HS)
    ii. Basic Science (BS)
    iii. Engineering Science (ES)
b. Professional Core Courses relevant to the chosen program of study
c. Electives
    i. Professional Electives (PE) relevant to the chosen program of study
    ii. Open Electives (OE) relevant to other programs of study
d. Project, Seminar and Internship
e. Skill Oriented Courses (SOC) and Industry Connect Courses (ICC)
f. Mandatory Courses (MC) as prescribed by AICTE / UGC

## 5.2. **Nomenclature of Credit Distribution**

| No. | Nature of Course | Credit | Nomenclarture |
|---|---|---|---|
| 1 | Theory Course / Elective Course (per Hour) | 1.0 | 1 hour / credit |
| 2 | Practical / Drawing Course (per Hour) | 0.5 | 0.5 hour / credit |
| 3 | Summer Internship (2nd Year \| 3rd Year) | 1.5 \| 3.0 | - |
| 4 | Full Semester Internship | 6.0 | - |
| 5 | Capstone Project | 6.0 | - |
| 6 | Moocs (Per Hour) | 1.0 | 1 hour / credit |
| 7 | Skill Advanced / Soft Skill Course (per Hour) | 2.0 | 0.5 hour / credit |
| 8 | Mandatory Course | - | - |
| 9 | Counseling/Mentoring | - | - |
| 10 | Sports/Hobby Clubs/Activities | - | - |

## 5.3. **Structure of Curriculum**

| Sem | No. of Theory Courses | No. of Lab Courses, Internship, Term Paper, Project | Total Credits |
|---|---|---|---|
| I | 5 Theory | 3 + Sports/Hobby Clubs/Activities | 19.5 |
| II | 6 (5 Theory + 1 MC) | 3 + Sports/Hobby Clubs/Activities | 19.5 |
| III | 7 (5 Theory + 1 SOC + 1 MC) | 3 + Sports/Hobby Clubs/Activities | 21.5 |
| IV | 6 (5 Theory + 1 SOC) | 3 + Sports/Hobby Clubs/Activities | 21.5 |
| V | 7 (3 Theory + 1 PE + 1 OE + 1 SOC + 1 MC) | 2 + Sports/Hobby Clubs/Activities + Summer Internship #1 | 21.5 |
| VI | 7 (3 Theory + 1 PE +1 OE + 1 SOC + 1 MC) | 3 + Sports/Hobby Clubs/Activities | 21.5 |
| VII | 7 (3 PE + 2 OE (MOOCs) + 1 Elective (HS) + 1 SOC ) | Summer Internship #2 | 23 |
| VIII | Project | Full Semester Internship | 12 |
| | | **Total Credits** | **160** |

## 5.4. **Credit Distribution for each Category**

| No. | Category | Credits | |
|---|---|---|---|
| | | Regular | Lateral |
| 1 | **Foundation Courses** | **55.5** | **13.5** |
| | Humanities and Social Science including Management (HS) | 10.5 | 06.0 |
| | Basic Science (BS) | 21.0[1] | 06.0[1] |
| | Engineering Science (ES) | 24.0[1] | 04.5[1] |
| 2 | **Professional Core Courses** | **51.0[1]** | **51.0[1]** |
| 3 | **Electives** | **27.0** | **27.0** |
| | Professional Electives | 15.0 | 15.0 |
| | Open Electives | 12.0 | 12.0 |
| 4 | **Project, Seminar and Internship** | **16.5** | **16.5** |
| 5 | **Skill Oriented Courses** | **10.0** | **10.0** |
| 6 | **Mandatory Courses**as prescribed by AICTE and UGC (Not to be accounted for CGPA) | - | - |
| 7 | **Audit Course** | - | - |
| Minimum credits to be earned for the award of the B. Tech. (Regular) degree | | **160** | **121** |

[1]The total number of credits may have marginal variation from one program to other program based on the requirement to accomadate few eseential courses related to the program of study

### 5.5. Assessment Pattern for the Courses

With the true spirit of implementing Outcome Based Education (OBE), each course is designed with customized assessment pattern addressing the various cognitive levels of Revised Bloom's Taxonomy (RBT) with appropriate proportion covering the breadth and depth of the courses. The Assessment Instrument or QPs shall be designed with a combination of question responses with short answer, long answer, higher order thinking skills through critical thinking and creativityand MCQ that fits best to the assessment of the intended learning outcomes. The course instructor can also take the liberty of setting their own customized question papers along with the distribution of marks leveraging the status of autonomous promoting higher order thinking skills and creativity through case studies or questions related to problems solving skills through open book examinations other than that of the one prescribed in the academic regulation 2023. This shall be deployed by taking necessary approval from the respective Chairman, Board of Studies and the Head of the Institution as well before the commencement of the course while preparing the course plan along with the rubircs indicating the criteria and scale/metirc for assessment. With regard to the assessment pattern for the skill oriented courses, appropriate assessment instrument shall be developed by the respective course facilitator that suits to assess the skills that are expected from the courses by taking approval from the respective Chairman, Board of Studies and the Head of the Institution as well before deploying for assessment. Incase of video based grading, suitable rubrics shall be developed for mearing the course outcomes or intended learning outcomes. In all the cases other than the assessment pattern being prescribed in the academic regulation 2023, the pattern of customized assessment pattern shall be submitted to the office of the Controller of Examinations before the commencement of the course.

### 5.6. Internship / Community Service Projects (CSP)

As per the guidelines specified in these regulations, each student is expected to undergo community service projects (CSP),internship in the form of summer and full semester internship (FSI) during the program of study and it is mandate for all the students. The curriculum offers two summer internships i.e., one at the end of second year and the other one is at the end of third year of study; each one spans for a duration of four to eights weeks. The CSP shall be taken at the level of second year as an alternate option to summer internship (Phase I) as per the standard operating procedure prescribed by the institution and the allotment is purely at the discretion of the Industry – Institute Engagement cell based on the requirement and availability of internship offers. With regard to the FSI, the curriculum provides flexibility at two different slots during VII and VIII semesters with a span of 12 weeks – 16 weeks. The students who are opting FSI either during semester VII or VIII shall register for the course during the semester V through the Head of the department and the same shall be forwarded to the Office of Controller of Examination (CoE) and Internship Cell. To ensure effective implementation of FSI, the Institute shall depute ~50% of the interns during semester VII and the rest during semester VIII. Accordingly, the courses pertaining to the semesters shall be inter-changed. The students who are opting for FSI in semester VIII shall be permitted to take up the capstone projectat the industries along with the FSI in the same industry,if he/she is interested and submit a separate report along with internship/training report.

Students will be evaluated by a panel of internal and external subject matter experts (SMEs) nominated by the Office of the CoE. It is mandate for all the learners going either for internship / CSPs to capture a video demonstrating the self reflection on the learning outcomes for grading by the course supervisor/guide.

5.7. **Project Work**

Each student is expected to carryout one capstone project relevant to his/her program of study or interdisciplinary of nature leading to design, development of solutions, and fabrication of system component or a product. On successful completion of the project work, the students are expected to submit a detailed project report along with the working models, if any for evaluation. The office of the CoE shall nominate a team of experts to assess the quality and evaluate the project as per the evaluation guidelines prescribed in the academic regulation. Incase, if any student is interested in doing industry oriented project (Individual) atthe industries or research organization, he/she shall take up the project duly approved by the Head of the Department, CoE and the Head of the Institution well before the commencement of the course. In such cases, the students should inform the respective department well in advance, preferably during semester VII. The students who opted FSI in the semester VII shall take up the courses as prescirbed in the curriculum during semester VIII along with the capstone project.

5.8. **Statutory Mandatory Courses and Audit Courses**

Mandatory courses are those courses which are designed inline with the requirement of AICTE. These courses do not carry any credits and are not accounted for the calculation of CGPA.The students shall register for the courses in the respective semester as specified in the curriculum. All the students (regular and lateral entry students) shall complete the mandatory course by taking two assessment in the form of multiple choice questions during the continuous assessment. A minimum of 40% of marks (average of two continuous assessment) is required to complete the course and the status of completion will be indicated in the grade memo and an online certification is also mandatory for a duration of 30 hours in the relevant area as specified in the curriculum. In addition to the above, the curriculum provides flexibility to nurture employability skills through audit courses and it is mandatory for all students to complete the audit courses for the award of the degree and it will not be counted for the calculation of CGPA. The academic regulation permits autonomous learning with mandatory courses promoting self learning ability among the learners.

5.9. **MOOCs and Autonomous Learning**

The curriculum provides adequate flexibility for the students to take up MOOCs through self-study mode enabling them to learn the courses on independent/autonomous mode with minimal guidance of faculty mentor to earn necessary credits for the award of the degree B. Tech. (Regular) and B. Tech. (Honors & Minor with Specialization) and the attendance is not mandatory. The courses shall be opted from MOOCs platform viz. NPTEL, SWAYAM or any other platforms as approved by the respective Chairman, Board of Studies (BoS). Incase of MOOCs through NPTEL, SWAYAM, the credits shall be directly transferred without conducting any further examination from the institution. For all other platforms, the assessment pattern for such courses which are part of the curriculum for the B. Tech. (Regular) degree shall be carried out as similar to

other regular theory and skill-oriented courses. And for B. Tech. (Honors) and B. Tech. (Minor with Specialization) shall be inline with the agencies or the platforms offering these courses. Further, if the grade is not specified by the particular agency or platform, the office of CoE shall follow the institutional SOP for the award of the grade and take necessary approval from the Academic Council through circulation. MOOCs shall be identified by the respective department taking necessary approval from the BoS/Chairman (BoS) and shall be intimated well in advance to the students. Futher, in case, if the student is preferred to undergo Semester Away Programme as per Clause 5.11 during semester VII, the credits earned through self-study courses shall be compensated for the calculation of CGPA. The curriculum provides flexibility to the students to select the semester VII on self-study mode to facilitate the Semester Away Program. Incase of notification of On-Job Training (OJT) by the institute industry-institute engagement cell during semester VI through VIII, the academic regulations 2023 provides flexibility enabling the students to opt self learning in the respective semester and can appear for continuous assessment and semester end examinations as per the examinations schedule and fulfill the credit requirement for the award of the B. Tech. program. In such cases, the attendance at the industries/research organization shall be taken for promotion from one semester to subsequent higher semesters for a duration of 15 weeks.

5.10. **Industry Supported Courses**

a. Students can opt for one-credit courses, offered by experts from industry/research organizations which are approved by academic council. Students can register such coursesfrom his/her second year of study as and when these courses are conducted by various departments. A student is also permitted to register for the courses of other departments, provided the student has fulfilled the necessary pre-requisites of the course being offered andsubject to the approval of both the Heads of Departments. There is no limit to the number of 1-credit or 2-credit courses a student can register during the programme of study. However, a student can register for only one course in a semester. These courses are evaluated by the respective course coordinator of the programme. The maximum number of credits that can be earned from industry supported courses is limited to four
b. If a student does not successfully complete the registered industry supported 1-credit or 2-credit courses in a semester, the registration of that course will be considered as cancelled. Further, it will not be treated as arrear and no supplementary examination will be conducted; alternatively, if he/she wishes, he/she can re-register for the same course in the ensuing semesters and successfully complete it as and when it is offered subsequently
c. The credits earned through these courses will be treated over and above the credit requirement for the award of the B. Tech. (Regular, Honours and Minor with specialization) programs

5.11. **Semester Away Programme (SAP) to Promote Multi-disciplinary Skills (Choice Based Semester System):** The interested students can have the option of undergoing Semester Away Programme leveraging Choice Based Semester System during semester VII with Higher Learning Institutions at Foreign Countries or Institutions of National Repute or Research Organizations in India, by earning necessary equivalent credits in the semester VII through course study, projects or whatever terms and conditions as prescribed by the respective organization.In addition to the above, the students can opt a combination of 1-, 2-, 3-, 4-credit

courses to compensate the credits required for semester VII on self study mode in case of shortage of credits.The students who are interested to opt for SAP shall register to the office of CoE during the beginning of semester III and initiate self-study mode for futuristic compensation of credits. The registration for this SAP is valid as long as the students maintain 8.0 CGPA in all semesters with no history of arrears. Incase, if the student fails to register during the above said period, he/she may register for the same by taking prior permission from the respective Head of the Department. Further, the students are encouraged to opt inter-disciplinary courses of their interest (need not be in the area of the program of study). The Controller of Examinations shall ensure that necessary approvals are taken from the Academic Council well before the time period of their SAP. In case of any uncertain circumstances, if the student fails to complete SAP, the registration will be cancelled automatically and he/she can earn the credits required for that particular semester through self-study mode.

5.12. **Procedure for Awarding Marks for Continuous Assessment**

**Theory**(Internal: 30 Marks | External 70 Marks)

**Continuous Internal Assessment #1 (First two and half units with a duration of 90 Minutes)**

| | |
|---|---|
| Descriptive Examination | : 20 Marks |
| Assignment | : 05 Marks |

**Continuous Internal Assessment #2 (Next two and half units with a duration of 90 Minutes)**

| | |
|---|---|
| Descriptive Examination | : 20 Marks |
| Assignment | : 05 Marks |

**Comprehensive Quiz (50 Multiple Choice Questions each carries 01 mark and scaled down to 05 Marks)**

The final internal marks will be awarded by considering equal proportion for both the CIA which shall be scaled down to 25 marks and 05 marks from comprehensive quiz.

**Laboratory Courses** (Internal: 30 Marks | External: 70)

| | |
|---|---|
| **Total Internal Marks** | **: 30 Marks** |
| Distribution for Continuous Evaluation | |
| Continuous Assessment | : 10 Marks |
| Record | : 10 Marks |
| Internal Test | : 10 Marks |
| **Total External Marks** | **: 70 Marks** |
| Experiment & Viva - Voce | : 50 Marks |
| Video assessment (Learning outcome) | : 20 Marks (One video shall be uploaded by the student demonstrating the self reflection on that particular laboratory course for grading) |

**Drawing and Design Related Courses**(Internal: 30 Marks | External: 70 Marks)

| | |
|---|---|
| Total Internal Marks | : 30 Marks |
| Distribution for Continuous Evaluation | |
| Continuous Assement | : 15 Marks |
| Internal Test | : 15 Marks |
| Total External Marks | : 70 Marks |

There shall be two internal tests in a semester for 15 marks each and final marks will be calculated by considering equal proportion for both the CIA.

**Mandatory Courses**

Assessment :As prescribed in the Academic Regulation

Online certification course :01 course (in the relevant area of the pursuing mandatory course with a minimum duration of 30 hours and the students need to submit the certification of completion and assessment compliance issued by the respective online learning platforms)

**Technical Paper Writing**

| | |
|---|---|
| Internal Review #1 | : 10 Marks |
| Internal Review #2 | : 10 Marks |
| Final Review and Presentation | : 30 Marks |

Paper Publications: Students are requested to publish their review articles to either peer-reviewed journals or any one of the reputed conferences and submit the published paper. It is mandatory for the award of the degree. Academic regulation suggest to publish the articles either in UGC – CARE or journals indexed by SCOPUS.

**Summer Internship** (Internal: 50 Marks)

| | |
|---|---|
| Interim Assessment and Report Writing | : 20 Marks |
| Final Presentation | : 30 Marks |

**Full Summer Internship** (Internal: 100 Marks | External: 100 Marks)

| | |
|---|---|
| Interim Review #1 (Industry Supervisor) | : 20 Marks (Rubrics based) |
| Interim Review #2 (Industry Supervisor) | : 30 Marks (Rubrics based) |
| Terminal Presentation | : 15 Marks (Presentation) |
| Report | : 25 Marks |
| Video based assessment | : 10 Marks |

In all the continuous assessment pertaining to internship, the major focus of the assessment will be predominently on skills and application of knowledge viz. Communication Skills, Team-Work, Organization Skills, Interpersonal Skills, Analytical and Problem Solving Skills, Leadership Skills, Work Ethics and any specific intiatives by the interns.

**Skill Oriented Courses** (Internal: 50 Marks)

Interim Assessment and Report Writing :15 Marks

| | |
|---|---|
| Outcomes | : 20 Marks |
| Final Presentation | :10 Marks |
| Video based assessment | : 05 Marks |

The outcomes shall be in the form of design, development of working model of a system component or a product and these 20 marks shall be awarded based on Rubrics that addresses Critical Thinking, Creativity, Collaboration and Communication.

**Project** (Internal: 100 Marks | External: 100 Marks)

Distribution of Marks (Continuous Internal Assessment)

| | |
|---|---|
| Innovativeness of the Project | : 10 Marks |
| Literature Survey | : 05 Marks |
| Experimentation/ Simulation | : 15 Marks |
| Presentation, Interpretation& Analysis of Results | : 15 Marks |
| Interim Review #1(Presentation) | : 05 Marks |
| Interim Review #2 (Presentation) | : 05 Marks |
| Product Development | : 15 Marks |
| Terminal Presentation | : 10 Marks |
| Report | : 05 Marks |
| Publication in Conference / Journal (CARE) | : 05 Marks |
| Video based assessment | : 05 Marks (Mandatory) |
| Online Certification | : 05 Marks (Mandatory) |

The online certification shall be from MOOCs platform with a minimum duration of 30 – 45 hours and the student need to earn the certification and for which there will not be any further assessment from the institution or program of study.

A student shall earn the following percentage of minimum percentage of marks in each theory, practical, design and drawing course in B. Tech. program.

- A minimum of 35% (24 and above out of 70 marks) of marks for each course Semester End Examinations (SEE) and
- A minimum of 40% marks for each course considering both CIA and SEE taken together

## 6. Attendance Finalization and Result Declaration

### 6.1. Procedure

The attendance shall be calculated as per this autonomous regulation 2020 for the students to appear for the end semester examinations as per clause 6.2. The Institute shall formulate a committee “Joint Board” constituting of Principal (Chairman), Chairpersons of all Boards of Studies, Controller of Examinations (Member Secretary) and two senior members of faculty. The tenure for the senior members of faculty shall be of 2 years. The member secretary shall place the attendance of all the students before the Joint Board for approval before the finalization and declaration of attendance. The same procedure shall be adopted for declaring the end semester examination results.

### 6.2. **Attendance Requirements and Result Declaration Procedure**

a. A student shall be eligible to appear for the end semester examinations if he/she acquires a minimum of 75% of attendance in aggregate of all the courses in a semester and shortage of attendance below 65% shall in no case be condoned and such cases will not be permitted to appear for the end semester examinations
b. Condonation for shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be permittedbased on medical leave (hospitalization / accident / specific illness) and on-duty leave for participation in College / University / State / National / International Sports events with prior approval from the competent authority. After taking necessary approval from the Head of the Institution or Competent Authority, the student shall be permitted to appear for the end-semester examination by paying the condonation fee as prescribed by the Office of CoE. However, the student who have represented the college in outside world activities shall be exempted in paying the condonation fee
c. A student who has secured less than 40% of attendance in a particular course shall not be permitted to appear for the end semester examination though he/she maintains more than 75% of attendance in aggregate of all courses in that particular semester. In such cases, the student need to reappear physically as and when the courses are being offered by the respective department and accordingly the time-table shall be optimized to avoid overlapping
d. Students, who do not meet the minimum required attendance in a semester, shall be detained in that particular semester and they will not be promoted to the next semester. In such cases, the student need to rejoin in that particular semester in the subsequent academic year
e. Academic regulations applicable to the semester in which re-admission is sought shall be applicable to the re-admitted student
f. In case if there are any professional electives and/or open electives, the same may also be re-registered if offered by the respective program of study. However, if those electives are not offered in the later semesters, alternatively, the students may opt other electives from the same set of elective courses offered under that category in that particular semester

## 7. Promotion Policies

During the four year (Regular) or three year (Lateral) program of study, it is mandatory for all students to maintain a minimum of 40% of the credits pertaining to the current year of study to get promoted to subsequent year of study, say 2$^{nd}$ year to 3$^{rd}$ year and so on. In case if the student fails to earn the necessary percentage of credits required for promoting to subsequent year of the program of study, he/she will be detained and he/she need to earn the required credits and take re-admission in the subsequent years of the academic year to complete the B. Tech. degree program.

## 8. Eligibility for the Award of the Degree

A student shall be declared to eligible for the award of the degree in B. Tech. (Regular) program if he/she has fulfilled the following requirements

a. The student should earn the minimum requirement of credits (160 for regular admission and 121
credits for lateral entry) and cleared all the mandatory courses as prescribed in the curriculum within the maximum duration of 8 consecutive academic years (Regular) and 6 consecutive academic years (Lateral) from date of admission
b. The student should maintain more than 5 CGPA at any point of time
c. The student shall not have any pending disciplnary issues

The student shall forfeit his/her Degree and his/her admission stands cancelled if he/she fails to meet the above compliance.

## 9. Award of Grades

| Range of Marks | Letter Grade | Grade Point |
|---|---|---|
| >= 90 | 'O' | 10 |
| >= 80 < 90 | 'A+' | 09 |
| >= 70 < 80 | 'A' | 08 |
| >= 60 < 70 | 'B+' | 07 |
| >= 50 < 60 | 'B' | 06 |
| >= 40 < 50 | 'C' | 05 |
| < 40 | 'F' | 0 |
| Absent | 'AA' | 0 |
| Non completion of a semester (Repeat) | 'I' | 0 |
| Withdrawal from end semester examination | 'W' | 0 |

After completion of the programme, the Cumulative Grade Point Average (CGPA) from the I Semester to VIII Semester (from III to VIII semester for lateral entry) is calculated using the formula:

$$CGPA = \frac{\sum_{i=1}^{n-1}(c_i \times g_i)}{\sum_{i=1}^{n-1} c_i}$$

where 'n' is the number of courses registered for, '$c_i$' is the credits allotted to the given course and '$g_i$' is the grade point secured in the corresponding course

## 10. Classification of the Degree Awarded

a. **B. Tech. (Honors):** In addition to the requirement as cited in (10.c), if the student secures 20 additional credits in accordance with the clause (14), he/she shall be declared with B. Tech. (Honors)

b. **B. Tech. (Minor with Specialization):** In addition to the requirement as cited in (10.c), if the student secures 20 additional credits in accordance with the clause (15), he/she shall be declared with B. Tech. (Minor with Specialization)

c. **B. Tech. (Regular) - First Class with Distintion:** The student who qualifies for the award of the B. Tech. degree in the chosen program of study with 160 credits (Regular) and 121 credits (Lateral) within 5 consecutive academic years (Considering the formal approval for the break of study from the competent authority) from the date of admission at his/her first attempt maintaining 7.5 CGPA and above shall be declared to have passed in first class with distintion and should not have been prevented from appearing end semester examinations for the want of attendance requirements

d. **B. Tech. (Regular) - First Class:** The student who qualifies for the award of the B. Tech. degree in the chosen program of study with 160 credits (Regular) and 121 credits (Lateral) within 4 consecutive academic years from the date of admission maintaining 6.75 CGPA and above shall be declared to have passed in first class and should not have been prevented from appearing end semester examinations for the want of attendance requirements

e. **B. Tech. (Regular) - Second Class:** The student who qualifies for the award of the B. Tech. degree in the chosen program of study with 160 credits (Regular) and 121 credits (Lateral) within 8 consecutive academic years from the date of admission maintaining 5.75 CGPA and above and less than 6.75 CGPA shall be declared to have passed in second class
f. **B. Tech. (Regular) - Pass:** All other students who have not covered and qualifies for the award of the degree maintaining 5.00 CGPA and above and less than 5.75 CGPA shall be declared to get Pass with minimum credit requirement for the award of the degree in B. Tech. program

**11. Flexibility to Add or Drop Self Study Courses (SSC)**

a. It is mandatory that all the students need to earn the minimum number of the credits for the award of B. Tech. degree in their respective program of study. However, a student can earn more number of credits if he/she opt, by registering additional courses, from the list of courses available in the curriculum of all disciplines, over and above to the existing courses from semester IV – VI. The student shall be permitted to drop any SSC at any point of time and registration for such courses gets cancelled and will not be reflected in Cumulative Grade Memo (CGM)
b. All the courses registered and cleared by a student in this mode will be mentioned in the CGM as additional acquired. However, the CGPA is calculated as per the minimum requirement of the credits for the award of the B. Tech. degree

**12. Withdrawal from the Examination**

a. A candidate may, for valid reasons, be granted permission by the Principal to withdraw from appearing for the examination in any course or courses of only one semester examination during the entire duration of the Degree Programme. Also, only ONE application for withdrawal is permitted for that semester examination in which withdrawal is sought
b. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination and if it is made prior to the commencement of the examination in that course or courses and also recommended by the Head of the Department
c. Such withdrawal from the examination shall be treated as absent for the 1st attempt to the respective examination and will lose the eligibility for First Class with Distinction
d. If any student is intended to drop FSI subsequent to his/her registration followed by allotment, he/she needs to re-register the course

**13.Transitory Regulations:** To enable the students to take admission or entry into NSRIT from other Institution either by Transfer, Re-admission, Admission, or Transfer from other engineering Institution affiliated to JNTUK/Academic regulation within the Institute, the following regulations shall be followed based on the nature of case as cited above.

- Transfer of candiate from Autonomous / Non-Autonomous Institution affiliated to JNTUK
- Within the Institution from one regulation to other academic regulation

a. Transfer of a candidate from Autonomous / Non-Autonomous Institution affiliated to JNTUK

Any canddate who is interested to take admission in NSRIT from a non-autonomous engineering institution affiliated to the parent university either in the semester III or thereafter, shall acquire the

credits required for graduation as per the Institute autonomous regulations and the candidature shall be treated under following category

Students from non-autonomous institution seeking admission into semester III shall be treated in par with the students taking admission for 3 year program of study (i.e. lateral entry students) and should have cleared all the courses in the semester I and II as per university regulation. The same shall be calculated as per NSRIT regulations if the student is seeking admission into NSRIT from an autonomous institution. The credits earned during semester I and II shared be calculated as per the Institute autonomous regulations and in case if the earned credits during first two semestersare not adequate to take admission in the semester III, the student shall take additional courses approved by the respective Board of Studies and Academic council during semester III at NSRIT on self study mode and the same procedure shall be followed for taking admission into higher semesters

b. **Within the Institution from one regulation to other academic regulation**

A student taking admission under one regulation, say Academic Regulation 2020 in the first year, shall continue with the same regulation and should earn the necessary credits as metioned in the academic regulation at the time of joining. However, In case of readmission into a subsequent new regulation, and if the readmission is into any of the semesters from semester I through IV, the student shall follow the current regulations to which he/she taking admission and continue with the same regulation till graduation. In case of any credit shortage, the necessary credits shall be earned on self study mode to compensate the required number of credits. In case of excess credits, it will be treated as over and above.

In both the cases (a) and (b), the details shall be forwarded to the parent university along with the proceedings of the Academic Council.

**14**. **B.Tech. (Honors):** The curriculum provides flexibility to enable the students to register for B.Tech. (Honors) program by earning additional 20 credits which is over and above the requirement for the award of B.Tech.(Regular) degree. He/She shall register in the office of the CoE during semester III provided he/she secures ≥8 CGPA without backlogs in earlier semesters. If he/she wishes to withdraw from B.Tech. (Honors) program at any point of time, the credits obtained will not be compensated for the award of the degree and considered as over and above. The maximum enrollment B. Tech. (Honors) shall be restricted to 10% of the total intake in a particular batch of students.

The additional 20 credits shall be earned by opting four 4-credit courses offered by the respective program of study which are categorized in the curriculum and these courses shall be offered with a combination of guided learning or taught courses or self study mode depending on the total number of students registered for that particular course and the Chairperson of the Board of Studies reserves the right to decide the mode of delivery. Apart from this, he/she shall choose two 2-credit MOOCs of 30 hours or 6 weeks duration. Above all, if any student fails to maintain the 8 SGPA in the subsequent semesters after semester III, the registration for the B. Tech. (Honors) program stands cancelled without any notification. In case of students admitted through lateral entry, the CGPA compliance will be considered from semester III onwards as already mentioned.

15. **B.Tech. (Minor with Specialization):** The curriculum provides flexibility to enable the students to register for B. Tech. (Minor with Specialization) program by earning additional 20 credits which is over and above the requirement for the award of B. Tech. (Regular) degree. He/She shall register in the office of the CoE during the semester III provided he/she secures ≥8 CGPA without backlogs in earlier semesters. If he/she wishes to withdraw from B. Tech. (Minor with Specialization) program at any point of time, the credits obtained will not be compensated for the award of the degree and considered as over and above. In case of students admitted through lateral entry, the CGPA compliance will be considered from semester III onwards.

    The student shall opt three inter-disciplinary courses each of 3-credit as listed in the curriculum offered by other programs and one 3-credit MOOCs of 30 hours or 6 weeks duration in addition to a project of 8-credit leading to design, process development, system component design & fabrication and application development relevant to the chosen field of interest prescribed in the curriculum.

16. **Academic Bank of Credits:** This academic regulation 2023 provides complete scope of academic flexibility in accordance with The Gazette of India, the notification issued by UGC pertaining to the Academic Bank of Credits (ABC) vide File No. 14-31/2018 (CPP – II) dated 28th July, 2021, New Delhi. The ABC provides a full length academic flexibility while removing rigid curriculum boundaries and creating new possibilities of life-long learning.

    Incase with students registering under ABC, it is very much mandate and recommended to complete the courses pertaining to professional core and the courses at the lower semesters, especially, the courses pertaining to Mathematics, Physics, Chemistry and few related to Engineering Sciences. Further, the students opting for industry connect courses can be accumulated, transferred and redeemed for the award of B. Tech (Regular) degree alone and courses in the curriculum other than the category of Basic Sciences, Engineering Sciences and Professional Core can be compensated.

17. **Temporary Break of Study from the Program**: The curriculum provides flexibility for the students having ≥9 CGPA to take a break of one year at any time after the end of I/II/III year of study to pursue entrepreneurship on full time. This period of gap shall be counted for the maximum time of graduation. A committee approved by the Academic Council shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the break of study.

18. **Revision of the Academic Regulations and Curriculum**

    The Joint Board Committee and the Academic Council of the institute reserve the right to revise, change or amend the regulations, the scheme of examinations, the curriculum and the syllabi from time to time if found necessary.

19. **Representation of Special Cases**

    In case of any clarification in the interpretation of the above rules and regulations, they shall be referred to the Joint Board Committee through the Head of the Institution. The Joint Board Committee will offer suitable interpretations/ clarifications /amendments required for special case on such references and get them ratified in the next meeting of the Academic Council. The decision of the Academic Council is final.

**20. Curriculum and Syllabi of various Programs of Study (Scan to view the Program Curriculum and Syllabi)**

## Mechanical Engineering

**Preamble:** The curriculum of B. Tech. (Mechanical Engineering) program offered by the Department of Mechanical Engineering under Academic Regulation 2020 is prepared in accordance with the curriculum framework of AICTE, UGC and Andhra Pradesh State Council of Higher Education (APSCHE). Further this Outcome Based Curriculum (OBC) is designed with Choice Based Credit and Semester System (CBCSS) enabling the learners to gain professional competency with multi- disciplinary approach catering the minimum requirement (Program Specific Criteria) of Lead Societies like American Society of Mechanical Engineers (ASME) and other Professional Bodies as per the Engineering Accreditation Commission (EAC) of ABET and NBA. In addition, the curriculum and syllabi are designed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Professional Bodies, Research Organizations and Parents to capture their voice of the respective stakeholders.

The Curriculum design, delivery, and assessment, the three major pillars of academic system are completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes facilitating the learners to achieve their Professional and Career Accomplishments.

### The Vision

To train the students to be professional and competent Mechanical Engineers to take up the challenges in the society and strive continuously for excellence in education and research

### The Mission

- To provide quality education for successful career and higher studies in MechanicalEngineering
- To emphasize academic and technical excellence in the profession
- To take up consultancy and research in solving the problems related to MechanicalEngineering

**Program Educational Objectives (PEOs)**

The PEOs are the educational goals that reflect Professional and Career Accomplishments that a graduate should attain after 4 – 5 years of his/her graduation.

The graduates of Mechanical Engineering of NSRIT will

1. Continue to excel in professional mechanical related careers or chosen career path that apply 21st century skills following ethical standards and practices contributing towards sustainable development by providing feasible and viable technical solutions catering the real-time engineering problems
2. Engage in experiential learning through their professional practices and adapt to changing skills sets in the pursuit of lifelong learning
3. Continue to demonstrate the skill sets that are very much essential to work successfully for a rewarding career in a multidisciplinary setting

**Program Outcomes (POs)**

The POs are the transactional statements of graduate attributes (GAs) that each graduating engineer should possess in terms of knowledge, skill and behavior with a minimum target performance level atthe time of graduation as fixed by the program of study seeking continuous improvement year on year.

The graduates of Mechanical Engineering of NSRIT will be able to demonstrate the following outcomes in terms knowledge, skill, and behavioral competencies at the time of graduation with the expected target performance level

1. Apply the knowledge of basic sciences and fundamental engineering concepts in solving engineering problems (Engineering Knowledge)
2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences (Problem Analysis)
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations (Design/Development of Solutions)
4. Perform investigations, design and conduct experiments, analyse and interpret the results to provide valid conclusions (Investigation of Complex Problems)
5. Select/develop and apply appropriate techniques and IT tools for the design & analysis of the systems (Modern Tool Usage)
6. Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practices (The Engineer and Society)
7. Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development (The Environment and Sustainability)
8. Demonstrate Knowledge of professional and ethical practices (Ethics)
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations (Individual and Team Work)
10. Communicate effectively among engineering community, being able to comprehend andwriteeffectively reports, presentation and give / receive clears instructions (Communication)
11. Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment (Project Finance and Management)
12. Recognize the need for, and have the ability to engage in independent and lifelong learning (Life Long Learning)

**Program Specific Outcomes (PSOs)**

1. Demonstrate adequate core competency in designing and fabricating mechanical systems, thermal and hydraulic machines, materials and similar others, and thereby providing sustainable computer aided solutions maintaining professional standards and value system
2. Demonstrate adequate knowledge in the allied specialization of Mechanical Engineering thatadds value addition for professional practices

**Category-wise Credit Distribution of Courses**

| | Category | AICTE | APSCHE | NSRIT (A) |
|---|---|---|---|---|
| HS | Humanities and Social Science | 12.0 | 10.5 | 10.5 |
| BS | Basic Science | 25.0 | 18.0 | 18.0 |
| ES | Engineering Science | 24.0 | 22.5 | 24.0 |
| PC | Professional Core | 48.0 | 55.5 | 54.0 |
| PE | Professional Elective | 18.0 | 15.0 | 15.0 |
| OE | Open Elective | 18.0 | 12.0 | 12.0 |
| | Internship (s), Project & Seminars | 15.0 | 16.5 | 16.5 |
| SC | Skill Oriented Courses | - | 10.0 | 10.0 |
| MC | Mandatory Courses | - | - | - |
| AC | Audit Course | - | - | - |
| | Total no. of credits | 160 | 160 | 160 |

## Mechanical Engineering

Credit requirement for the award of the degree under academic Regulation 2020 – 2021 for the candidates admitted from the academic year 2021 onwards

| | Four Years | Three Years |
|---|---|---|
| B. Tech. (Regular Degree) | 160 | 121 |
| B. Tech. (Honors Degree) | 180 | 141 |
| B. Tech. (With Minor specialization other than Chosen Branch of Engg. & Tech.) | 180 | 141 |

Semester I

| No. | Code | Course | Pos | Contact Hours L | T* | P | C | |
|---|---|---|---|---|---|---|---|---|
| 01 | 20HSX01 | Communicative English | 10 | 3 | 0 | 0 | 3.0 | HS |
| 02 | 20BSX11 | Linear Algebra and Differential Equations | 1, 12[1] | 3 | 1 | 0 | 3.0 | BS |
| 03 | 20BSX21 | Engineering Chemistry | 1 | 3 | 0 | 0 | 3.0 | BS |
| 04 | 20ESX01 | Engineering Drawing | 1, 5, 10 | 1 | 0 | 4 | 3.0 | ES |
| 05 | 20ESX02 | Programming for Problem Solving Using 'C' | 1 | 3 | 0 | 0 | 3.0 | ES |
| 06 | 20HSX02 | Communicative English Lab | 10 | 0 | 0 | 3 | 1.5 | HS |
| 07 | 20BSX22 | Engineering Chemistry Lab | 1, 4 | 0 | 0 | 3 | 1.5 | BS |
| 08 | 20ESX07 | Programming for Problem Solving Using 'C' Lab | 1 | 0 | 0 | 3 | 1.5 | ES |
| | | Sub-total | | 13 | 01 | 13 | **19.5** | |

Semester II

| No. | Code | Course | Pos | L | T* | P | C | |
|---|---|---|---|---|---|---|---|---|
| 01 | 20BSX12 | Partial Differential Equations and Vector Calculus | 1 | 3 | 1 | 0 | 3.0 | BS |
| 02 | 20BSX31 | Engineering Physics | 1 | 3 | 0 | 0 | 3.0 | BS |
| 03 | 20ESX05 | Basic Electrical and Electronics Engineering | 1 | 3 | 1 | 0 | 3.0 | ES |
| 04 | 20ESX04 | Engineering Mechanics | 1, 2, 4 | 3 | 1 | 0 | 3.0 | ES |
| 05 | 20ME201 | Computer Aided Engineering Drawing | 1, 5, 10 | 1 | 0 | 4 | 3.0 | ES |
| 06 | 20BSX32 | Engineering Physics Lab | 1, 4 | 0 | 0 | 3 | 1.5 | BS |
| 07 | 20ESX08 | Basic Electrical and Electronics Engineering Lab | 1, 4 | 0 | 0 | 3 | 1.5 | ES |
| 08 | 20ESX06 | Engineering Workshop | 4 | 0 | 0 | 3 | 1.5 | ES |
| 09 | 20MCX01 | Environmental Science | - | 2 | 0 | 0 | - | MC |
| | | Sub-total | | 15 | 03 | 13 | **19.5** | |

Semester III

| No. | Code | Course | Pos | L | T* | P | C | |
|---|---|---|---|---|---|---|---|---|
| 01 | 20BSX13 | Numerical Methods and Transforms | 1 | 3 | 1 | 0 | 3.0 | BS |
| 02 | 20ME301 | Thermodynamics | 1, 2, 4, PSO 1 | 3 | 1 | 0 | 3.0 | PC |
| 03 | 20ME302 | Material Science and Metallurgy | 1, 7, 12 | 3 | 0 | 0 | 3.0 | PC |
| 04 | 20ME303 | Mechanics of Solids | 2, 3, 12, PSO 1 | 3 | 1 | 0 | 3.0 | PC |
| 05 | 20ME304 | Manufacturing Processes | 1, 6, 12 | 3 | 0 | 0 | 3.0 | PC |
| 06 | 20ME305 | Material Science and Metallurgy Lab | 1, 4 | 0 | 0 | 3 | 1.5 | PC |
| 07 | 20ME306 | Mechanics of Solids Lab | 1, 4 | 0 | 0 | 3 | 1.5 | PC |
| 08 | 20ME307 | Manufacturing Processes Lab | 1, 4 | 0 | 0 | 3 | 1.5 | PC |
| 09 | 20MES01 | Short-term Skill Oriented Elective | 5, 10, PSO 1 | 1 | 0 | 2 | 2.0 | SC |
| 10 | 20MCX02 | Constitution of India | - | 2 | 0 | 0 | - | MC |
| | | Sub-total | | 18 | 03 | 11 | **21.5** | |

[1]Suggested tutorial hours will not carry any credits

[1]By default, all courses are mapped to PO 12 as they are weakly contributing

[1]It is mandate for all students to pursue an online certification course for minimum duration of 30 hours covering the areas of Sustainability, Climate changes, Environmental Impact Assessment in line with Sustainable Development Goals (SDG)

Semester IV

| No. | Code | Course | Pos | Contact Hours L | T | P | C | | |
|---|---|---|---|---|---|---|---|---|---|
| 01 | 20HSX03 | Managerial Economics and Financial Analysis | 11 | 3 | 0 | 0 | | 3.0 | HS |
| 02 | 20CS403 | Python Programming | 1 | 3 | 1 | 0 | | 3.0 | ES |
| 03 | 20ME403 | Kinematics of Machinery | 2, 3, PSO 1 | 3 | 1 | 0 | | 3.0 | PC |
| 04 | 20ME404 | Fluid Mechanics and Hydraulic Machines | 2, 3, PSO 1 | 3 | 1 | 0 | | 3.0 | PC |
| 05 | 20ME405 | Internal Combustion Engines and Gas Turbines | 2, 3, PSO 2 | 3 | 1 | 0 | | 3.0 | PC |
| 06 | 20ME406 | Fluid Mechanics and Hydraulic Machines Lab | 1, 4 | 0 | 0 | 3 | | 1.5 | PC |
| 07 | 20ME407 | Thermal Engineering Lab | 1, 4 | 0 | 0 | 3 | | 1.5 | PC |
| 08 | 20CS407 | Python Programming Lab | 1 | 0 | 0 | 3 | | 1.5 | ES |
| 09 | 20MES02 | Short-term Skill Oriented Elective | 1, 2, 4, 5, 10 | 1 | 0 | 2 | | 2.0 | SC |
| | | | Sub-total | 16 | 04 | 11 | | 21.5 | |

Semester V

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 01 | 20ME501 | Dynamics of Machinery | 2, 3, 4,12, PSO 1 | 3 | 1 | 0 | | 3.0 | PC |
| 02 | 20ME502 | Design of Machine Elements I | 2, 3, 4,12, PSO 1 | 2 | 1 | 0 | | 3.0 | PC |
| 03 | 20ME503 | Metal Cutting and Machine Tools | 1, 6, 12 | 3 | 0 | 0 | | 3.0 | PC |
| 04 | - | Professional Elective I | - | 3 | 0 | 0 | | 3.0 | PE |
| 05 | - | Open Elective I | - | 3 | 0 | 0 | | 3.0 | OE |
| 06 | 20ME506 | Dynamics of Machinery Lab | 1, 4 | 0 | 0 | 3 | | 1.5 | PC |
| 07 | 20ME507 | Metal Cutting and Machine Tools Lab | 1, 3, 4 | 0 | 0 | 3 | | 1.5 | PC |
| 08 | - | Technical Paper Writing | 12 | 0 | 0 | 4 | | 2.0 | SC |
| 09 | 20MCX03 | Intellectual Property Rights and Patents | - | 2 | 0 | 0 | - | | MC |
| 10 | - | Summer Internship #1[2] | 5, 8, 9, 10, PSO 1 | 0 | 0 | 0 | | 1.5 | IN |
| | | | Sub-total | 15 | 02 | 14 | | 21.5 | |

[1]The students are expected to identify one research area in the recent trends, collect recent research articles, prepare a technical research review paper and publish in renowned annual conferences/ journals, preferably indexed in Scopus or UGC care

[1]The students are expected to identify one research area in the recent trends, collect recent research articles, prepare a technical research review paper and publish in renowned annual conferences/ journals, preferably indexed in Scopus or UGC care

[1]The work pertaining to summer Internship #1 and #2 shall be completed at the end of the semesters IV & VI respectively. The assessment shall be carried out during the semesters V and VII

It is mandate for all the students to undergo 4-6 weeks of industrial training and appear for assessment during Semester V with report. With regard to Community Service Project (CSP), based on the availability the students can opt CSP as an alternate option for summer internship #1 for a duration of 08 weeks

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Semester VI** | | | | | | | | |
| 01 | 20ME601 | Mechanical Measurements and Metrology | 1, 6, 12 | 3 | 0 | 0 | 3.0 | PC |
| 02 | 20ME602 | Design of Machine Elements II | 2, 3, 4, PSO 1 | 3 | 1 | 0 | 3.0 | PC |
| 03 | 20ME603 | Heat Transfer | 1, 2, 3, 4, PSO 2 | 3 | 1 | 0 | 3.0 | PC |
| 04 | - | Professional Elective II | - | 3 | 0 | 0 | 3.0 | PE |
| 05 | - | Open Elective II | - | 3 | 0 | 0 | 3.0 | OE |
| 06 | 20ME606 | Computer Aided Machine Drawing | 1, 5, 10, PSO 1 | 0 | 0 | 3 | 1.5 | PC |
| 07 | 20ME607 | Mechanical Measurements and Metrology Lab | 1, 4 | 0 | 0 | 3 | 1.5 | PC |
| 08 | 20ME608 | Heat Transfer Lab | 1, 3, 4, PSO 2 | 0 | 0 | 3 | 1.5 | PC |
| 09 | 20MES04 | Short-term Skill Oriented Elective | 1, 4, 5 | 0 | 0 | 4 | 2.0 | SC |
| 10 | 20MCX04 | Indian Traditional Knowledge | - | 2 | 0 | 0 | - | MC |
| | | | Sub-total | 16 | 02 | 15 | **21.5** | |
| **Semester VII** | | | | | | | | |
| 01 | - | Professional Elective III | - | 3 | 0 | 0 | 3.0 | PE |
| 02 | - | Professional Elective IV | - | 3 | 0 | 0 | 3.0 | PE |
| 03 | - | Professional Elective V | 12 | 3 | 0 | 0 | 3.0 | PE |
| 04 | - | Open Elective III | - | 3 | 0 | 0 | 3.0 | OE |
| 05 | - | Open Elective IV | 12 | 3 | 0 | 0 | 3.0 | OE |
| 06 | 20HSX04 | Professional Ethics | 8 | 3 | 0 | 0 | 3.0 | HS |
| 07 | 20MES05 | Finishing School for Mechanical Engineering | - | 0 | 0 | 4 | 2.0 | SC |
| 08 | - | Summer Internship #2[4] | 5, 8, 9, 10, PSO 1 | 0 | 0 | 0 | 3.0 | IN |
| | | | Sub-total | 16 | 0 | 08 | **23.0** | |
| **Semester VIII** | | | | | | | | |
| 01 | - | Full Semester Internship[3] | 5-10, PSO 1, PSO 2 | 0 | 0 | 0 | 06 | IN |
| 02 | - | Capstone Project[3] | 5-10, PSO 1, PSO 2 | 0 | 0 | 0 | 06 | IN |
| | | | Sub-total | 0 | 0 | 0 | **12.0** | |
| | | | **Total Credits** | - | - | - | **160** | |

[1]It is mandate for all the students to pursue an online certification course for minimum duration of 30 hours covering the application of ITK in Science Engineering & Technology

[1]It is mandate for all the students to undergo 6-8 weeks of industrial training and appear for assessment during Semester VII with report and those opted FSI during Semester VII shall appear through online for reviews

[1]Students opting for FSI in VII semester have to take up courses of VII semester in VIII semester. The students are expected to do a capstone project parallelly demonstrating their POs & PSOs and submit a separate report

List of Electives

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Professional Elective #1 | | | | | | | |
| 1 | 20ME001 | Applied Thermodynamics | - | 3 | 0 0 | 3.0 | PE |
| 2 | 20ME002 | Unconventional Machining Processes | - | 3 | 0 0 | 3.0 | PE |
| 3 | 20ME003 | Rotor Dynamics | - | 3 | 0 0 | 3.0 | PE |
| 4 | 20ME004 | Composite Materials | - | 3 | 0 0 | 3.0 | PE |
| 5 | 20ME005 | Product Design | - | 3 | 0 0 | 3.0 | PE |
| 6 | 20ME006 | Production Planning and Control | - | 3 | 0 0 | 3.0 | PE |
| Professional Elective #2 | | | | | | | |
| 7 | 20ME007 | Refrigeration and Air Conditioning | - | 3 | 0 0 | 3.0 | PE |
| 8 | 20ME008 | Flexible Manufacturing Systems | - | 3 | 0 0 | 3.0 | PE |
| 9 | 20ME009 | Optimization Techniques | - | 3 | 0 0 | 3.0 | PE |
| 10 | 20ME010 | Material Characterization | - | 3 | 0 0 | 3.0 | PE |
| 11 | 20ME011 | CAD/CAM | - | 3 | 0 0 | 3.0 | PE |
| 12 | 20ME012 | Total Quality Management | - | 3 | 0 0 | 3.0 | PE |
| Professional Elective #3 | | | | | | | |
| 13 | 20ME013 | Power Plant Engineering | - | 3 | 0 0 | 3.0 | PE |
| 14 | 20ME014 | Advanced Welding Technology | - | 3 | 0 0 | 3.0 | PE |
| 15 | 20ME015 | Finite Element Method | - | 3 | 0 0 | 3.0 | PE |
| 16 | 20ME016 | Condition Monitoring | - | 3 | 0 0 | 3.0 | PE |
| 17 | 20ME017 | Computer Integrated Manufacturing | - | 3 | 0 0 | 3.0 | PE |
| 18 | 20ME018 | Operations Research | - | 3 | 0 0 | 3.0 | PE |
| Professional Elective #4 | | | | | | | |
| 19 | 20ME019 | Gas Dynamics and Jet Propulsion | - | 3 | 0 0 | 3.0 | PE |
| 20 | 20ME020 | Advance Metal Casting | - | 3 | 0 0 | 3.0 | PE |
| 21 | 20ME021 | Design Innovations | - | 3 | 0 0 | 3.0 | PE |
| 22 | 20ME022 | Non Destructive Evaluation | - | 3 | 0 0 | 3.0 | PE |
| 23 | 20ME023 | Robotics and Automation | - | 3 | 0 0 | 3.0 | PE |
| 24 | 20ME024 | Project Planning and Management | - | 3 | 0 0 | 3.0 | PE |
| Professional Elective #5 | | | | | | | |
| The curriculum provides academic flexibility to choose any of the domain specific courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self - study mode. The course shall be of 45 – 60 hours duration (4-credits) and the assessment shall be as per the academic regulation 2020. | | | | | | | PE |
| Open Elective #1 | | | | | | | |
| 25 | 20CEO01 | Urban Environmental Service | - | 3 | 0 0 | 3.0 | OE |
| 26 | 20CSO01 | Data Structures and Algorithms | - | 3 | 0 0 | 3.0 | OE |
| 27 | 20AIO01 | Machine Learning for Engineers | - | 3 | 0 0 | 3.0 | OE |
| 28 | 20DSO01 | Introduction to Database Management Systems | - | 3 | 0 0 | 3.0 | OE |
| 29 | 20ECO01 | Architectures and Algorithms of IoT | - | 3 | 0 0 | 3.0 | OE |
| 30 | 20EEO01 | Introduction to Renewable Energy Sources | - | 3 | 0 0 | 3.0 | OE |
| 31 | 20MEO01 | Nano Technology | - | 3 | 0 0 | 3.0 | OE |
| 32 | 20SHO01 | Women and Society | - | 3 | 0 0 | 3.0 | OE |
| Open Elective #2 | | | | | | | |
| 33 | 20CEO02 | Ecology Environment and resource Management | - | 3 | 0 0 | 3.0 | OE |
| 34 | 20CS004 | Internet of Things | - | 3 | 0 0 | 3.0 | OE |
| 35 | 20AIO02 | Fundamentals of Deep Learning | - | 3 | 0 0 | 3.0 | OE |
| 36 | 20DSO02 | Introduction to Data Science | - | 3 | 0 0 | 3.0 | OE |
| 37 | 20ECO02 | IoT for Smart Grids | - | 3 | 0 0 | 3.0 | OE |
| 38 | 20EEO02 | Electrical Safety and Management | - | 3 | 0 0 | 3.0 | OE |
| 39 | 20MEO02 | Fundamentals of Automobile Engineering | - | 3 | 0 0 | 3.0 | OE |
| 40 | 20SHO02 | Design the Thinking | - | 3 | 0 0 | 3.0 | OE |
| Open Elective #3 | | | | | | | |
| 41 | 20CEO03 | Disaster, Risk Mitigation and Management | - | 3 | 0 0 | 3.0 | OE |
| 42 | 20CS404 | Operating Systems | - | 3 | 0 0 | 3.0 | OE |
| 43 | 20AIO03 | Intelligent Robots and Drone Technology | - | 3 | 0 0 | 3.0 | OE |
| 44 | 20DSO03 | Introduction to Big Data | - | 3 | 0 0 | 3.0 | OE |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 45 | 20ECO03 | Privacy and Security in IoT | - | 3 | 0 0 | 3.0 | OE |
| 46 | 20EEO03 | Low-cost Automation | - | 3 | 0 0 | 3.0 | OE |
| 47 | 20MEO03 | Industrial Automation | - | 3 | 0 0 | 3.0 | OE |

Open Elective #4

The curriculum provides academic flexibility to choose any of the inter-disciplinary courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration and the assessment shall be as per the academic regulation 2020. OE

B. Tech. (Honors)

| | | | | | | |
|---|---|---|---|---|---|---|
| **Category I** | | | | | | |
| 1 | 20MEH01 Advanced Thermodynamics | - | 4 | 0 0 | 4.0 | HO |
| 2 | 20MEH02 Advanced Heat Transfer | - | 4 | 0 0 | 4.0 | HO |
| 3 | 20MEH03 Jet Propulsion and Rocket Engineering | - | 4 | 0 0 | 4.0 | HO |
| **Category II** | | | | | | |
| 4 | 20MEH04 Design and Analysis of Engineering Materials | - | 4 | 0 0 | 4.0 | HO |
| 5 | 20MEH05 Advanced Manufacturing Methods | - | 4 | 0 0 | 4.0 | HO |
| 6 | 20MEH06 Rapid Prototyping | - | 4 | 0 0 | 4.0 | HO |
| **Category III** | | | | | | |
| 7 | 20MEH07 Advanced Strength of Materials | - | 4 | 0 0 | 4.0 | HO |
| 8 | 20MEH08 Advanced Finite Element Analysis | - | 4 | 0 0 | 4.0 | HO |
| 9 | 20MEH09 Advanced Optimization Techniques | - | 4 | 0 0 | 4.0 | HO |
| **Category IV** | | | | | | |
| 10 | 20MEH10 Integrated Computer Aided Design | - | 4 | 0 0 | 4.0 | HO |
| 11 | 20MEH11 Industrial Robotics | - | 4 | 0 0 | 4.0 | HO |
| 12 | 20MEH12 Design of Smart Technologies | - | 4 | 0 0 | 4.0 | HO |

B. Tech. (Minor with Specialization)

| | | | | | | |
|---|---|---|---|---|---|---|
| **Category I** | | | | | | |
| 1 | 20CEM01 Air Pollution | - | 3 | 0 0 | 3.0 | MI |
| 2 | 20CSM01 E-Commerce | - | 3 | 0 0 | 3.0 | MI |
| 3 | 20MEM01 Biomaterials | - | 3 | 0 0 | 3.0 | MI |
| 4 | 20EEM01 Basic Control Systems | - | 3 | 0 0 | 3.0 | MI |
| 5 | 20ECM01 Fundamentals of Electronics | - | 3 | 0 0 | 3.0 | MI |
| 6 | 20AIM01 Fundamentals of Neural Networks | - | 3 | 0 0 | 3.0 | MI |
| 7 | 20DSO03 Introduction to R Programming | - | 3 | 0 0 | 3.0 | MI |
| **Category II** | | | | | | |
| 8 | 20CEM02 Climate Change Mitigation and Adaptation | - | 3 | 0 0 | 3.0 | MI |
| 9 | 20CSM02 Knowledge Discovery and Databases | - | 3 | 0 0 | 3.0 | MI |
| 10 | 20MEM02 Micro Electromechanical Systems | - | 3 | 0 0 | 3.0 | MI |
| 11 | 20EEM02 Design of Photovoltaic systems | - | 3 | 0 0 | 3.0 | MI |
| 12 | 20ECM02 Digital Electronics | - | 3 | 0 0 | 3.0 | MI |
| 13 | 20AIM02 Machine Learning with Python | - | 3 | 0 0 | 3.0 | MI |
| 14 | 20DSM02 Data Management and Analysis | - | 3 | 0 0 | 3.0 | MI |
| **Category III** | | | | | | |
| 15 | 20CEM03 Sustainability and Pollution Prevention Practices | - | 3 | 0 0 | 3.0 | MI |
| 16 | 20CSM03 Database Security | - | 3 | 0 0 | 3.0 | MI |
| 17 | 20MEM03 Surface Engineering | - | 3 | 0 0 | 3.0 | MI |
| 18 | 20EEM03 Electrical Engineering Material Science | - | 3 | 0 0 | 3.0 | MI |
| 19 | 20ECM03 Analog Electronic Circuits | - | 3 | 0 0 | 3.0 | MI |
| 20 | 20AIM03 Interpretable Machine learning | - | 3 | 0 0 | 3.0 | MI |
| 21 | 20DSM03 Data Governance | - | 3 | 0 0 | 3.0 | MI |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Short Term Skill Oriented Electives | | | | | | | |
| 34 | 23MES01 | Computer Aided Modeling | | 0 | 0 4 | 2.0 | SC |
| 35 | 23MES02 | Computer Numerical Control Programming | | 0 | 0 4 | 2.0 | SC |
| 36 | 23MES04 | Computer Aided Analysis | | 0 | 0 4 | 2.0 | SC |
| Long Term Skill Oriented Courses (Industry Oriented)* | | | | | | | |
| 37 | 20ICC01 | Competitive Programming | - | 2 | 0 8 | 6.0 | LTS |
| 38 | 20ICC02 | Web Technologies – Theory to Practice | - | 2 | 0 8 | 6.0 | LTS |
| 39 | 20ICC03 | Java and Springboard | - | 2 | 0 8 | 6.0 | LTS |
| 40 | 20ICC04 | Robotics Process Automation (RPA) | - | 2 | 0 8 | 6.0 | LTS |
| 41 | 20ICC05 | Information Security and Forensics | - | 2 | 0 8 | 6.0 | LTS |
| 42 | 20ICC06 | Battery Technologies for EV | - | 2 | 0 8 | 6.0 | LTS |
| 43 | 20ICC07 | Block chain Technology | - | 2 | 0 8 | 6.0 | LTS |
| 44 | 20ICC08 | Network Administration | - | 2 | 0 8 | 6.0 | LTS |
| 45 | 20ICC09 | Product Engineering | - | 2 | 0 14 | 9.0 | LTS |
| 46 | 20ICC10 | Machine Learning Engineer | - | 2 | 0 8 | 6.0 | LTS |
| 47 | 20ICC11 | Data Scientist | - | 2 | 0 8 | 6.0 | LTS |
| 48 | 20ICC12 | Technical and Business Communication | - | 2 | 0 8 | 6.0 | LTS |

## BS 20BSX13 Numerical Methods and Transforms 3 1 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs PO1 | PO12 | DoK |
|---|---|---|---|---|
| 20BSX13.1 | Calculate the approximate roots of the algebraic equations and transcendental equations by different techniques | 3 | 1 | L1, L2, L3 |
| 20BSX13.2 | Make use of the concepts of interpolation to estimate the unknown functional values | 3 | 1 | L1, L2, L3 |
| 20BSX13.3 | Find approximate values of finite integrals using different numerical techniques and use different algorithms for approximating solutions of ordinary differential equation to its analytical computations | 3 | 1 | L1, L2, L3 |
| 20BSX13.4 | Apply the Laplace transform to solve ordinary differential equations with initial conditions | 3 | 1 | L1, L2, L3 |
| 20BSX13.5 | Solve engineering problems using Fourier transforms | 3 | 1 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

### Unit I: Iterative Methods 11 + 1 Hour

Introduction – Bisection Method – Secant Method – Method of False Position – Iteration Method – Newton - Raphson Method – Jacobi and Gauss - Seidel Methods Solving System of Equations.

*Convergence of – Bisection Method, Secant Method, Method of False Position Newton - Raphson Method*

### Unit II: Cayley-Hamilton Theorem and Quadratic Forms 11 + 1 Hour

Introduction – Finite Differences – Forward Differences – Backward Differences – Central Differences – Relations Between Operators – Newton's Forward and Backward Formulae for Interpolation – Interpolation with Unequal Intervals – Lagrange's Interpolation Formula – Newton's Divide Difference Formula.

*Errors in Polynomial Interpolation – Error Propagation in a Difference Table - Milne's Method and Adams - Bashforth Methods*

### Unit III: Numerical Integration and Solution of Ordinary Differential Equations 11 + 1 Hour

Numerical Integration: Trapezoidal Rule – Simpson's 1/3rd and 3/8th Rule
Solution of Ordinary Differential Equations by Taylor's Series – Picard's method of successive approximations – Euler's Method – Runge - Kutta Method (Second and Fourth order).

*Cubic Spline Interpolation, Numerical Differentiations*

### Unit IV: Laplace Transforms 11 + 1 Hour

Laplace Transforms of Standard Functions – Shifting Theorems – Transforms of Derivatives and Integrals. Unit Step Function – Inverse Laplace Transforms – Convolution Theorem (Without Proof).
Applications: Solving Ordinary Differential Equation (Initial Value Problems) using Laplace Transforms.

*Simple Harmonic Motion, Higher Order Differential Equation with Variable Coefficient*

### Unit V: Fourier Transforms 11+1 Hour

Fourier Transforms: Fourier Integrals - Fourier Cosine and Sine Integrals- Fourier Transform - Sine and Cosine Transform - Properties.

*Finite Fourier Sine Transforms, Finite Fourier Cosine Transform*

### Text Books

1. Grewal B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2018
2. Ramana B. V., "Higher Engineering Mathematics", Tata McGraw Hill Education, 2018

### Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics",10th Edition, Wiley, India, 2015
2. Bali N. P., "Engineering Mathematics",22nd Edition, Lakshmi Publications, 2018
3. Peter o'Neil, "Advanced Engineering Mathematics" 8th Edition, Cengage Publications, 2017
4. Dr. IyengerT. K. V., Dr. Prasad. M. V. S. S. N., Ranganatham S. and Dr. Krishna Gandhi B., "Engineering Mathematics I, II & III ", S. Chand Publications, 2019

### Web References

1. https://nptel.ac.in/courses/122/102/122102009/
2. https://nptel.ac.in/courses/111/106/111106139/
3. https://nptel.ac.in/courses/111/102/111102129/

### Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 20 | 20 |
| L2 | 50 | 40 |
| L3 | 30 | 40 |
| Total (%) | 100 | 100 |

### Sample Short and Long Answer Questions of Various Cognitive Levels

### L1: Remember

1. Identify the root lies between which values for $x^3 - 5x + 1 = 0$
2. Prove that $(1+\Delta)(1-\nabla)=1$
3. Find the first difference of the polynomial $x^4-12x^3+42x^2-30x+9$ with interval of differencing h=2
4. Define unit step function
5. Stateconvolution theorem

### L2: Understand

1. Find a real root of xtanx+1=0 using false position method
2. Find a real root of the equation $xe^x-cosx=0$ using Newton - Raphson method
3. Use Gauss backward interpolation formula to find f(32) given that f(25)=0.2707 f(30)=0.3027 ,f(35)=0.3386, f(40)=0.3794
4. Using Lagrange's formula find the value of f(1) given that

| X | -2 | -1 | 2 | 7 |
|---|---|---|---|---|
| Y | -1 | 0 | 4 | 11 |

### L3: Apply

1. Using Newton - Raphson method compute $\sqrt[3]{37}$ correct to 4 decimal places
2. Find $\sqrt{12}$&$\frac{1}{\sqrt{12}}$ by the fixed point iteration method
3. The population of a nation in the decimal census was given below .Estimate the population in the year 1925 using appropriate interpolation formula

| Year x | 1891 | 1901 | 1911 | 1921 | 1931 |
|---|---|---|---|---|---|
| Population y | 46 | 66 | 81 | 93 | 101 |

4. Given that $Sin45^0$ =0.7077, $Sin50^0$ = 0.766, $Sin55^0$ =0.8192, $Sin60^0$ =0.866 find $Sin40^0$ using Newton's forward difference formula
5. Solve $y'=y-x^2$, y(0)=1 using Picard's method up to fourth approximation

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Board of Studies (ME)

## PC 20ME302Thermodynamics

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | | DoK |
|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO4 | PO12 | PSO1 | |
| 20ME302.1 | Relate the fundamental concepts of thermodynamics and processes of thermodynamics | 3 | - | - | 1 | 1 | L2 |
| 20ME302.2 | Demonstrate the principle of first law of thermodynamics and energy transfer. | 3 | 2 | - | 1 | 1 | L2 |
| 20ME302.3 | Explain the second law of thermodynamics and functions, usage and the relations. | 3 | 2 | - | 1 | 1 | L2 |
| 20ME302.4 | Illustrate pure substance and diagrams of related properties and phase transformations | 3 | 2 | 1 | 1 | 1 | L2 |
| 20ME302.5 | Interpret the Ideal gas equation and perfect gas equation for studying the gas behaviour and its properties. | 3 | 2 | 1 | 1 | 1 | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

### Unit I: Basic Concepts — 11 + 1 Hours

System, boundary, Surrounding, Universe, control volume, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process - Reversible,Quasi static & Irreversible Processes, cycle, Causes of Irreversibility. Energy in State and in Transition, Types, Work and Heat, Point and Path function. Zero Law of Thermodynamics, Concept of Temperature, Principles of Thermometry, and Reference Points. Constant volume gas Thermometer, Scales of Temperature.

### Unit II: First law of Thermodynamics — 11 + 1 Hours

Joule's Experiments – First law of Thermodynamics, Corollaries, and First law applied to a Process, applied to a flow system, Energy balance for closed systems-Specific heats, Internal energy, Enthalpy and Specific heats of Solids, liquids and Ideal gases, Some steady flow energy equation applied to Nozzle, Turbine, Compressor and heat exchanger devices.

### Unit III: Thermodynamic Laws — 11 + 1 Hours

Limitations of the First Law, Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin, Planck and Clausius Statements and their Equivalence, Corollaries, PMM of Second kind, Carnot cycle and its specialties, Carnot's theorem, Thermodynamic scale of Temperature. Clausius Inequality, Entropy, Principle of Entropy Increase, Availability and Irreversibility (Basic definitions). Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law ofThermodynamics.

### Unit IV: Pure Substances — 11 + 1 Hours

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollere Charts, Phase Transformations. Triple point and critical point, properties during change of phase, Dryness Fraction, Clausius, Chaperon Equation, Property tables. Various Thermodynamic processes and energy Transfer, Steam Calorimetric.

### Unit V: Ideal Gas Constants — 11 + 1 Hours

Ideal Gas equation of state- Compressibility factor, Vander Waals equation of state- Beattie, Bridgeman equation of state-Benedict, Webb-Rubin equation of state, Viral equation of state, compressibility charts, variable specific heats. Mixtures of perfect Gases, Dalton's Law of partial pressure, Avogadro's Laws of additive volumesEquivalent Gas constant and Molecular Internal Energy, Enthalpy, Specific Heat and Entropy of Mixture of Perfect Gases and Vapour. Psychometric Properties, Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, Saturated Air, Vapour pressure, Degree of saturation, Adiabatic Saturation , Carrier's Equation, Psychometric chart.

## Text Books

1. Nag.P.K-EngineeringThermodynamics,6thEdition,McGrawHill- 2013



2. Sonntag,Borgnakke,VanWylen,FundamentalsofThermodynamics–6thEdition,Wiley-2015
3. YunusACenegel,MichaelABoles,Thermodynamics,anEngineeringApproach,8thEdition-MCH- 2014
4. Dr.J.P.HolmanThermodynamics–,McGrawHill-6thEdition,McGrawHill- 2013

## Reference Books

1. PrasannaKumar, Thermodynamics,PearsonPublishers- 6thEdition,McGrawHill- 2011
2. Jones&Dugan, EngineeringThermodynamics–PHI- 6thEdition,McGrawHill- 2012.
3. Dr.Y.V.C.Rao-An Introduction to Thermodynamics– Universities presses publications- 2012.
4. W.Z.Black&J.G.Hartley, Thermodynamics, 3rd Edition- Pearson Publications- 2010.

## Web References

1. https://nptel.ac.in/courses/112/105/112105123/
2. https://nptel.ac.in/courses/112/105/112105266/
3. https://nptel.ac.in/courses/101/104/101104063/

## Internal Assessment Pattern

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

## Sample Short and Long Answer Questions of Various Cognitive Levels

### L1: Remember

1. Whatarethetypesofthermodynamicsystems?
2. Definequasi-staticprocess.
3. Whatissecondlawofthermodynamics?
4. Listtheentropycategorieswithrespecttothermodynamicrelations.
5. Write theenthalpyfunctionsofthermodynamicsproperties.
6. Whatareavailabilityandirreversibility?
7. DefineCarnot'stheorem.
8. Describethetriplepointandcriticalpoint.
9. Whatis idealgas?
10. Definedrybulbtemperatureand wetbulbtemperature.

### L2: Understand

1. Describetheconceptofthermometryanditsreferencepoints
2. Whatarethedifferencesbetweenpointfunctionandpathfunction?
3. Describethecorollariesoffirstlawofthermodynamics
4. DemonstrateKelvinPlanckandClausiusstatement withexample

### L3: Apply

1. A pump discharges a liquid into a drum of rate of the 0.032 $m^3$/sec .Thedrum constitute the diameter of 1.5m and 4.2 in length, which can hold 3000kg of theliquid. Find the density of the liquid at the mass flow rate of the liquid handled by thepump.
2. IllustrateFirstlawappliedtoaflowsystem.
3. An engine cylinder has a piston of area 0.12sq.m and contains gas at a pressure of1.5Mpa,thegasexpandsaccordingtotheprocessWhichrepresentedbyastraight lineon a pressure volume. The final pressure is 0.15MPa. Calculate the work done on a gasbythepiston.
4. DesignP-V-TsurfacesandT-S,h-s diagrams.

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**BoardofStudies(ME)**

Dr. P.N.E. Naveen
Assoc. Prof.

Head of the Department
Mechanical Engineering

**PC** **20ME303 Material Science and Metallurgy** **3 0 0 3**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | DoK |
|---|---|---|---|---|---|
| | | PO1 | PO7 | PO12 | |
| 20ME303.1 | Classifymetals and alloys based on behaviour of bonds and properties. | 3 | 2 | 2 | L2 |
| 20ME303.2 | Illustrate the regions of stability of the phases occur in an alloy system. | 3 | 2 | 2 | L2 |
| 20ME303.3 | Compare cast irons and steels with respect to their properties and practical applications. | 3 | 2 | 2 | L2 |
| 20ME303.4 | Summarize the affect of various alloying elements on iron-iron carbide system, various heat treatment and strengthening processes. | 3 | 2 | 2 | L2 |
| 20ME303.5 | Make use of non-ferrous metals and alloys for practical applications. | 3 | 2 | 2 | L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: Structure of Metals And Constitution of Alloys** **12 Hours**

Bonds in Solids, Metallic bond, crystallization of metals, Packing Factor - SC, BCC, FCC& HCP-line density, plane density. Grain and grain boundaries, effect of grain boundaries on the Properties of metal / alloys – determination of grain size. Imperfections point, line, surface and volume- Slip and Twinning. Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds

**Equilibrium Diagrams** :Experimental methods of construction of equilibrium diagrams, Isomorphism alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peristaltic reaction. Transformations in the solid state, allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni and Fe-Fe3

**UNIT –II: Ferrous Metals and Alloys:** **12 Hours**

Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroid graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels. Non-ferrous Metals and Alloys: Structure and properties of Copper and its alloys, Aluminum and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.

**UNIT – III: Heat Treatment of Alloys** **12 Hours**

Effect of alloying elements on Fe-Fe3C system, Annealing, normalizing, hardening, TTT diagrams, tempering, harden ability, surfac methods, Age hardening treatment, Cryogenic treatment of alloys.

**UNIT – IV: Powder Metallurgy** **12 Hours**

Basic processes- Methods of producing metal powders- milling atomization/Granulation-Reduction. Electrolytic Deposition. Compacting methods. Sintering methods of manufacturing sintered parts. Sintering Secondary operations. Sizing, coining, machining -Factors determining the use of powder metallurgy. Application of this process

**UNIT – V: Ceramic and Composite Materials:** **12 Hours**

Crystalline ceramics, glasses, cermets, abrasive materials, Classification of composites, various methods of component manufacture of composites, particle reinforced materials, and fiber reinforced materials, metal ceramic mixtures, metal matrix composites and C – C composites. Nanomaterials, definition, properties and applications.

**Text Books:**

1. Sidney H. Avener – Introduction to Physical Metallurgy - McGrawHill- 6th Edition- 2015
2. Donald R.Askeland-Essential of Materials science and engineering –Cengage- 7th Edition- 2015
3. Dr.V.D.kodgire- Material Science and Metallurgy, Everest Publishing House- 4th Edition- 2015
4. Callister &Baalasubrahmanyam, Materials Science and engineering- Wiley Publications- 11th Edition- 2015

**References:**

1. Fischer – Material Science for Engineering students –Elsevier Publishers- 11th Edition-2010

2. Raghavan.V-Material science and Engineering - PHI Publishers- 5th Edition- 2009
3. Yip-Wah Chung- Introduction to Material Science and Engineering –CRC Press- 8th Edition- 2012
4. Suryanarayana. A V K-Material Science and Metallurgy– B S Publications- 13th Edition- 2013
5. Jindal. U.C-Material Science and Metallurgy– Pearson Publications- 15th Edition-2016

**Web References:**

1 www.edinformatics.com/math_science/how_is_heat_transferred.htm
2 https://www.quora.com/Why-are-dimensionless-numbers-used-in-heat-transfer-and-fl
3 http://nptel.ac.in/courses/103103032/16
4 web.mit.edu/16.unified/www/FALL/thermodynamics/notes/node128.html
5 web.pdx.edu/~yongkang/main/class/Internal%20Flow.pdf

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 30 | 30 |
| L2 | 30 | 30 |
| L3 | 40 | 40 |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1) Define elasticity and plasticity
2) Define Space Lattice.
3) What is the significance of liquids, solidus and solves lines in phase diagram?
4) Compare nodular cast iron and malleable cast iron.
5) When will you prefer annealing?
6) What are the properties of Titanium alloys?
7) List abrasive materials.

**L2: Understand**

1. Explain point defect, Line defect and plane defect. b) Mention the types of solid solutions with examples.
2. Draw iron-carbon equilibrium diagram and mark on it all salient temperatures, composition and phases involved.
3. a) Classify different types of cast iron. Why silicon is added to cast iron? Explain the effects of any four alloying elements on the properties of cast iron.
4. Explain the structure and properties of plain carbon steels.
5. a) Discuss different types of annealing processes. b) Define harden ability of a material and list the factors affecting harden ability.
6. a) What are the types of copper alloy, their composition, properties and applications?b) Enlist the properties of pure Aluminum and mention the composition, specific properties and applications of any one aluminum alloy.
7. a) What are Nano materials? What are their advantages? b) What is a Composite material? How it is classified? Explain briefly.

**L3: Apply**

1) Write equations for the following invariant reactions: eutectic, peristaltic, monotectic, eutectoid and peritectoid. How many degrees of freedom do exist at invariant reaction points in binary phase diagram
2) Explain different types of transformations in solid state? Illustrate with an example
3) Compare annealing and normalizing. When do you use them
4) Find the degrees of freedom in a binary system (C=2) at single phase, double phase, and triple phase region at atmospheric pressure conditions using phase rule

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**BoardofStudies(ME)**

## PC 20ME304 Mechanics of Solids

3 1 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs PO2 | PO3 | PO12 | PSO 01 | DoK |
|---|---|---|---|---|---|---|
| 20ME304.1 | Outline the concepts of stresses and strains of varying cross-sectional bodies | 3 | 3 | - | 1 | L1, L2 |
| 20ME304.2 | Solve the shear force and bending moment problems for beams of various supports and loads | 3 | 3 | 1 | 1 | L1, L2,L3 |
| 20ME304.3 | Identify shear stresses due to application of twisting moment | 3 | 3 | 1 | 1 | L1, L2,L3 |
| 20ME304.4 | Solve the slope and deflection for beams of various load and support arrangements | 3 | 3 | 2 | 1 | L1, L2,L3 |
| 20ME304.5 | Interpret the stress analysis on thin and thick cylinder shells. | 3 | 3 | 1 | 1 | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: Simple Stresses & Strains** 11+1Hour

Elasticity and plasticity, Types of stresses & strains, Hooke's law, stress – strain diagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio & volumetric strain, Bars of varying section, composite bars, Temperature stresses, Complex Stresses, Stresses on an inclined plane under different axial and biaxial stress conditions, Principal planes and principal stresses, Mohr's circle, Relation between elastic constants, Strain energy, Resilience, Gradual, sudden, impact and shock loadings.

**Unit II: Shear Force And Bending Moment** 11 + 1 Hour

Definition of beam, Types of beams, Concept of shear force and bending moment, S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, 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 & Shear Stresses** 11 + 1 Hour

FlexuralStresses:Theory of simple bending, Assumptions, Derivation of bending equation: M/ I = fly = E/R Neutral axis, Determination bending stresses, section modulus of rectangular and circular sections (Solid and Hollow), Angle and Channel sections, Design of simple beam sections.

Shear stresses: Derivation of formula, Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

**Unit IV: Deflection of Beams & Torsion** 11 + 1 Hour

Deflection of beams:Bending into a circular arc, slope, deflection and radius of curvature, Differential equation for the elastic line of a beam, Double integration and Macaulay's methods, Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, U.D.L uniformly varying load. Mohr's theorems, Moment area method, application to simple cases including overhanging beams, Statically indeterminate Beams and solution methods.

Torsion:Introduction, Derivation, Torsion of Circular shafts, Pure Shear,Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

**Unit V: Thin and Thick Cylinders & Columns** 11 + 1 Hour

Thin seamless cylindrical shells, Derivation of formula for longitudinal and circumferential stresses, hoop, longitudinal and Volumetric strains, changes in diameter, and volume of thin cylinders, Riveted boiler shells, Thin spherical shells. Wire wound thin cylinders. Lame's equation, cylinders subjected to inside & outside pressures, compound cylinders.

Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula

**Text Books**

1. Bansal. R.K.- Strength of Materials, Laxmi Publications- 15th Edition- 2015
2. Popov, Prentice Hall- Solid Mechanics, Engle wood cliffs,New Jersey- 13th Edition-2017.
3. GH Ryder, Strength of materials, Mc Millan publishers India Ltd- 10th Edition-2011
4. Gere and Timosherko, Mechanics of Materials- CBS Publishers- 12th Edition- 2014

**Reference Books**

1. Ramamrutham.S,Strength of Materials, Dhanpat Rai Publications- 11th Edition-2017

2. Bhavikatti.S.S.-Mechanics of solids –New Age International Publications- 15th Edition-2018
3. Jindal, Strength of Materials, Umesh Publications- 9th Edition- 2010
4. Andrew Pytelaand Ferdinond L. Singer Longman- Strength of Materials LSA Publication- 2013.

**Web References**

1. https://drive.google.com/file/d/0BytKfvgX-GD6c2FFRF9GLTNNVTA/view
2. https://drive.google.com/file/d/1R-kxYKtjVB7q-Klq60n1KrL-RpRQJJDB/edit

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 20 | 20 |
| L2 | 20 | 20 |
| L3 | 60 | 60 |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Define elasticity and plasticity
2. State the Hooke's Law?
3. Write the types of loads?
4. What are the General sign conventions for shear force and bending moment in general?
5. State the assumptions made in the theory of simple bending.

**L2: Understand**

1. What do you mean by "a bar of uniform strength"?
2. Distinguish the Impact and Shock loading?
3. Write a note on impact loads?
4. Express Poisson's ratio in terms of shear and Bulk module.
5. What is statically determinate beam? Give some examples

**L3: Apply**

1. Two vertical rods one of steel and other of copper are each rigidly fixed at the top and50 cm apart. Diameters and lengths of each rod are 2 cm and 4m respectively. A crossbar fixed to the rods at the lower end carries a load of 5000 N such that the cross barremains horizontal even after loading. Find the stresses in each rod and the position ofthe load on the bar. Take E for steel = $2x10^5$ N/mm² and E for copper = $1x10^5$N/mm².
2. A beam of length 6m is simply supported at its ends. It is loaded with a gradually varying load of 750 N/m from left end to 1500 N/m to the right end. Construct the SF and BM diagrams and find the magnitude and position of the maximum BM.
3. A beam of symmetrical section 30cm deep and I= 12000cm4, carries U.D.L. of 16kN/m. Calculate the maximum span of the beam if the maximum bending stress is not to exceed160N/mm2. With this span, calculate the maximum central load if the bending stress is not to exceed the limit given above.
4. A beam of uniform section, 10 meters long, is simply supported at the ends. It carries point loads of 110 KN and 60 KN at distances of 2m and 5m respectively from the left end. Calculate: The deflection under each load and maximum deflection. Given: E = $200x10^6$N/m²and I = $118x10^{-4}$m⁴.
5. A closed cylindrical vessel made of steel plates 4 mm thick with plane ends, carries fluid under a pressure of 3N/mm². The diameter of the cylinder is 25 cm and length is 75 cm, calculate the longitudinal and hoop stress in the cylinder wall and determine the change in the in diameter, length and volume of the cylinder. Take E= $2.1x10^5$ N/mm² and Poisson's ratios is 0.286.

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Chairman
Board of Studies (ME)

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology (A)
Visakhapatnam-531173

**PC** **20ME305 Manufacturing Processes** 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with Pos | | | DoK |
|---|---|---|---|---|---|
| | | PO1 | PO6 | PO12 | |
| 20ME305.1 | Demonstrate the various casting methods for product making with their merits and demerits. | 2 | - | 1 | L1, L2 |
| 20ME305.2 | Choosethe various materials joining process and associated defects with possible cause and cure | 2 | 1 | 1 | L1, L2, L3 |
| 20ME305.3 | Develop various metal forming process with its application | 2 | - | 2 | L1, L2, L3 |
| 20ME305.4 | Experiment with the various processes involved in sheet metal forming | 2 | - | 2 | L1, L2, L3 |
| 20ME305.5 | Make use of special manufacturing processes for customized applications | 2 | 2 | 2 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

**Unit I: Introduction to Casting** **12 Hours**

Steps involved in making a casting, Advantage of casting and its applications. Patterns and Pattern making, Types of patterns. Materials used for patterns, pattern allowances and their construction, Molding, molding methods, ingredients of molding sand, Molding materials, Properties of molding sand, Testing of molding sand. Types of molding, Hand molding. Machine molding. Core, different types of cores, materials, properties of core sand, core manufacturing.

**Unit II: Die Casting** **12 Hours**

Principles of Gating, Gating ratio and design of Gating systems. Risers, Types, function and design, casting design considerations. Methods of melting and types of furnaces, cupola, electric arc, resistance and induction furnace. Solidification of castings-Solidification of pure metals and alloys-Short & long freezing range alloys. Fettling, Casting defects. Basic principles and applications of special casting processes - Centrifugal casting, True, semi and centrifuging, Die casting, Investment casting and shell molding.

**Unit-III: Welding** **12 Hours**

Welding : Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy acetylene Gas cutting. Basic principles of Arc welding, power characteristics, Manual metal arc welding, Submerged arc welding, TIG & MIG welding. Electro slag welding. Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermal welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering & Brazing. Heat affected zones in welding; pre & post heating, Weld ability of metals, welding defects, causes and remedies, destructive and nondestructive testing of welds.

**Unit-IV: Plastic Deformation** **12 Hours**

Plastic deformation in metals and alloys-recovery, re-crystallization and grain growth. Hot working and Cold working strain hardening and Annealing. Bulk forming processes: Forging, Types of Forging, Smith forging, Drop Forging, Roll forging, Forging hammers, Rotary forging, forging defects. Rolling, fundamentals, types of rolling mills and products, Forces in rolling and power

requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

**Unit-V: Sheet Metal Forgings** **12 Hours**

Sheet metal forming, Blanking and piercing. Forces and power requirement in these operations, Deep drawing, Stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools. High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitations.

**Text Books:**


1. Kalpakjian S and Steven R Schmid, Manufacturing Processes for Engineering Materials — Pearson Publications- 15th Edition-2015
2. Rao. P.N, Manufacturing Technology -Vol I-TMH- 13th Edition-2014
3. Ghosh.A&A.K.Malik – Manufacturing Science –East West Press Pvt. Ltd- 10th Edition-2011
4. Lindberg, Process and materials of manufacture- - PHI- 12th Edition-2017


**Reference Books:**


1. Jain.R.K- Production Technology- Khanna- Tata McGrawHill- 10th Edition-2011
2. Sharma.P.C-Production Technology-S. Chand- 13th Edition-2013
3. Shaun.H.S.- Manufacturing Processes- Pearson- 12th Edition-2012
4. Kaushish.P.S.- Manufacturing Processes- PHI Publishers DistributorsPvt.Ltds- 5th Edition-2015


**Web References:**

1. https://www.thomasnet.com/articles/custom-manufacturing-fabricating/types-of-casting-processes/
2. http://www.velhightech.com/Documents/ME8451%20Manufacturing%20Technology%20II.pdf
3. https://www.sciencedirect.com/topics/materials-science/plastic-deformation
4. https://www.machinemfg.com/sheet-metal-fabrication-technological-process

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. List out the steps involved in solving a problem.
2. List any four types of patterns.
3. What are the Steps involved in making a casting?
4. Give the reasons of welding processes.
5. Explain steps involved in a casting process with a neat sketch.
6. What is the high energy rate forming processes ?
7. Define Casting.
8. Explain type of patterns and also explain any three patterns with a neat sketch.
9. Explain injection molding and Blow molding.
10. What is the difference between the solidification of pure me als and metal alloys

**L2: Understand**

1. Explain the two types of crucible furnaces with diagrams?
2. What is the difference between the solidification of pure me als and metal alloys?

3. Explain briefly the Investment casting and Die casting?



4. How do you classify the welding processes?
5. What is meant by penetration? Explain its relevance to welding.

**L3: Apply**

1. Explain the two types of crucible furnaces with diagrams?
2. What is the difference between the solidification of pure me als and metal alloys?
3. Explain briefly the Investment casting and Die casting?
4. How do you classify the welding processes?
5. What is meant by penetration? Explain its relevance to welding
6. Briefly describe the oxy-acetylene welding equipment?

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Board of Studies (ME)

## PC 20ME307 Mechanics of Solids Lab

0 0 3 1.5

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | |
|---|---|---|---|---|
| | | PO1 | PO4 | PO10 |
| 20ME307.1 | Find the stiffness and rigidity modulus of spring | 3 | 2 | 2 |
| 20ME307.2 | Evaluate the strength of various engineering materials through destructive tests | 3 | 2 | 2 |
| 20ME307.3 | Calculate young's modulus of wood/steel materials | 3 | 2 | 2 |
| 20ME307.4 | Measure the deformations in various beam members | 3 | 2 | 2 |
| 20ME307.5 | Compare the compressive strength of wood/Concrete/Brick materials along and across the grains | 3 | 2 | 2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

### List of Experiments

1. Find the spring index and modulus of rigidity of the spring material by conducting compression and tensile tests.
2. Estimate the young's modulus of the given cantilever beam material (Steel)
3. Evaluate the young's modulus of the given simple supported beam material
4. Find the shear strength on a given specimen under double shear apparatus
5. Compare the compressive strength of the wood/Concrete/Brick (along and across the grains)
6. Calculate the Rockwell's hardness number for given material
7. Calculate the Brinell's hardness number for given material
8. Determine the impact strength of given materials using IZOD Impact testing machine
9. Determine the impact strength of given materials using CHARPY Impact testing machine
10. Compute the modulus of rigidity and shear strength of the given sample
11. Verify the Maxwell's Reciprocal theorem on beams.
12. Determine the Modulus of Elasticity (E) of wood by conducting bending test

### References

1. Lab Manual for Mechanics Of Solids, Department of Mechanical Engineering, NSRIT

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Board of Studies (ME)

## PC 20ME308 ManufacturingProcesses Lab

**0 0 3 1.5**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | |
|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PO4 |
| 20ME308.1 | Test the properties of molding | 1 | 2 | 1 | 1 |
| 20ME308.2 | Fabricate joints using gas welding and arc welding | 1 | 2 | 1 | 1 |
| 20ME308.3 | Perform injection molding studies on plastics. | 1 | 2 | 2 | 1 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

### List of Experiments

1. To Make on Taper Section under Pattern Making
2. To Make on I-Section under Pattern Making
3. To Make on Stepped Cone Pulley
4. To Make on lap Joint under Arc Welding
5. To Make on Butt Joint under Arc Welding
6. To Make on Spot welding under Arc Welding
7. To Make on Taper Section under Casting Making
8. To Make on Taper Section under Casting Making
9. To Make on Stepped cone pulley under Casting Making
10. To Make on Injection Molding.

### References

2. Lab Manual for Manufacturing Process Lab, Department of Mechanical Engineering, NSRIT

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Board of Studies (ME)

## SC 20MES01 Computer Aided Modelling 1 0 2 2

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | |
|---|---|---|---|---|---|
| | | PO1 | PO5 | PO10 | PSO1 |
| 20MES01.1 | Recollect the various part designs with 2D and 3D tools | 3 | 2 | 2 | 1 |
| 20MES01.2 | Elucidate 3D tools and various assemblies with different approaches | 3 | 2 | 2 | 1 |
| 20MES01.3 | Develop automotive parts and assemblies with various sheet metal parameters and constraints. | 3 | 3 | 2 | 2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**Unit I: Part Design** **09 Hours**

Importance of 3d modelling and views associated with 3d models, Conversion of Sketches to 3d models by Material Add and Remove, Associating views and drawing sketch to obtain the final 3d models, Make use of reference elements like point, Line, Plane, Sketch based features like Extrude, Revolve, Sweep, Multi section solids, Dress up features like Fillets, Chamfers, Patterns, Transformation features like Move, Copy, Rotate, Mirror, Symmetry, Adding materials properties for 3d models, Using dynamic sectioning features and output features, Draft analysis for created models and measure the inertia and weight, Following proper tree structure for creating the products, Boolean operations.

**Unit II: Assembly** **09 Hours**

Clear explanation over Top down & Bottom up assemblies, creating individual parts and making them Assemble by using any of the Assembly pattern, Inserting parts and giving constraints between parts, Sub assemblies creations, Creating views of the final assembly on drafting sheet, Creating front view side view and top view & Isometric view of Assembly, Creating dimensions, part numbers, Bill of materials, Title block creation and Broken, auxiliary views creation, About Shape Design in automobile industries, Introduction to types of Surfaces in a automobile parts, A B & C Surfaces in automotive parts, Plastic Features in automobile vehicles, Premastering of products

**Unit III: Generative Sheet Metal Design** **09 Hours**

Sheet metal parameters and application in industries, Creating sheet metal walls and flanges, Bending for the created sheets, Views management and Sheet metal properties, Advanced sheet metal operations, Sheet metal cutting & Stamping operations, Rolled surfaces for sheet, Drafting the folded and Unfold views, Sheet metal features in automotive vehicles

### Experiments List

1. Show 2D tools and toolbars in interface with view tool bar, operation tool bar, specification tree
2. Demonstrate 3D tools and toolbars in interface with sketch based, dress up, transformation, annotation features.
3. Identify materials for different part designs
4. Explain graphic property tools and toolbar in part design
5. What is assembly design bottom up approach?
6. Demonstrate space analysis, constraints and move properties in assembly design
7. Experiment with product structure tools by considering any mechanical component or assembly
8. Translate DMU kinematics to DMC generic animation
9. Construct an part by using sheet metal parameters with elaborate demonstration in specification tree
10. Make use of sheet metal formation in BIW concept

### Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 20 | 30 |
| L2 | 40 | 30 |
| L3 | 40 | 40 |
| Total (%) | 100 | 100 |

**Sample Questions of Various Cognitive Level**

**L1: Remember**

1. Show 2D tools and toolbars in interface with view tool bar, operation tool bar, specification tree.
2. What is assembly design bottom up approach?

**L2: Understand**

1. Demonstrate 3D tools and toolbars in interface with sketch based, dress up, transformation, annotation features.
2. Explain graphic property tools and toolbar in part design.
3. Demonstrate space analysis, constraints and move properties in assembly design.
4. Translate DMU kinematics to DMC generic animation.

**L3: Apply**

1. Identify materials for different part designs.
2. Experiment with product structure tools by considering any mechanical component or assembly.
3. Construct an part by using sheet metal parameters with elaborate demonstration in specification tree
4. Make use of sheet metal formation in BIW concept. Make use of sheet metal formation in BIW concept.

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## MC 20MCX02 Constitution of India

**2 0 0 0**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | DoK |
|---|---|---|---|---|---|
| | | PO1 | PO2 | PO12 | |
| 20MCX02.1 | Summerizing the basic features and modalities aboutIndian Constitution | 3 | 3 | 1 | L1 |
| 20MCX02.2 | Identify the Indian Federalism and Panchayath Raj systems in Indian Constitution | 3 | 3 | 1 | L1 |
| 20MCX02.3 | Identify theLegislature and Judiciary systems in Indian Constitution | 3 | 3 | 1 | L2 |
| 20MCX02.4 | Interpreting the political system that exists in India | 3 | 3 | 1 | L1, L2 |
| 20MCX02.5 | Categorising the contemporary issues in global politics and Election commission in India | 3 | 3 | 1 | L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

### Unit I: Indian Constitution — 10 Hours

Meaning of the Indian Constitution, Historical Background of the Constituent Assembly, Government of India Act of 1935 and Indian Independence Act of 1947, Indian Constitution and its Salient Features, The role of B. R. Ambedkar in the making of the Indian Constitution,The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System, Centre-State Relations, Amendment of the Constitutional,The Historical Perspectives of the Constitutional Amendments in India, Emergency Provisions: National Emergency, President Rule, Financial Emergency and Local Self Government – Constitutional Scheme in India.

### Unit II: Indian Federalism — 10 Hours

Meaning and Definition of Federalism, Structure and Features of Indian Federalism, Difference between Indian and Federation of other States, Difference between Federal and Unitary Features, Critical Evaluation of the Indian Federal System, Decentralisation of Powers, Centre-State Relations, 73rd Amendment, Panchayath Raj Institutions.

### Unit III: Union Government — 10 Hours

Powers of Indian Parliament, Functions of Rajya Sabha and Lok Sabha, Powers and Functions of the President, Powers and Functions of the Prime Minister. Judiciary – The Independence of the Supreme Court, Appointment of Judges, Judicial Review, Public Interest Litigation, Lok Pal and Lok Ayukta, The Lokpal and Lokayuktas Act 2013.

### Unit IV: Challenges to Indian Political System — 10 Hours

Caste: A General Overview of the Indian Scenario,The Caste Issues in the Pre Independence Period, Gandhi Ambedkar Debate and the Poona Pact.The Politics of Caste in the Post Independence Period, Mandal Commission Reservation Policy in Government Jobs.The History of Communalism in India, The Concept of Terrorism and its Emergence in the Global Phenomenon since the End of Cold War.

### Unit V: India's External Relations and Election Commission10 Hours

Cold War and Post Cold War Era, Foreign Policy, Indian and its Neighbours, India's Extended Neighbourhood in West Asia and South East Asia. India's Relations with the United States and Russia, India and the World Organisations, India in the 21st Century. Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission, Functions of Commissions for the welfare of SC/ST/OBC and women.

### Text Books

1. Austin G., "Working of a Democratic Constitution of India", Oxford University Press, New Delhi, 2004
2. Basu D. D., "An Introduction to the Constitution of India", Prentice Hall, New Delhi, 2005

3. Chandhoke N. and Priyadarshini, "Contemporary India: Economy, Society, Politics", Oxford University Press, New Delhi, 2009
4. Jayal N. G. and Mehta P. B., Oxford Companion to Indian Politics", Oxford University Press, New Delhi, 2010
5. Vanaik A. and Bhargava R. "Understanding Contemporary India: Critical Perspectives", Orient Blackswan, New Delhi, 2010

**Reference Books**

1. Noorani A. G., "Constitution Questions in India: The President, Parliament and the States", Oxford University Press, New Delhi, 2000
2. Chakravarthy B. and Pandey K. P., "Indian Government and Politics", Sage Publications, New Delhi, 2006
3. Bajpai. Kanti and Pant V. Harsh, "India's Foreign Policy: A Reader", Oxford University Press, New Delhi, 2013
4. Laxmikanth M., "Indian Polity for Civil Services Examinations", Tata McGraw Hill, New Delhi, 2016
5. Singh M. P. and Saxena R., "Indian Politics: Contemporary Issues and Concerns", PHI Learning, New Delhi, 2008

**Web References**

1. https://en.wikipedia.org/wiki/Federalism.in.India
2. https://legislative.gov.in/constitution-of-india
3. https://en.wikipedia.org/wiki/Foreign_relations_of_India
4. https://en.wikipedia.org/wiki/Government_of_India

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Board of Studies (ME)

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology (A)
Visakhapatnam-531173

## HS 20HSX03 Managerial Economics and Financial Analysis 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs PO11 | PO12 | DoK |
|---|---|---|---|---|
| 20HSX03.1 | Understand the theoretical concepts of managerial economics to make decisions for business problems | 3 | 1 | L1, L2 |
| 20HSX03.2 | Gain adequate theoretical knowledge on microeconomics concepts to perform successful business operations | 3 | 1 | L1, L2 |
| 20HSX03.3 | Understand the basic accounting principles and capital formation and planning | 3 | 1 | L1, L2 |
| 20HSX03.4 | Apply accounting concepts to analyze financial strength of business | 3 | 1 | L3, L4 |
| 20HSX03.5 | Gain theoretical knowledge on the entrepreneurship management and types of firms | 3 | 1 | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

### Unit I: Introduction to Managerial Economics and Demand Analysis 9 Hours

Definition of Managerial Economics – Scope of Managerial Economics and its Relationship with other Subjects – Concept of Demand, Types of Demand, Determinants of Demand- Demand Schedule, Demand Curve, Law of Demand and its Limitations- Elasticity of Demand, Types of Elasticity of Demand and Measurement - Demand Forecasting and Methods of Forecasting.

*Role of Managerial Economist, Law of Supply*

### Unit II: Production and Cost Analysis 9 Hours

Theory of Production: Meaning and Factors of Production, Production Function with One Variable Input (Law of Variable Proportion), With Two Variable Inputs (Law of Returns to Scale) Theory of Cost: Different Cost Concepts and Different Relations between Cost and Output in Short Run and Long Run. Managerial uses of Revenue and Cost Concepts Break-Even Point). Pricing Strategies.

*Economies of Scale and Diseconomies of Scale*

### Unit III: Introduction to Accounting and Financial Planning 9 Hours

Financial Accounting - Concepts and Conventions – Double Entry System – Preparation of Journal, Ledger and Trial Balance – Preparation of Final Accounts: Trading, Profit and Loss Account and Balance Sheet.
Capital and Capital Budgeting: Capital Budgeting: Meaning of Capita l - Capitalization - Meaning of Capital Budgeting - Time Value of Money - Methods of Appraising Project Profitability - Traditional Methods and Modern Methods.

*Branches of Accounting, Concept of Working Capital*

### Unit IV: Financial Analysis through ratios 9 Hours

Computation, Analysis and Interpretation of Liquidity Ratios (Current Ratio and Quick Ratio), Activity Ratios (Inventory Turnover Ratio and Debtor Turnover Ratio), Capital Structure Ratios (Debt - Equity Ratio, Interest Coverage Ratio) and Profitability Ratios (Gross Profit Ratio, Net Profit Ratio,Operating Ratio, P/E Ratio and EPS).

*Cash Flow Statement and Funds Flow Statement (Theory Only)*

### Unit V: Introduction of Entreprenuership and New Economic Environment 9 Hours

Definition of Entrepreneur and Entreprenuership, Internal and External Factors; Types of Entrepreneurs; Classification of Entrepreneurship.
Characteristic Features of Business, Features and Evaluation of Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises, Changing Business Environment in Post - Liberalizations Scenario.

*Industrial Policy 1991*

### Text Books

1. Appa Rao N., Vijay Kumar P., "Managerial Economics and Financial Analysis", Cengage Publications, New Delhi, 2011
2. Siddiqui S. A. and Siddiqui A. S., "Managerial Economics and Financial Analysis", New Age International Publishers, 2012
3. Kuberudu B. and Ramana T. V., "Managerial Economics and Financial Analysis", Himalaya Publishing House, 2014
4. Aryasri A. R., "Managerial Economics and Financial Analysis", Tata Mcgraw Hill, 2011

### Reference Books

5. Maheswari V., "Managerial Economics", Sultan Chand, 2014
6. Suma Damodaran, " Managerial Economics", Oxford, 2011
7. Varitha Agarwal, " Managerial Economics", Pearson Publications, 2011
8. Sanjay Dhameja, "Financial Accounting for Managers", Pearson Publications, 2011
9. Maheswari V., "Financial Accounting", Vikas Publications, 2012
10. Dominick Salvatore, "Managerial Economics: Principles and World Wide Application", 7th Edition, Oxford University Press, 2012

### Web References

1. https://btechgeeks.com/mefa-notes/#google_vignette
2. https://www.smartzworld.com/notes/managerial-economics-and-financial-analysis-pdf-notes-mefa
3. https://www.scribd.com/document/259129127/Mefa-course-plan
4. https://www.coursera.org/browse/business/entrepreneurship

### Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 40 | 40 |
| L2 | 20 | 20 |
| L3 | 20 | 20 |
| L4 | 20 | 20 |
| Total (%) | 100 | 100 |

### Sample Short and Long Answer Questions of Various Cognitive Levels

#### L1: Remember

6. What is Managerial Economics?
7. What is meant by Elasticity of demand? How do you measure it?
8. Define different product curves
9. Define Accounting
10. Define Partnership

#### L2: Understand

5. Explain the role of a Managerial Economist in a Business firm
6. Explain the concept cross elasticity of demand. Illustrate your answer with suitable examples
7. Explain the formation of a Joint Stock Company
8. Distinguish between a partnership and a joint stock company
9. Explain accounting principles

#### L3: Apply

1. Journalise the following transactions

| | |
|---|---|
| 2013 Jan 1st | ABC Firm commenced business with Rs.40000 |
| Jan 2nd | Deposited into bank Rs.30000 |
| Jan 3rd | Bought goods worth Rs.48000 from Kamala |
| Jan 4th | Sold goods worth Rs.60000 |

2. Calculate Net Profit Ration from the following data
   Sales returns Rs.100000 — Administration expences Rs.10000
   Gross Profit Rs.40000 — Selling expences Rs.10000
   Incolne from investment Rs.5000 — Loss on account of fire Rs.3000
3. From the following particulars findout
   Selling price Rs.200 per unit
   Variable cost Rs.100 per unit
   Total fixed cost Rs.96000
   i) Break even units and values
   ii) Sales to earn a profit Rs.20000
4. The following are the Ratios related to XYZ Limited company.
   Inventory holding period 2 months
   Gross profit ration 25 %
   Gross profit for the current year announced Rs.200000
   Closing stock is excess of Rs 40000 over opening stock. Findout
   A) Sales
   B) Cost of goods sold
   C) Closing stock
   D) Opening stock

**L4: Analyze**

1. A Project cost is Rs.144000. The average annual cash inflows are likely to be Rs.45000 for a period of 5 Years calucalte IRR for the project
2. The cost of project is Rs.50000 The annual cash iunflows for the next 4 years are Rs.25000 what is the PBP for the project
3. A firm is considering two different investment options A & B detailes of both the options are given below (Rs, in Lakhs)

| | Investment cost | Inflow 1 | Inflow 2 | Inflow 3 |
|---|---|---|---|---|
| Option A | (25) | 10 | 10 | 12 |
| Option B | (40) | 15 | 20 | 24 |

4. ARR method (ARR on original investment)
   Inintial investment Rs.1200000

| Year | Cashinflows (Rs) | |
|---|---|---|
| | Project A | Project B |
| 1 | 600000 | 500000 |
| 2 | 500000 | 300000 |
| 3 | 200000 | 200000 |
| 4 | - | 300000 |

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Board of Studies (ME)

Head of the Department
Mechanical Engineering
R.V.R. & J.C. College of Engineering
Vishakhapatnam-531173

## ES 20CS403 Python Programming 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs PO1 | PO12 | DoK |
|---|---|---|---|---|
| 20CS403.1 | Illustrate the use of basic concepts of Python Programming | 3 | 1 | L1, L2 |
| 20CS403.2 | Demonstrate the use of control Structures and Data Structures in Python | 3 | 1 | L1, L2 |
| 20CS403.3 | Build programs using functions for resolving simple problems | 3 | 1 | L1, L2 |
| 20CS403.4 | Explain the usage of Object oriented concepts and files | 3 | 1 | L1, L2 |
| 20CS403.5 | Apply mathematical libraries for analyzing data sets with GUI | 3 | 1 | L1, L2 |

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: CreateDoK: Depth of Knowledge

### Unit I: Introduction 9 + 3 Hours

Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Keywords, Reading Input from the Keyboard, Performing Calculations

Operators:Arithmetic Operators, Comparison (Relational) Operators, Bitwise Operators, Logical Operators, Assignment Operators, Membership Operators, Identity Operators, Type Conversions, Expressions, More about Data Output.

*More about Data Output*

### Unit II: Control Statements, Data Structures and Strings 9 + 3 Hours

Control Statements: If, if-Else, For, While, Break, Continue, Pass

Data Structures: List, Tuples, Sets, Dictionaries, Sequences, List Comprehension

Strings: String Formatting, Accessing Character and Substring in Strings, Data Encryption, Strings and Number Systems, String Methods

*More about While, Continue*

### Unit III: Functions and Modules 9 + 3 Hours

Functions: Defining Simple Functions, Functions as Abstraction Mechanisms, Problem Solving with Top - Down Design, Design with Recursive Functions, Case Study Gathering Information from a File System, Managing a Program's Namespace, Higher Order Function.

Modules: Creating Modules, Import Statement, From. Import Statement, Name Spacing, Builtin Modules - Os, Random, Math, Cmath, Pprint, Json, Request, Date, Regex.

Packages: Introduction to PIP, Installing Packages using PIP.

*More Programs using Functions*

### Unit IV: File Operations and OOPs 9 + 3 Hours

File Operations: Reading Config Files In Python, Writing Log Files In Python, Understanding Read Functions, Read(), Readline() and Readlines(), Understanding Write Functions, Write() and Writelines(), Manipulating File Pointer using Seek, Programming using File Operations.

Object Oriented Programming: Concept of Class, Object and Instances, Constructor, Class Attributes and Destructors, Real Time use of Class in Live Projects, Inheritance, Overlapping and Overloading Operators, Adding and Retrieving Dynamic Attributes of Classes, Programming using OOPs Support.

Design with Classes: Objects and Classes, Data Modeling Examples, Case Study on ATM, Structuring Classes with Inheritance and Polymorphism.

*Case Study on Library*

**Unit V** **9 + 3 Hours**

Graphical User Interfaces: The Behavior of Terminal Based Programs and GUI -Based, Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources. Programming: Introduction to Programming Concepts with Scratch.
Mathematical Libraries: NumPy, SciPy, Sympy, Pandas, StatsModels, Matplotlib and Gnuplot.

*Other Useful GUI Resources*

### Text Books

1. Kenneth A. Lambert, " Fundamentals of Python First Programs", 1st Edition, Cengage Learning, Inc., 2017
2. Vamsi Kurama, "Python Programming: A Modern Approach", 1st Edition, Pearson Education, 2018
3. Mark Lutz, "Learning Python", 1st Edition, Orielly, 2019

### Reference Books

1. Gowrishankar S., Veena A., "Introduction to Python Programming", CRC Press, 2019
2. Daniel Liang Y., "Introduction to Programming Using Python", 1st Edition, Pearson, 2012
3. Allen Downey, "Think Python", 2nd Edition, Green Tea Press, 2017
4. Chun W., "Core Python Programming", 2nd Edition, Pearson, 2006

### Web References

1. https://www.tutorialspoint.com/python3/python_tutorial.pdf

### Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 50 | 50 |
| L2 | 50 | 50 |
| Total (%) | 100 | 100 |

### Sample Short and Long Answer Questions of Various Cognitive Levels

#### L1: Remember

1. What is the difference between list and tuples in Python?
2. What are the key features of Python?
3. What type of language is python?
4. How is Python an interpreted language?
5. What is pep 8?

#### L2: Understand

1. Give a comparison between lists, tuples, dictionaries and sets
2. Explain about methods in Lists of Python with appropriate examples
3. Explain the operators in python with appropriate examples
4. Explain how to implement inheritance in Python
5. Explain modules and Packages

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Board of Studies (ME

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology
Visakhapatnam-531173

PC **20ME403 Kinematics of machinery** 3 1 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | DoK |
|---|---|---|---|---|---|---|
| | | PO2 | PO3 | PO12 | PS01 | |
| 20ME403.1 | Identify different principles and inversions of planar mechanisms. | 1 | 1 | 1 | 1 | L3 |
| 20ME403.2 | Model lower pair mechanisms | 1 | 1 | 1 | 1 | L3 |
| 20ME403.3 | Illustrate velocity and acceleration diagrams in plane motion of a body. | 2 | 1 | 1 | 1 | L2 |
| 20ME403.4 | Choose cam, follower profiles with various motion-displacement principles. | 2 | 2 | 1 | 1 | L3 |
| 20ME403.5 | Build the higher pairs mechanisms | 2 | 1 | 1 | 1 | L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

**UNIT – I: Mechanisms** **11 + 1 Hour**

Mechanisms: Elements or Links, classification, rigid Link, flexible and fluid link. Types of kinematic pairs, sliding, turning, rolling, screw and spherical pairs, lower and higher pairs, closed and open pairs, constrained motion, completely, partially or successfully constrained and incompletely constrained. Grubbers criterion , Grashoff's law , Degrees of freedom, Kutzbach criterion for planar mechanisms, Mechanism and machines, classification of machines, kinematic chain, inversion of mechanism, inversion of mechanism, inversions of quadric cycle, chain, single and double slider crank chains.

*Problems on Degrees of freedom and inversion mechanisms*

**UNIT – II: Lower pair Mechanism** **11 + 1 Hour**

Lower Pair Mechanism: Exact and approximate copiers and generated types, Peaucellier, Hart and Scott Russell, Grasshopper, Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph. Conditions for correct steering, Davis Steering gear, Ackerman's steering gear, velocity ratio; Hooke's Joint: Single and double, universal coupling, application, problems.

*Problems on steering gear mechanism.*

**UNIT – III: Plane motion of body** **11 + 1 Hour**

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 for a given mechanism, Kleins construction, Coriolis acceleration.

Plane motion of body: Instantaneous centre 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.

*Determination of Coriolis component of acceleration.*

**UNIT – IV: Cams, follower and belt drives** **11 + 1 Hour**

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 3 cases. Analysis of motion of followers: Roller follower – circular cam with straight, concave and convex flanks.

Power Transmissions : Introduction, Belt and rope drives, selection of belt drive- types of belt drives, belts, materials used for belt and rope drives, velocity ratio of belt drives, slip of belt, creep of belt, tensions for flat belt drive, angle of contact, centrifugal tension, maximum tension of belt, Chains- length, angular speed ratio, classification of chains.

*Maximum velocity and acceleration, displacement analysis.*

**UNIT – V: Gears** **11 + 1 Hour**

Gears: Higher pairs, friction wheels and toothed gears–types, law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloid and involutes profiles. 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.

Introduction to gear Trains, Train value, types, simple and reverted wheel train. Epicyclical gear Train. Methods of finding train value or velocity ratio. Epicyclical gear trains.

*Selection of gear box-Differential gear for an automobile.*

**Text Books:**

1. Jagadeesh lal, Theory of Mechanisms & Machines by, Metropolitan Pvt. Ltd- 15th Edition-2015
2. Thomas Bevan, Theory of Machines, CBS Publishers- 13th Edition-2014
3. Rattan S.S, Theory of Machines, TMH Publishers- 10th Edition-2011
4. Vickers, Theory of machines and Machinery, Oxford- 12th Edition-2017

**References:**

1. Sadhu Singh, Theory of Machines, Pearsons Education Publications- 10th Edition-2011
2. Ghosh.A & Malik.A.K, Theory of Mechanisms and machines, East West Press Pvt. Ltd- 13th Edition-2013
3. Ashok G. Ambekar, Mechanism and Machine Theory, PHI Publishers- 12th Edition-2012
4. J.J Uicker, G.R.Pennock & J.E.Shigley, Theory of machines and Mechanisms, Oxford publishers- 5th Edition-2015

**Web References:**

1. https://nptel.ac.in/courses/112/104/112104121/
2. https://nptel.ac.in/courses/112/105/112105268/

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 30 | 20 |
| L2 | 30 | 40 |
| L3 | 40 | 40 |
| Total (%) | 100 | 100 |

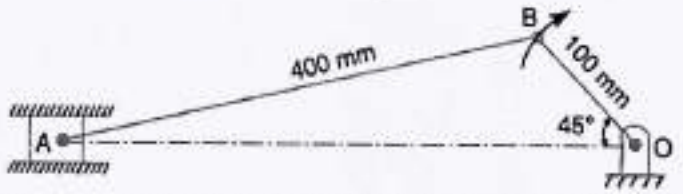
**Sample Questions of Various Cognitive Levels**

**L1: Remember**

3. In a crank and slotted lever quick return motion mechanism, the distance between the fixed centers is 240 mm and the length of the driving crank is 120 mm. Find the inclination of the slotted bar with the vertical in the extreme position and the time ratio of cutting stroke to the return stroke. If the length of the slotted bar is 450 mm, find the length of the stroke if the line of stroke passes through the extreme positions of the free end of the lever.
4. What is Kutzback's criterion for degree of freedom of plane mechanisms? In what way is Gruber's criterion different from it?
5. Explain double slider crank chain mechanism and its inversion with neat diagrams.
6. How to determine coriolis acceleration component and which cases it occurs?

**L2: Understand**

1. Explain with a neat sketch, Pantograph mechanism. State its applications.
2. Draw a neat sketch of the Scott Russell's mechanism, and explain its working. How this mechanism can be modified to produce Grasshopper mechanism
3. Locate all the instantaneous centres of the slider crank mechanism as shown in Figure. the lengths of crank OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s, find: 1. Velocity of the slider A, and 2. Angular velocity of the connecting rod AB.




4. An engine mechanism, the crank CB = 100 mm and the Connecting rod BA = 300 mm with centre of gravity G, 100 mm from B. In the position shown, the crankshaft has a speed of 75 rad/s and an angular acceleration of 1200 rad/s². Find: 1. Velocity of G and angular velocity of AB, and 2. acceleration of G and angular acceleration of AB.


5. PQRS is a four bar chain with link PS fixed. The lengths of the links are PQ is 62.5 mm ; QR = 175 mm ; RS = 112.5 mm ; and PS = 200 mm. The crank PQ rotates at 10 rad/Sec clockwise. Draw the velocity and acceleration diagram when angle QPS = 60° and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of links QR and RS.
6. Use the following data in drawing the profile of a cam in which a knife-edged follower is raised with uniform acceleration and deceleration and is lowered with simple harmonic motion: Least radius of cam = 60 mm; Lift of follower = 45 mm; Angle of ascent = 60 degrees; Angle of dwell between ascent and descent = 40 degrees; Angle of descent = 75 degrees If the cam rotates at 180 rpm, determine the maximum velocity and acceleration during ascent and descent.
7. A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below :
   1. To raise the valve through 50 mm during 120° rotation of the cam ;
   2. To keep the valve fully raised through next 30°;
   3. To lower the valve during next 60°; and
   4. To keep the valve closed during rest of the revolution i.e. 150°. The diameter of the roller is 20 mm and the diameter of the cam shaft is 25 mm. Draw the profile of the cam when (a) the line of stroke of the valve rod passes through the axis of the cam shaft, and (b) the line of the stroke is offset 15 mm from the axis of the cam shaft. The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. Determine the maximum acceleration of the valve rod when the cam shaft rotates at 100 r.p.m. Draw the displacement, the velocity and the acceleration diagrams for one complete revolution of the cam.

**L3: Apply**

1. Shaft rotating at 200 rpm drives another shaft at 300 rpm and transmits 6 kW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4m. The smaller pulley is 0.5 m in diameter. Calculate the stress in the belt, if it is 1. An open belt drive and 2. A cross belt drive. Take $\mu = 0.3$.
2. A pinion with 24 involutes teeth of 150 mm pitch circle diameter drives a rack. The addendum of the pinion and rack is 6 mm. What is the least pressure angle which can be used if interference is to be avoided? Using this pressure angle, find the length of arc of contact and the number of teeth in contact.
3. Derive an expression for length of path of contact, length of arc contact and contact ratio for a pair of involutes gears in contact.
4. Derive an equation to determine the length of path of contact by a pair of mating spur gear.
5. Locate all the instantaneous centers of the slider crank mechanism as shown in Figure. The lengths of crank OB and connecting rod AB are 100 mm and 400 mm respectively. If the crank rotates clockwise with an angular velocity of 10 rad/s, find: 1. Velocity of the slider A, and 2. Angular velocity of the connecting rod AB.

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Board of Studies (ME)

## PC 20ME404 Fluid Mechanics & Hydraulic Machines 3 1 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | DoK |
|---|---|---|---|---|---|---|
| | | PO2 | PO3 | PO12 | PS01 | |
| 20ME404.1 | Classify the properties of fluid and study of fluid in static condition | 1 | 1 | 1 | 1 | L2 |
| 20ME404.2 | Interpret the dynamics of fluids and boundary layer conditions | 1 | 1 | 1 | 1 | L2 |
| 20ME404.3 | Demonstrate natural and forced convention using dimensional analysis | 2 | 1 | 1 | 1 | L2 |
| 20ME404.4 | Select the appropriate pump based on its working principle and operation | 2 | 2 | 1 | 1 | L3 |
| 20ME404.5 | Identify the performance and construction of various types of flow in turbines. | 2 | 1 | 1 | 1 | L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: Fluid Properties and Flow Characteristics** **11 + 1 Hours**

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity and Measurement of pressures. Flow characteristics, application of continuity equation, energy equation and momentum equation. Total Pressure and Centre pressure for Plane Surface. Buoyancy and Floating-buoyancy centre of buoyancy, Meta centre, Meta centric height, Condition of Equilibrium of floating and submerged bodies.

*Oscillation of a floating Body*

**UnitII:FlowthroughCircularConduits** **11 + 1 Hours**

Types of Fluid motion -Rate of flow, Continuity equation, Velocity and acceleration, Potential function and Vortex flow. Equation of motion-Euler's equation of motion, Bernoulli's equation, applications of Bernoulli's equation .Concept of control volume, energy equation and momentum equation .Hydraulic and energy gradient. Laminar flow through circular conduits and circular annuli Boundary layer concepts – types of boundary layer thickness. Darcy Weisbach equation, friction factor-minor losses. Flow through pipes in series and parallel.

*Free Liquid Jets, Orifice and Mouth piece*

**Unit III: Dimensional Analysis** **11 + 1 Hours**

Need for dimensional analysis, methods of dimensional analysis. Similitude, types of similitude, Dimensionless parameters, application of dimensionless parameters – Model analysis.

*Undistorted and distorted models*

**Unit IV: Pumps** **11 + 1 Hours**

Impact of jets - Theory of roto-dynamic machines, various efficiencies, velocity components at entry and exit of the rotor, velocity triangles. Centrifugal pumps, working principle, work done by the impeller, performance curves. Reciprocating pump, working principle, Rotary pumps, classification.

*Jet Propulsion of ships*

**Unit V: Turbines** **11 + 1 Hours**

Classification of turbines, Heads and efficiencies, velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines, working principles, work done by water on the runner, draft tube. Specific speed, unit quantities, performance curves for turbines, governing of turbines.

*Hydraulic Press and Hydraulic Accumulators*

**Text Books:**

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.
2. Bansal.R.K "Fluid Mechanics and Hydraulic Mchinary", 6th Edition, Laxmi Publications, 2005.

3. Dixon "Fluid Mechanics", 7th Edition ,Elesvier

**Reference Books:**

1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016
3. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery",Eurasia Publishing, 2011
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010

**Web References:**

1. https://www.nptel.ac.in/courses/112/104/112104118/
2. http://nptel.ac.in/courses/Webcourse-contents/IITKANPUR/machine/ui/Course_home-7.htm
3. http://nptel.ac.in/courses/112105162/9
4. http://www.slideshare.net/ArchieSecorata/fluid-mechanicsfundamentalsandapplications-by-cengel-cimbala-3rd-c2014-txtbk

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 60 | - |
| L2 | 40 | 40 |
| L3 | - | 60 |
| L4 | - | - |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Define Surface tension on a liquid droplet.
2. Define buoyancy.
3. Define dimensional analysis.
4. Define momentum thickness.

**L 2: Understand**

1. A U-tube is made of two capillaries of diameter 1mm and 1.5mm respectively. The tube is kept vertically and partially filled with water of surface tension 0.0736 N/m and zero contact angle. Calculate the difference in the levels of the menisci caused by the capillary
2. State Darcy-Weisbach equation OR What is the expression for head loss due to friction?
3. List the repeating variables used in Buckingham π theorem
4. Explain in detail about Specific speed of turbine & Type
5. Briefly explain about Cavitations in centrifugal pumps

**L 3: Applying**

**1.** A centrifugal pump with an impeller diameter of 0.4m runs at 1450rpm. The angle at outlet of the backward curved vane is 25° with tangent. The flow velocity remains constant at 3m/s. If the manometric efficiency is 84%. Determine the fraction of the kinetic energy at outlet recovered as static head.

**2.** A reaction turbine at 450 rpm, head 120 m, diameter at inlet 120 cm, flow area 0.4 m2 has angles made by absolute and relative velocities at inlet 20° and 60° respectively. Find volume flow rate, H.P and Efficiency.

3. Derive expression for the force exerted by the jet of water on a series of moving radial curved vanes mounted on a wheel. Also find the maximum efficiency.

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Board of Studies (ME)

Head of the Department
Mechanical Engineering
R.V.R. & J.C. Institute of Technology (A)
Venkhapuram-522019

## PC 20ME405 IC Engines and Gas Turbines

3 1 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | DoK |
|---|---|---|---|---|---|---|
| | | PO2 | PO3 | PO12 | PSO2 | |
| 20ME405.1 | Interpret the effect of various operating parameters in engine performance. | 3 | 1 | 1 | 1 | L2 |
| 20ME405.2 | Experiment with fuel metering and fuel supply for different IC engines | 3 | 1 | 1 | 1 | L3 |
| 20ME405.3 | Organize performance analysis of IC engines with normal and abnormal combustion phenomena. | 3 | 2 | 1 | 1 | L3 |
| 20ME405.4 | Contrast the effects of conventional and non-conventional fuels for IC engines. | 3 | 2 | 1 | 1 | L2 |
| 20ME405.5 | Develop the performance characteristics of gas turbines | 3 | 1 | 1 | 1 | L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

**Unit–I:AirstandardCycles&ActualCyclesandAnalysis** **11+1Hours**

Introduction of air standard cycles Otto, diesel and dual cycles, its comparison. Comparison of Air Standard and Actual Cycles, Introduction to IC Engines, Time Loss Factor, Heat Loss Factor, Exhaust & Blow down-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines

**Unit–III:I.C.Engines** **11+1Hours**

I.C. Engines : Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems – Fuel, Carburetor, Fuel Injection System, Ignition, Cooling and Lubrication, principles of supercharging and turbo charging

**Unit–III:CombustioninS.I.andC.I.Engines** **11+1Hours**

Combustion in S.I. Engines : Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Types of Abnormal combustion, pre-ignition and knocking (explanation of ) – 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 – IV : Measurement, Testing and Performance** **11+1Hours**

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 and chart

**Unit–V:GasTurbines,JetPropulsions&Rockets** **11+1Hours**

Brayton cycle,Simple gas turbineplant– ideal cycle, essential components– parameters of performance– actual cycle – regeneration,inter cooling and reheating – closed cycle type gas turbines, merits and demerits, types of combustion chambers. Jet propulsions,Principle of operation –classification of jet propulsive engines – working principles with schematic diagrams and representation on t-sdiagram-thrust,thrustpowerandpropulsionefficiency–turbojetengines,thermodynamiccycle,performanceevaluation(Definitionsand Simple Problems). Rocketsworking principle – classification – propellant type – thrust, propulsive efficiency – specific impulse –solidandliquidpropellantrocketengines(onlyTheoreticalconcepts)

**TextBooks:**

1. Heywood J.B, I.C.Engines Fundamentals,10th Edition, TMH Publications, 2015
2. Ganesan. V, I.C.Engines, 15th Edition, TMH Publications., 2017
3. Pathak G.K. &DKChevan, I.C.Engines, 9th Edition, Standard Publications, 2011
4. Rajput R.K, Thermal Engineering, 10th Edition, TMH Publications, 2015

**References:**

1. Fergnson & Wiley, I.C.Engines, 7th Edition, Cengage Publications, 2012
2. Teylor, The I.C.EngineintheoryandPractice, Vol.I, 2018
3. Ramadhas A.S., AlternativeFuelsforTransportation, 10th Edition, S. Chand Publications, 2019

**Web References:**

1. https://books.google.co.in/books/about/Internal_Combustion_Engines.html
2. https://www.expresslibrary.mheducation.com/product/ic-engines50044944

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 30 | 20 |
| L2 | 30 | 40 |
| L3 | 40 | 40 |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Define the phenomenon Knocking in spark ignited engines?
2. What are assumptions made in air standard cycles?
3. What is meant by delay period?
4. Define Volumetric efficiency?
5. Define Mean effective pressure?
6. What is meant by abnormal combustion?
7. What do you mean by performance of IC engine?
8. List out the main parts of a CI & SI engine?

**L2: Understand**

1. Explain its importance for calculation o f volumetric efficiency in the performance test?.
2. List the different methods used for finding friction power and indicated power of an engine ,Explain in detail.?
3. Explain normal and abnormal combustions in SI engine?
4. Explain the phenomenon of knock in SI engine. Discuss the effect of engine variables on knock?
5. Discuss about Exhaust Blow down and Loss due to Gas exchange process.
6. What is ignition lag? Explain the factors effecting ignition lag?

**L3: Apply**

1. Determine the process of evaluating indicated power of an IC engine?
2. Compare actual cycle and air standard cycle of SI engine?
3. The following data was recorded during testing of a 4-stroke cycle gas engine, Diameter= 10 cm, Stroke= 10 cm, Speed= 1200 rpm, Area of the positive loop of the indicator diagram=5.75 cm2 . Area of the negative loop of the indicator diagram=0.25 cm, Length of the indicator diagram= 55 mm, Spring constant= 3.5 bar/cm. Find the indicated power of the engine.
4. Discuss the various methods for measurement of brake power?
5. Does the flame front exist in a C.I. engine? Explain
6. A test on a single-cylinder, four-stroke oil engine having a bore of 15 cm and stroke 30 cm gave the following results; speed 300 rpm; brake torque 200 Nm; indicated mean effective pressure 7 bar; fuel consumption 2.4 kg/h; cooling water flow 5 kg/min; cooling water temperature rise 350C; air-fuel ratio 22; exhaust gas temperature 4100C; barometer pressure 1 bar; room temperature 200C. The fuel has a calorific value of 42 MJ/kg and contains 15% by weight of hydrogen. Take latent heat of vaporization as 2250 kJ/kg. Determine: (i) The indicated thermal efficiency. (ii) The volumetric efficiency based on atmospheric conditions. Draw up a heat balance in terms of kJ/min. Take Cp for dry exhaust gas = 1 kJ/kgK and super-heated steam Cp = 2.1 kJ/kgK; R = 0.287kJ/kgK.?

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**Board of Studies (ME)**

Head of the Department
Mechanical Engineering
R.S. Rai Institute of Technology (A)
Visakhapatnam-531173

## PC 20ME406 Fluid Mechanics and Hydraulic Machinery Lab 0 0 3 1.5

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with Pos | | |
|---|---|---|---|---|
| | | PO1 | PO2 | PO4 |
| 20ME406.1 | Find the forces of water jet striking on various types of vanes | 3 | 2 | 2 |
| 20ME406.2 | Evaluate the performance Pelton Wheel | 3 | 2 | 2 |
| 20ME406.3 | Evaluate the performance Francis Turbine | 3 | 2 | 2 |
| 20ME406.4 | Evaluate the performance Kaplan Turbine | 3 | 2 | 2 |
| 20ME406.5 | Evaluate the performance Single Stage Centrifugal Pump | 3 | 2 | 2 |
| 20ME406.6 | Evaluate the performance on Multi Stage Centrifugal Pump | 3 | 2 | 2 |
| 20ME406.7 | Evaluate the performance Reciprocating Pump | 3 | 2 | 2 |
| 20ME406.8 | Compare the accuracy of Venturimeter | 3 | 2 | 2 |
| 20ME406.9 | Compare the accuracy of Orifice | 3 | 2 | 2 |
| 20ME406.10 | Find the Friction Factor of given pipe. | 3 | 2 | 2 |
| 20ME406.11 | Find the Loss of Head Factor of given pipe. | 3 | 2 | 2 |
| 20ME406.12 | Calculate the Coefficient of Discharge of Flow Meter | 3 | 2 | 2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember| L2: Understand |L3: Apply |L4: Analyze|L5: Evaluate| L6: Create, DOK: Depth of Knowledge

### 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.

### References

3. Lab Manual for Fluid mechanics and hydraulic machinery, Department of ME

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## PC 20ME407Thermal Engineering Lab

0 0 3 1.5

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with Pos | | |
|---|---|---|---|---|
| | | PO1 | PO4 | PS02 |
| 20ME407.1 | Interpret the effect of various operating parameters in engine performance. | 3 | 1 | 1 |
| 20ME407.2 | Experiment with fuel metering and fuel supply for different IC engines | 3 | 1 | 1 |
| 20ME407.3 | Organize performance analysis of IC engines with normal and abnormal combustion phenomena. | 3 | 2 | 1 |
| 20ME407.4 | Contrast the effects of conventional and non conventional fuels for IC engines. | 3 | 2 | 1 |
| 20ME407.5 | Develop the performance characteristics of gas turbines | 3 | 1 | 1 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

### List of Experiments

1. I.C. Engines valve and port timing diagrams
2. Testing of Fuels – Viscosity, flash point, fire point, carbon residue, calorific value.
3. I.C. Engine performance test and Exhaust emission measurements (4 -stroke High Speed diesel engine)
4. I.C. Engine performance test and Exhaust emission measurements (4 -stroke Low Speed diesel engine)
5. Evaluation of friction power by conducting Morse test on 4-stroke multi cylinder engine.
6. Determination of Friction Power by retardation test on IC engine.
7. I.C. Engine heat balance at different loads and show the heat distribution curve.
8. Economical speed test of an IC engine.
9. Estimation of steam quality by throttling and separating calorimeter
10. Performance test on reciprocating air compressor unit.
11. Dis-assembly / assembly of different parts of two wheelers. 3 wheelers & 4 wheelers. Tractor & Heavy duty engines covering 2-stroke and 4 stroke, SI and CI engines.

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Mechanical Engineering
N.S. Raju Institute of Technology (Autonomous)
Visakhapatnam-530 041

**PC** **20CS407Python Programming Lab** **0 0 3 1.5**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs PO4 |
|---|---|---|
| 20CS407.1 | Make use of Control Structures in Python Programming | 3 |
| 20CS407.2 | Create Programs using Functions | 3 |
| 20CS407.3 | Build the Programs using OOPs principles | 3 |
| 20CS407.4 | Make use of functions to draw turtle graphics | 3 |
| 20CS407.5 | Develop the programs using MatPlotlib library | 3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

**List of Experiments**

1. a. Write a program that asks the user for a weight in kilograms and converts it to pounds
   b. Write a program to find total and average of 3 numbers
   c. Write a program that uses a for loop to print the numbers 8, 11, 14, 17, 20, . . . , 83, 86, 89

2. a. Write a program that should print out the user's name the specified number of times

b. Use for loop to print a triangle like the one below. Allow the user to specify how high the triangle should be

c. Generate a random number between 1 and 10. Ask the user to guess the number and print a message based on whether they get it right or not

3. a. Write a program that asks the user for two numbers and prints Close if the numbers are within .001 of each other and Not close otherwise

b. Write a program that asks the user to enter a word and prints out whether that word contains any vowels

c. Write a program that asks the user to enter two strings of the same length. If they are not, the program should print an appropriate message and exit

4. a. Write a program that asks the user for a large integer and inserts commas into it according to the standard American convention for commas in large numbers

b. Write a program that asks the user for an algebraic expression and then inserts multiplication symbols where appropriate

5. Write a program that generates a list of 20 random numbers between 1 and 100.
   Print the list.
   a. Print the average of the elements in the list.
   b. Print the largest and smallest values in the list.
   c. Print the second largest and second smallest entries in the list
   d. Print how many even numbers are in the list

6. a. Write a program that asks the user for an integer and creates a list that consists of the factors of that integer

b. Write a program that generates 100 random integers that are either 0 or 1. Then find the longest run of zeros, the largest number of zeros in a row

c. Write a program that removes any repeated items from a list so that each item appears at most once. For instance, the list [1,1,2,3,4,3,0,0] would become [1,2,3,4,0]

7. Write a function called sum digits that is given an integer num and returns the sum of the digits of numbers

8. a. Write a function called root that is given a number x and an integer n and returns x1/n. In the function definition, set the default value of n to 2

b. Write a function called primes that is given a number n and returns a list of the first n primes. Let the default value of n be 100

c. Write a function called merge that takes two already sorted lists of possibly different lengths, and merges them into a single sorted list: i.Do this using the sort method ii. Do this without using the sort method

9. a. Write a program that reads a file consisting of email addresses, each on its own line. Your program should print out a string consisting of those email addresses separated by semicolons.
b.Write a program that reads a list of temperatures from a file called temps.txt, converts those temperatures to Fahrenheit, and writes the results to a file called ftemps.txt.

10. Write programs to demonstrate the usage of class
11. Write programs to demonstrate the usage of GUI
12. Write programs to demonstrate the usage MatPlotlib library

## References

1. Lab Manual for"Python Programming", Department of Computer Science Engineering, NSRIT

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Mechanical Engineering
N.S. Raju Institute of Technology (A)
Visakhapatnam-531173

SC

## 20MES02 Computer Numerical Control Programming 1022

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | | DoK |
|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO4 | P05 | PO10 | |
| 20MES02.1 | Delineate the operation sequence and route sheet for given mechanical parts. | 3 | 1 | 1 | 1 | 1 | L1 |
| 20MES02.2 | Exemplify the selection criteria for CNC machines by describing principle, operation, procedural steps for different tooling. | 3 | 1 | 2 | 1 | 1 | L2 |
| 20MES02.3 | Load the part program with interface software application for automatic part programming. | 3 | 2 | 2 | 2 | 3 | L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: CreateDoK: Depth of Knowledge

**Unit I: Fundamentals of process planning** **09 Hours**

Process planning, Structure of process plan, Factors influencing process plan, Sequence of operation of process plan, CAM, NC,CNC and DNC, Selection criteria for CNC machines, Adoptive Control, Classifications of CNC Machine, Modes of operation of CNC, Working of: Machine Structure, Sideways, Spindle drive, Axis drive, Recirculation ball screw Feedback devices (transducers, encoders), Automatic tool changer (ATC), Automatic pallet changer (APC), CNC axis and motion nomenclature, CNC tooling – tool pre setting, qualified tool, tool holders and inserts

**Unit II: G and M Codes** **09 Hours**

Axes Identification in CNC turning and Machining centres, Machine zero, home position, work piece zero, program zero, CNC part programming: Programming format and Structure of part program, ISO G and M codes for turning and milling-meaning and applications of important codes.

**Unit III: CNC Part Programming** **12 Hours**

Compensations: Tool length compensation, Pitch error compensation, Tool radius compensation, Simple part programming for turning using ISO format having straight turning, taper turning (linear interpolation) and convex/concave turning (circular interpolation), Simple part programming for milling using ISO format, Importance, types, applications and format for: Canned cycles, Macro, Do loops, Subroutine, Mirror image, CNC turning and milling part programming using canned cycles, Do loops and Subroutine, CAD CAM integration: Concept Steps involved in CAD/CAM integration, CAM software.

### Experiments List

1. What is the operation sequence for given drawing
2. How to prepare route sheet for given drawing
3. Demonstrate CAM, NC, CNC and DNC and differentiate them.
4. Choose the selection criteria for CNC machines
5. Show working principle of CNC system with sketches.
6. Identify different modes of operations of CNC machine.
7. Explain different tooling used in CNC systems.
8. Develop part programs for given component on turning and milling machine.
9. Make use of various positions of machine and parts.
10. Utilize the program using canned cycles, Do loops and Subroutine

### Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 20 | 20 |
| L2 | 40 | 40 |
| L3 | 40 | 40 |
| Total (%) | 100 | 100 |

**Sample Questions of Various Cognitive Levels**

**L1: Remember**

7. What is the operation sequence for given mechanical component
8. How to prepare route sheet for given mechanical component
9. Choose the selection criteria for CNC machines for given mechanical component.
10. Show working principle of CNC system with sketches.

**L2: Understand**

5. Demonstrate CAM, NC, CNC and DNC and differentiate them.
6. Explain different tooling used in CNC systems.

**L3: Apply**

5. Identify different modes of operations of CNC machine.
6. Develop part programs for given component on turning and milling machine.
7. Make use of various positions of machine and parts.
8. Utilize the program using canned cycles, Do loops and Subroutine

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## PC 20ME501Dynamics of Machinery 3103

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | | DoK |
|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO4 | PSO1 | PSO2 | |
| 20ME501.1 | Determine gyroscopic couple and its effect and analyze dynamic forces in slider crank mechanism | 2 | 2 | 1 | 3 | 3 | L1,L2, L3 |
| 20ME501.2 | Compute frictional losses, torque transmission of mechanical systems of bearings, clutches, breaks and dynamometers and its types. | 2 | 2 | 1 | 3 | 3 | L1,L2, L3 |
| 20ME501.3 | Calculate turning moment in flywheels and equilibrium speed for governors. | 2 | 2 | 1 | 3 | 3 | L1,L2, L3 |
| 20ME501.4 | Develop knowledge of analytical and graphical methods for calculate balancing of rotary and reciprocating masses. | 2 | 2 | 1 | 3 | 3 | L1,L2, L3 |
| 20ME501.5 | Apply knowledge of vibrations and find out the methods to calculate the natural frequencies of different vibration systems | 2 | 2 | 1 | 3 | 3 | L1,L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

### Unit I: Gyroscopes and Dynamic Force Analysis 12 Hours

Gyroscopes: Angular velocity, angular acceleration, gyroscopic couple, gyroscopic effect on aeroplanes, ships, stability of four-wheel and two- wheel automobiles, rigid disc at an angle fixed to a rotating shaft. Dynamic Force Analysis: Slider crank mechanism, dynamically equivalent system, engine force analysis.

*Inertia of connecting rod.*, turning moment of crankshaft

### Unit II: Bearings, Clutches, Breaks and Dynamometers 12 Hours

Pivots, Collars and Clutches: Pivots and collars, uniform pressure, uniform wear, Types of clutches– single-, and multi-plate. Brakes and Dynamometers: Types of brakes – Block brake, band brake, disc brake, band and block brake, internal expanding shoe brake, effect of brake. Types of dynamometers - Prony, rope brake, belt transmission, epicyclic train.

*Bevis-Gibson torsion dynamometers.*

### Unit III: Flywheels and Governors 12 Hours

Flywheels: Turning moment diagrams, fluctuation of energy, flywheels, dimensions of flywheel rim, applications. Governors: Types of governors, principles of inertia and centrifugal governors- Watt, Porter, Proell, Hartnell, Hartung, Sensitiveness, hunting, isochronism, stability, power

*Effort, controlling force of a governor.*

### Unit IV: Balancing 12 Hours

Static and dynamic balancing of rotating masses, force balancing of four bar linkage, Primary and Secondary balancing of reciprocating engine, balancing of inline four stroke engines (2,4,6 cylinders), V-engines, three cylinder radial engines, direct and reverse crank method, introduction to field balancing.

*Wheel balancing, Advanced balance technology.*

### Unit V: Vibrations 12 Hours

Free Vibration of spring mass system – oscillation of pendulums, centers of oscillation and suspension. transverse loads, vibrations of beams with concentrated and distributed loads. Dunkerly's methods, Raleigh's method, whirling of shafts, critical speeds, torsional vibrations, two and three rotor systems, Simple problems on forced damped vibration, vibration isolation and transmissibility.

*Advanced Vibration Technology, Damping Technology*

### Text Books

1. Rattan S. S, Theory of Machines, 4th Edition, Tata McGraw Hill, New Delhi– 2014
2. Thomas Bevan, The Theory of Machines: A textbook for Engineering students, Pearson, New Delhi-2010
3. Hubert Hahn, Rigid Body Dynamics of Mechanisms: 1 Theoretical Basis, Springer; Softcover reprint of hardcover 1st

ed.2002 edition (30 November 2010)



**Reference Books**

5. Sadhu Singh. Theory of machines: kinematics and dynamics, 3rd Edition, Pearson Education India- 2012
6. Norton RC, Kinematics and Dynamics of Machinery, 3rd Edition in SI Units, Tata McGraw Hill Education Pvt. Ltd-2011

**Web References**

4. https://nptel.ac.in/courses/112/104/112104114/
5. https://nptel.ac.in/courses/112/101/112101096/

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 10 | 10 |
| L2 | 30 | 30 |
| L3 | 60 | 60 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

5. Write about gyroscopic planes?
6. State the applications of cone clutch?
7. List the advantages of slider crank mechanism?
8. Write about sensitiveness?
9. Define hammer blow and swaying couple?
10. Write about vibration isolation and transmissibility?

**L2: Understand**

5. Explain about the effect of precession motion on the stability of moving vehicles such as motor car?
6. What are the differences between Porter and Proell Governors? Why the speed range of Proell governor is less than that of a similar Porter type?
7. Derive from first principles, the expression for the frictional moment (or torque due to friction) of a conical pivot assuming uniform pressure
8. With a neat sketch, explain the working of a Hartnell governor
9. Explain the terms: variation of tractive force, swaying couple, and hammer blow.
10. Distinguish the longitudinal, transverse and torsional free vibrations

**L3: Apply**

1. The rotor of a marine turbine has a moment of inertia of 750kg.m2 and rotates at 3000rpm clockwise when viewed from aft. If the ship pitches with angular simple harmonic motion having a periodic tile of 16 seconds and an amplitude of 0.1 radian, find the
   i) Maximum angular velocity of the rotor axis
1. Draw the turning moment diagram for a four stroke cycle internal combustion engine. A single cylinder four stroke cycle engine develops 15 kW Power at 330 rpm. The maximum fluctuation of energy is 80% of the indicated energy per cycle .The engine is connected through a gearing to a machine having a speed of 726 rpm .the moment of inertia of rotating parts of the engine is 104 kg-m 2 and that of the machine is 9.5 kg-m 2 . Determine the weight of additional flywheel that will be required to keep the overall range of speed variation to 0.75% of mean speed. Radius of gyration of the flywheel is 0.45 m.

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## PC 20ME502Design of Machine Elements I 3103

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | | DoK |
|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PS01 | PS02 | |
| 20ME502.1 | Calculate different stresses in the machine components subjected to various static loads, failures and suitability of a material for an engineering application. | 2 | 3 | 3 | 3 | 3 | L1, L2 |
| 20ME502.2 | Calculate dynamic stresses in the machine components subjected to variable loads. | 2 | 3 | 3 | 3 | 3 | L2 |
| 20ME502.3 | Design riveted, welded, bolted joints, keys, cotters and knuckle joints subjected to static loads and their failure modes | 2 | 3 | 3 | 3 | 3 | L2 |
| 20ME502.4 | Design the machine shafts and suggest suitable coupling for a given application. | 2 | 3 | 3 | 3 | 3 | L2 |
| 20ME502.5 | Calculate stresses in different types of springs subjected to static loads and dynamic loads. | 2 | 3 | 3 | 3 | 3 | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**Unit I: INTRODUCTION:** **12 Hours**

General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design–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. the concept of stiffness in tension, banding, torsion and combined situations – static strength design based on fracture toughness.

*Failure modes (bending - pitting - micro pitting - scuffing)*

**Unit II: STRENGTH OF MACHINE ELEMENTS:** **12Hours**

Stress concentration – theoretical stress concentration factor – fatigue stress concentration factor notch sensitivity – design for fluctuating stresses – endurance limit – estimation of endurance strength – goodman's line – soderberg's line – modified goodman's line, Gerber's parabola.

*Gear types (spur - helical - bevel - worm)*

**Unit III: RIVETED AND WELDED JOINTS** **12 Hours**

Design of joints with initial stresses – eccentric loading. Bolted joints – design of bolts with pre-stresses – design of joints under eccentric loading – locking devices – bolts of uniform strength.

**KEYS, COTTERS AND KNUCKLE JOINTS:** Design of keys-stresses in keys-cotter joints-spigot and socket, sleeve and cotter, jib and cotter joints- knuckle joints.

*Gear configurations (parallel axis, orthogonal axis, planetary)*

**Unit IV: SHAFTS:** **12 Hours**

Design of solid and hollow shafts for strength and rigidity – design of shafts for combined bending and axial loads – shaft sizes – BIS code. Use of internal and external circlips, gaskets and seals (stationary & rotary).

**SHAFT COUPLING:** Rigid couplings – muff, split muff and flange couplings: rigid flanged coupling, protected rigid flanged coupling, Bushed pin type flexible coupling.

*Examples of gearboxes (motorcycle and car transmissions)*

**Unit V: MECHANICAL SPRINGS:** **12 Hours**

Stresses and deflections of helical springs – extension -compression springs – springs for fatigue loading, energy storage capacity – helical torsion springs – co-axial springs, leaf springs.

*Belts (flat - V - ropes),Pressure vessels*

Note: Design data book is NOT Permitted for examination.

**Text Books**

1. Machine Design/ Shigley, J.E/McGraw Hill.2007



2. Machine Design/V.B.Bhandari/ McGrawHill Education,2011
3. RAGHAVENDRA/Design Of Machine Elements I Dme I (Pb 2020)
4. A Textbook Of Machine Design/ R.S. Khurmi / Paperback– 7 May 2012

**Reference Books**

1. Machine design / Schaum Series/McGrawHill Professional
2. Machine Design / Norton/ Pearson publishers
3. Machine design / NC Pandya & CS Shah/Charotar Publishing House Pvt. Limited

**Web Reference**

1. https://www.youtube.com/watch?v=wG2MBL-NqeM&list=PLGiGNMkNq6Qu7h6mgBe1LdXEWCRtVhjBA
2. https://www.youtube.com/watch?v=3fgilT1OpiU&list=PLGiGNMkNq6Qu7h6mgBe1LdXEWCRtVhjBA&index=2

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1 (%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Derive an expression for the impact stress induced due to a falling load.
2. Write short notes on maximum shear stress theory.
3. Define factor of safety for fatigue loading.
4. Define the terms pitch, back pitch, diagonal pitch, and margin.

**L2: Understand**

1. Write short notes on flexible couplings.
2. Derive an expression for bending stress in torsional helical spring.

**L3: Apply**

1. Design a compression helical spring to carry a load of 500 N with a deflection of 25 mm. The spring index may be taken as 8. Assume the following values of the spring material: Permissible shear stress=350 Mpa Modulus of rigidity =84 KN/mm2. Wahl's factor =(4C-1)/(4C-4) +0.615/C, where C is spring index.

2. Design and draw muff coupling to connect two shafts transmitting 40 kW at 120 rpm. The permissible shear and crushing stress for the shaft and key material(mild steel) are 30 MPa and 80 MPa respectively. The material of muff is cast iron with permissible shear stress of 15 MPa. Assume that the maximum torque transmitted is 25 percent greater than the mean torque.

3. A circular steel bar 50 mm diameter and 200 mm long is welded perpendicularly to steel plate to form a cantilever to beloaded with 5 KN at the free end. Determine the size of the weld, assuming the allowable stress in the weld as100 MPa.

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## PC 20ME503 Metal Cutting and Machine Tools

**3 0 0 3**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | | DoK |
|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PSO1 | PSO2 | |
| 20ME503.1 | Apply cutting mechanics to metal machining upon machining force and power | 2 | 2 | 1 | 3 | 3 | L1, L2, L3 |
| 20ME503.2 | Demonstrate turning, milling machines, drill press, grinding machines | 2 | 2 | 1 | 3 | 3 | L2 |
| 20ME503.3 | Select cutting tool materials and tool geometries for different machining processes. | 2 | 2 | 1 | 3 | 3 | L3 |
| 20ME503.4 | Select suitable machining processes and conditions for differentmetals. | 2 | 2 | 1 | 3 | 3 | L3 |
| 20ME503.5 | Explain the principles of finishing processes | 2 | 2 | 1 | 3 | 3 | L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

### Unit I: Fundamentals of Machining

**12 Hours**

Elementary treatment of metal cutting theory – element of cutting process – geometry of single point cutting tool, tool angles, chip formation and types of chips – built up edge and its effects, chip breakers, mechanics of orthogonal cutting –Merchant's force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, tool wear, machinability, tool materials and properties.

*Study and illustrate the various tool angles for various conditions*

### Unit II: Lathe Machines

**12 Hours**

Engine lathe – principle of working, specification of lathe – types of lathe – work holders tool holders – box tools taper turning, thread turning – for lathes and attachments, constructional features of speed gear box and feed gear box. Turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classification – single spindle and multi-spindle automatic lathes – tool layout and cam design for automats.

*Calculate the cutting tools angles for single point cutting tools, Solve the simple problems*

### Unit III: Surface Machining and Drilling

**12 Hours**

SHAPING, SLOTTING AND PLANNING MACHINES: Principles of working – principal parts – specifications, operations performed, machining time calculations.

DRILLING & BORING MACHINES: Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring Machines – fine Boring Machines – jig boring machine, deep hole Drilling Machine.

*Study the tool wear monitoring methods associated to shaping, drilling and boring machines*

### Unit IV: Surface Machining with Milling Machines

**12 Hours**

Principles of working – specifications – classification of Milling Machines – principal features of horizontal, vertical and universal Milling Machine, machining operations, types of cutters, geometry of milling cutters – methods of indexing, accessories to milling machines.

*Compare the CNC milling and conventional milling machine operations and their functional performance*

### Unit V: Finishing Processes

**12 Hours**

Theory of grinding – classification of grinding machines, cylindrical and surface grinding machines, tool and cutter grinding machines, different types of abrasives, bonds, specification and selection of a grinding wheel. Lapping, Honing & Broaching operations, comparison to grinding.

*Study the Unconventional Machining process, Inspection of quality of finishing processed components*

### Text Books

1. Kaushish J. P, Manufacturing Processes, 2nd Edition PHI Publishers-2007
2. Rao P. N, Manufacturing Technology Vol-II, 2nd Edition Tata McGraw Hill, 2008
3. Jain K. C & Chitaley A. K, Production Engineering, 4th Edition ,PHI Publishers, 2007

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Define tool life
2. Howdoestherakeangleaffectthelifeofthecuttingtool?
3. What special tooling is associated with the turret lathe?
4. Differentiate between Turret andCapstanlathes.
5. List the factors affectingtool life
6. State the functions of clapper box in shaper
7. Draw the Straddle milling with aneat sketch
8. What are the functions of a grindingfluid?
9. What are the applications of super finishing operations?
10. What are the principle parts of shapingmachinetool

**L2: Understand**

1. Explain the different types of tool post withneatsketches
2. Draw a neat sketch of taper turning by taper turningattachmentmethod
3. Differentiate between shaping, planning andslottingmachines
4. Sketch a few work holding devices used indrillingmachine
5. Compare the column type milling machine and knee type millingmachine
6. Explain briefly the lapping process. Give the examples oflapping work

**L3: Apply**

1. Explain in detail the single-spindle automatic lathe and compare it with multispindle automatic lathe
2. In an orthogonal cutting experiment with a tool of rake angle $\alpha=7^0$, the chip thickness was found to be 2.5 mm when the uncut chip thickness was set to 1 mm. Find: i) the shear angle, β, ii) the friction angle γ, assuming that Merchant's formula holdsgood
3. Sketch and describe any one quick return mechanism of shaper
4. Apply the different types of cutters used in milling operations and give an application of eachtype
   Select the different types of indexing methods with example for special purpose gear

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## PC 20ME506 Dynamics of Machinery Lab

**0 0 3 1.5**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | |
|---|---|---|---|---|---|
| | | PO1 | PO4 | PSO1 | PSO2 |
| 20ME506.1 | Analyze the motion of motorized gyroscopic couple | 1 | 2 | 3 | 2 |
| 20ME506.2 | Determine the position of sleeve against the controlling force and speed in governors | 1 | 2 | 3 | 2 |
| 20ME506.3 | Measure the frequency of damped and un-damped vibrations of a spring mass system | 1 | 2 | 3 | 2 |
| 20ME506.4 | Determine balancing mass for rotating and reciprocating mass systems. | 1 | 2 | 3 | 2 |
| 20ME506.5 | Determine drive train ratios. | 1 | 2 | 3 | 2 |
| 20ME506.6 | Measure speed of rotating machinery components | 1 | 2 | 3 | 2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

### List of Experiments

11. Determine whirling speed of shaft theoretically and experimentally
12. Plot follower displacement vs. cam rotation for various Cam Follower systems
13. Determine the position of sleeve against controlling force and speed of a Hartnell governor and plot the characteristic curve of radius of rotation.
14. Analyze the motion of a motorized gyroscope when the couple is applied along its spin axis.
15. Determine the frequency of un-damped free vibration of an equivalent spring mass
16. system.
17. Determine the frequency of damped force vibration of a spring mass system.
18. Find the moment of inertia of a flywheel.
19. Find coefficient of friction between belt and pulley
20. Plot slider displacement, velocity and acceleration against crank rotation for single crank mechanism/Four bar mechanism
21. Study various types of gears- Spur, Helical, Worm and Bevel Gears
22. Study the static and dynamic balancing using rigid blocks

### References

4. Lab Manual for Dynamics of Machinery Lab, Department of Mechanical Engineering, NSRIT

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Chairman
Board of Studies (ME)

## PC 20ME507 Metal Cutting and Machine Tools Lab

0 0 3 1.5

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | |
|---|---|---|---|---|---|
| | | PO1 | PO4 | PSO1 | PSO2 |
| 20ME507.1 | Understand the working principle of various machine tools | 1 | 3 | 3 | 3 |
| 20ME507.2 | Practice the different operations of Lathe machine | 1 | 3 | 3 | 3 |
| 20ME507.3 | Fabricate the components using milling machine | 1 | 3 | 3 | 3 |
| 20ME507.4 | Experiment the usage of shaping and planning machine | 1 | 3 | 3 | 3 |
| 20ME507.5 | Experiment the usage of drilling and slotting machine | 1 | 3 | 3 | 3 |
| 20ME507.6 | Apply the different grinding methods to achieve high degree surface machining | 1 | 3 | 3 | 3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

### List of Experiments

1. Introduction of general purpose machines -lathe, drilling machine, milling machine, shaper, planing machine, slotting machine, cylindrical grinder, surface grinder and tool and cuttergrinder.
2. Step turning and taper turning on lathemachine
3. Thread cutting and knurling on lathemachine.
4. Drilling andtapping
5. Shaping andplanning
6. Slotting
7. Milling
8. Cylindrical surface grinding
9. Grinding of toolangles.

### References

5. Lab Manual for Machine Tools Lab, Department of Mechanical Engineering, NSRIT

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**MC 20MCX03 Intellectual Property Rights and Patents** 2 0 0 0

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with Pos PO11 | PO12 | DoK |
|---|---|---|---|---|
| 20MCX03.1 | Acquireknowledgeonintellectualpropertyrights | - | - | L1,L2 |
| 20MCX03.2 | Knowabouttheacquisitionoftrademarks. | - | - | L1,L2 |
| 20MCX03.3 | Identifytheimportanceofcopyrights,Patentsand Transferofownership. | - | -- | L1, L2 |
| 20MCX03.4 | Reciprocatetonewdevelopmentsofintellectualpropertyrights | - | - | L1, L2 |
| 20MCX03.5 | International Overview Of IPR | - | - | L1,L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**UnitI: Introduction to Intellectual property:4Hours**

Concepts, types of intellectual property,international organizations, agencies and importance of intellectual propertyrights.IndustrialProperty,technologicalResearch,InventionsandInnovations – Important examples of IPR.,IPR in India and Abroad

**Unit II: Introduction toTrade Marks: 4 Hours**

Purpose and function of trademarks, acquisition of trade markrights,selectingandevaluatingtrademark,trademarkregistrationprocesses.TradeSecretsandIndustrialDesignregistration in India and Abroad

**Unit III: Registration of Copy Rights4 Hours**

Fundamentals of copy right law,rights of reproduction, rights to perform the work publicly, copy right ownership issues, copyrightregistration, International copyright laws.
**Law of patents:** Foundation of patent law, patent searching process, ownership rights andtransfer.

**Unit IV: Latest development of Intellectual property Rights** **4 Hours**

New developments in trademark law; copy right law, patent law, intellectual property audits.
InfringementofIPRs,EnforcementMeasures,Emerging issues–

**Unit V:Enforcement Of IPRs4 Hours**
International overview on intellectual property, international – trade mark law, copy right law, international patent law international development in trade secrets law.

**Text Books**

1. Intellectualpropertyright,Deborah,E. Bouchoux,cengagelearning.
2. Intellectual property right - Unleashing the knowledge economy, PrabuddhaGanguli,TataMcGraw Hill PublishingCompanyLtd.

3. Cornish,WilliamRodolph&Llewelyn,David.Intellectualproperty:patents,copyright,trademarks andallied rights. Sweet& Maxwell,8/e,2013.

**Reference Books**

1. Cornish,WilliamRodolph.Casesandmaterialsonintellectualproperty.Sweet&Maxwell, 5/e,2006.
2. Lo,JackandPressman,David.Howtomakepatentdrawings:apatentityourselfcompanion. Nolo, 5/e 2007.

Web References

1. https://www.investopedia.com/terms/i/intellectualproperty.asp
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3217699/
3. https://www.wto.org/english/tratop_e/trips_e/intel1_e.htm

Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 40 | 40 |
| L2 | 60 | 60 |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

11. What is Industrial property?
12. What are the fundamentals of copy rights
13. Define patents and its approval process
14. Define copy right law.
15. Define transfor of trade marks.

**L2: Understand**

10. Explain the role trade scorets in company law.
11. Explain the concept owenership rights of patents with suitable examples
12. Explain the international patent law.
13. Distinguish between copy rights and patents.
14. Explain copt right registration.

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Board of Studies (MBA)

| | | | | | |
|---|---|---|---|---|---|
| IN | **Summer Internship #1** | **0** | **0** | **0** | **1.5** |

At the end of the course, students will be able to

| No. | Course Outcomes |
|---|---|
| 1 | Demonstrate the theoretical learning outcomes |
| 2 | Integrate theory and practice during graduation |
| 3 | Comprehend the industry practices in the relevant and allied field of study |
| 4 | Develop communication skills in terms of oral, written, and graphical communications |
| 5 | Develop problem solving skills |
| 6 | Develop work habits and teamwork in a multidisciplinary setting for a successful career after graduation |

**Note:** All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes

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## AC Technical Paper Writing

**0 0 2 0**

At the end of the course, students will be able to

| No. | Course Outcomes |
|---|---|
| 1 | Develop searching latest relevant literature pertaining to the topic of interest |
| 2 | Develop self-learning ability to become a lifelong independent learner |
| 3 | Develop the habit of writing technical manuscript as per the requirement |
| 4 | Develop presentation skills and speak with appropriate technical phrases |
| 5 | Explore the research topics and develop research interests |
| 6 | Comprehend the latest technologies, techniques, tools, and methodologies |

**Note:** All the above course outcomes are relatively mapped to all POs as it caters to all program outcomes

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## PC 20ME601Mechanical measurements & Metrology 3103

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | | DoK |
|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PSO1 | PSO2 | |
| 20ME601.1 | Describe the construction and working principles of measuring instruments for measurement of displacement and speed and select appropriate instrument for a given application | 3 | 2 | 1 | 1 | 1 | L1, L2 |
| 20ME601.2 | Describe the construction and working principles of measuring instruments for strain, force, Torque, power, acceleration and Vibration and select appropriate instrument for a given application. | 3 | 2 | 1 | 1 | 1 | L2 |
| 20ME601.3 | Explain shaft basis system and hole basis systems for fits and represent tolerances for a given fit as per the shaft basis system and hole basis system and design limit gauges based on the tolerances for quality check in mass production. | 3 | 2 | 1 | 1 | 1 | L2 |
| 20ME601.4 | Explain methods for linear, angle and flatness measurements and select a suitable method and its relevant instrument for a given application. | 3 | 2 | 1 | 1 | 1 | L2 |
| 20ME601.5 | To measure the threads, gear tooth profiles, surface roughness and flatness using appropriate instruments and analyze the data | 3 | 2 | 1 | 1 | 1 | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**Unit I: Measurement Of Displacement And Speed** **12 Hours**

Basic principles of measurement – measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. dynamic performance characteristics – sources of error, classification and elimination of error. **MEASUREMENT OF DISPLACEMENT**: Theory and construction of various transducers to measure displacement – piezo electric, inductive, capacitance, resistance, ionization and photo electric transducers, calibration procedures.
**MEASUREMENT OF SPEED** : Mechanical tachometers – electrical tachometers – stroboscope,

*Contact and noncontact type of tachometer*

**Unit II: Measurement Stress, Acceleration,Force** **12 Hours**

**STRESS STRAIN MEASUREMENTS**: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, strain gauge rosettes.
**MEASUREMENT OF FORCE, TORQUE AND POWER**- Elastic force meters, load cells, torsion meters, dynamometers. **MEASUREMENT OF ACCELERATION AND VIBRATION**: Different simple instruments – principles of seismic instruments – Vibrometor and accelerometer using this principle.

*VibrationTechnologyand damper Technology*

**Unit III: Systems OF Limits and Limit Gauges** **12 Hours**

**SYSTEMS OF LIMITS AND FITS**: Introduction, nominal size, tolerance, limits, deviations, fits -Unilateral and bilateral tolerance system, hole and shaft basis systems- interchange ability, deterministic & statistical tolerances, selective assembly. International standard system of tolerances, selection of limits and tolerances for correct functioning.
**LIMIT GAUGES**: Taylor's principle – design of go and no go gauges; plug, ring, snap, gap, taper, profile and position gauges.
*Gauge design, gauge factor*

**Unit IV: Measurement of Linear, Angles And Tapers 12 Hours**

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

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

**OPTICAL MEASURING INSTRUMENTS**: Tools maker's microscope and uses - autocollimators, optical projector, optical flats and their uses. Interferometry- Interference of light, Michelson's interferometer, NPL flatness interferometer, and NPL gauge interferometer.

**COMPARATORS:** Types - mechanical, optical , electrical and electronic, pneumatic comparators and their uses.

*NPL Technology And Advanced Technologys In Optics*

**Unit V: Measurement of Surface Roughness, Gear and Screw Threads 12 Hours**

**SURFACE ROUGHNESS MEASUREMENT**:Differences between surface roughness and surface waviness –Numerical assessment of surface finish-CLA, Rt., R.M.S. Rz, R10 values, Method of measurement of surface finish – Profilograph, Talysurf, ISI symbols for indication of surface finish.

**GEAR MEASUREMENT**: Nomenclature of gear tooth, tooth thickness measurement with gear tooth vernier & flange micro meter, pitch measurement, total composite error and tooth to tooth composite errors, rolling gear tester, involute profile checking.

**SCREW THREAD MEASUREMENT**: Elements of measurement – errors in screw threadsconcept of virtualeffective diameter, measurement of effective diameter, angle of thread and thread pitch, and profile thread gauges.

*Advanced measurement in gears, Advanced measurement in screws*

## Text Books

1. Engineering Metrology / R.K.Jain / Khanna Publishers
2. Measurement Systems: Applications & design / D.S Kumar/
3. Engineering Metrology / Mahajan / Dhanpat Rai Publishers
4. Dr.J.P.HolmanThermodynamics –, McGrawHill-6thEdition , McGraw Hill- 2013

## Reference Books

1. Measurement systems: Application and design/Doeblin Earnest. O. Adaptation/ TMH
2. Experimental Methods for Engineers / J.P.Holman/McGraw Hill
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
4. Instrumentation, measurement & analysis / B.C.Nakra&K.K.Choudhary/TMH

## Web References

6. **https://nptel.ac.in/courses/112/105/112105123/**
7. **https://nptel.ac.in/courses/112/105/112105265/**
8. **https://nptel.ac.in/courses/101/104/101104063/**

## Internal Assessment Pattern

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 40 |
| L3 | 20 | 30 |
| Total(%) | 100 | 100 |

1. .

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Define the term metrology and applied to engineering industry. State its significance
2. Describe briefly the sysem of obtaining different types of fits with suitable example

Explain the terminology of surface roughness as per Indian standard. Draw neat sketch

3. Explain the principle of measuring shaft torque using strain gauge torsion meter?
4. Explain instrumental, environmental and observational errors by citing suitable examples. Explain the measures taken to minimize these errors

**L2: Understand**

1. Explain terms line standards and end standards with example
2. Describe the uses and advantages of dial indicator
3. hat are the measuring techniques employed in optical projector
4. Define displacement. Suggest a suitable transducer for the measurement of a small linear motion. Give reasons to justify your choice
5. Explain hole basis system and shaft basis system with a neat sketch

**L3: Apply**

1. Describethe working principle and uses of lever type dial test indicator
2. How to measure gear tooth thickness?
3. Explain any four alignment test of milling machine
4. Explain the working principle of pneumatic load cell for the measurement offorce.
5. Describe briefly the sysem of obtaining different types of fits with suitable example

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## PC 20ME602 Design of Machine Elements II 3103

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with Pos | | | | | DoK |
|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PSO1 | PSO2 | |
| 20ME602.1 | Select the suitable bearing based on the application of the loads and predict the life of the bearing | 2 | 3 | 3 | 3 | 3 | L1, L2 |
| 20ME602.2 | Design of IC Engines parts. | 2 | 3 | 3 | 3 | 3 | L2 |
| 20ME602.3 | Design of power transmission elements such as gears, belts, chains, pulleys, ropes, levers and power screws. | 2 | 3 | 3 | 3 | 3 | L2 |
| 20ME602.4 | Design spur & helical gear for different engineering applications | 2 | 3 | 3 | 3 | 3 | L2 |
| 20ME602.5 | Design of Machine tool elements | 2 | 3 | 3 | 3 | 3 | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**Unit I: BEARINGS** **12 Hours**

Classification of bearings- applications, 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: ENGINE PARTS** **12 Hours**

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 center cranks – crank pins, crank shafts. Pistons, forces acting on piston – construction design and proportions of piston.

*Cylinder, cylinder liners*

**Unit III: POWER TRANSMISSIONS SYSTEMS, PULLEYS** **12 Hours**

Transmission of power by belt and rope drives , transmission efficiencies, belts – flat and V types – ropes - pulleys for belt and rope drives, materials, chain drives.

**DESIGN OF POWER SCREWS:** Design of screw, square ACME, buttress screws, design of nut, compound screw, differential screw.

*Ball screw- possible failures.*

**Unit IV: SPUR & HELICAL GEAR DRIVES** **12 Hours**

Spur gears- helical gears – load concentration factor – dynamic load factor, surface compressive strength – bending strength – design analysis of spur gears – estimation of centre distance, module and face width, check for plastic deformation.

*Check for dynamic and wear considerations.*

**Unit V: MACHINE TOOL ELEMENTS:** **12 Hours**

Levers and brackets: design of levers – hand levers-foot lever – cranked lever – lever of a lever loaded safety valve- rocker arm straight – angular- design of a crank pin – brackets- hangers- wall boxes. Wire Ropes: Construction, Designation, Stresses in wire ropes, rope sheaves and drums. Design of curved Beams: introduction, stresses in curved beams, expression for radius of neutral axis for rectangular, circular, trapezoidal and t-section.

*Design of crane hooks, c –clamps.*

Note: Design data book is permitted for examination

**Text Books**

1. Machine Design/V.B.Bhandari/TMH Publishers
2. Machine Design/ NC Pandya & CS Shaw/ Charotar publishers

3. Design data book



**Reference Books**

1. Machine Design: An integrated Approach / R.L. Norton / Pearson Education
2. Mech. Engg. Design / JE Shigley/Tata McGraw Hill education
3. Design of machine elements- spots/Pearson Publications

**Web Reference**

1. https://www.youtube.com/watch?v=_0qkzumn1FI&list=PLZOPOIoQ19tF7kN2ByTot-oCzkYCrZq8e&index=1
2. https://www.youtube.com/watch?v=O1LrOI6jDOw&list=PLZOPOIoQ19tF7kN2ByTot-oCzkYCrZq8e&index=2

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Derive the expression for finding the life of the bearing subjected to variable loading.
2. Explain the stresses developed in the connecting rod. What do you mean by whipping stress?
3. Derive the expression for the radius of the neutral axis for a trapezoidal section.
4. Explain the design procedure of Power screw and screw jack and write the condition for
5. self - locking screws.

**L2: Understand**

1. Explain the design procedure of Power screw and screw jack and write the condition for self - locking screws.
2. Describe the interference phenomenon in involute gears. Also, state the conditions to avoid interference.

**L3: Apply**

1. A roller chain is used to connect two shafts spaced 25 pitches apart to transmit 75 kW at 300 rpm of a 17 tooth driver sprocket to 34 tooth driven sprocket. The working period is 18 hours per day with abnormal service conditions. Specify the length and size of the chain.

2. Design an overhung crankshaft with two main bearings for an I.C engine with the following data:
Cylinder bore=250 mm, Stroke length=300 mm, Flywheel weight=25 kN, Maximum pressure=2.5 N/mm2 , Maximum torque at crank rotation 300 , the pressure at that instant = 1.7 N / mm2 .

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## PE 20ME603Heat Transfer 3 1 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with Pos | | | | | DoK |
|---|---|---|---|---|---|---|---|
| | | PO1 | PO2 | PO3 | PSO1 | PSO2 | |
| 20ME603.1 | Illustrate the basic principles of heat transfer to basic engineering systems and can solve problems involving steady state heat conduction with and without heat generation in simple geometries. | 2 | 3 | 2 | 3 | 3 | L1,L2, L3 |
| 20ME603.2 | Apply Heisler's charts for transient heat conduction problems and explain velocity and thermal boundary layers in flow over flat plate and through circular pipe. | 2 | 3 | 2 | 3 | 3 | L1,L2, L3 |
| 20ME603.3 | Enumerate Nusselt numbers in forced and natural convection using empirical relations. | 2 | 3 | 2 | 3 | 3 | L1,L2, L3 |
| 20ME603.4 | Draw pool boiling curve, describe film wise condensation, and use LMTD and NTU methods in designing heat exchangers. | 2 | 3 | 2 | 3 | 3 | L1,L2, L3 |
| 20ME603.5 | Illustrate radiation laws and estimate radiate heat exchange between different surfaces and with radiation shields. | 2 | 3 | 2 | 3 | 3 | L1,L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

### Unit I: Introduction and One Dimensional Steady State Heat Conduction 12 Hours

Modes of heat transfer – Fourier's law of heat conduction– general heat conduction equation in Cartesian and cylindrical coordinates.Steady state heat conduction in a slab - Composite slab, coaxial cylinders and concentric spheres conduction-convection systems - overall heat transfer coefficient - electrical analogy- critical radius of insulation - types of fins– rectangular fin with insulated tip – fin effectiveness and fin efficiency.
*Application to error measurement of temperature.*

### Unit II: One Dimensional Transient Heat Conduction and Dimensional Analysis 12 Hours

Lumped heat capacity analysis Biot and Fourier numbers – solution of transient conduction systems for slabs, cylinders and spheres using Heisler'scharts.
Buckingham-PI-theorem–dimensionalanalysis applied of forcedconvection andnaturalconvection–significance of Reynolds', *Prandtl and Nusselt numbers.*

### Unit III: Convection 12 Hours

Fundamentals Of Convection:Velocity and thermal boundary layers in flow on a horizontal flat plate - velocity and thermal boundary layers in laminar flow through a circular pipe – hydrodynamic and thermal entry lengths - Reynolds and Colburn analogies.
Forced Convection: Empirical correlations for Nusselt numbers for flow over flat plates – Empirical correlations for Nusselt numbers for flow through pipes.
Natural Convection: Velocityand thermal boundary layers in heat transfer by naturalconvection from a vertical plate (derivations not included) – Boussinesq approximation – empiricalcorrelations for vertical plates and cylinders for laminar and turbulent natural convection.
*Applications of Convections*

**Unit IV: Boiling, Condensation and Heat Exchangers** **12 Hours**

Regimes of saturated pool boiling – Dropwise and filmwise condensation- Nusselt's analysis for laminar film wise condensation on a vertical plate.

Heat Exchangers: Parallel and counter flow double pipe heat exchangers- overall heat transfer coefficient – fouling factors - LMTD method of heat exchangeranalysis – effectiveness

*NTU method of heat exchanger analysis.*

**Unit V: Thermal Radiation** **12 Hours**

Emissivepower – black body – Stefan-Boltzmann's law– Emissivity– Kirchhoff's law- radiation heat exchange between two black isothermal surfaces – concept of radiation shape factor- heat exchangebetween two large gray planes, and concentric cylinders – exchange between a small gray bodies in a large enclosure

*Radiation shields. advantages, disadvantages and applications.*

**Text Books**

5. SachdevaR.C,"Fundamentals of Engg. Heat and Mass Transfer",5thEdition, NewAge International Publications, 2013
6. NagP.K.,"Heat Transfer", 3rdEdition, TMH, 2015
7. RajputR.K.,"Heat and Mass Transfer",RevisedEdition, S.Chand Publications, 2014
8. Cengel, "Heat and Mass Transfer", 5th Edition, McGraw Hill Publications, 2015.

**Reference Books**

7. Incropera F.P, Dewitt D.P,BergmanT.L, Lavine A.S, Seetharamu K.S, SeetharamT.R,"Fundamentals of Heat and Mass Transfer",WileyIndia, 1st Edition,McGrawHill, 2013.
8. Frank Kreith, Manglik R. M & Bohn M. S, "Principles of Heat Transfer",SpecialEdition,Cengage learning publishers, 2012.
9. KumarD.S, "Heat and Mass Transfer", 3rd Edition, S.K.Kataria& Sons Publications, 2012.
10. Holman J. P, "Heat Transfer", Indian Edition, TMH Publications, 2014.

**Web References**

9. https://nptel.ac.in/courses/112101097/
10. http://web.mit.edu/lienhard/www/ahttv212.pdf/
11. https://ocw.mit.edu/courses/mechanical-engineering/2-051-introduction-to- heat-transfer-fall-2015/

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

11. Whatarethedifferent modes of heat transfer?
12. DefineFin.
13. Define Fin effectiveness and fin efficiency
14. State and explain Buckingham π theorem.
15. Define Stefan Boltzman Law.
16. What are different types of convective heat transfer?
17. Define Heat Exchanger and list out various types of heat exchangers.
18. Define the term overall heat transfer coefficient? And explain its significance.
19. List and explain various non dimensional numbers using in heat transfer.
20. Name the different boiling regimes in the order they occur in a vertical tube during flow boiling.

**L2: Understand**

11. Explain the concept of momentum and energy equation.
12. Discuss the detailed classification of convective heat transfer.
13. Explain the regimes of pool boiling.
14. Differentiate between pool boiling and flow boiling.
15. Differentiate between film condensation and drop wise condensation.
16. Distinguish between a black body and grey body.
17. Explain the phenomena of natural convection over a vertical hot plate.

**L3: Apply**

11. Derive general heat conduction equation in cylindrical coordinates.
12. Identify the different modes of heat transfer in the following systems/operations.
    (i) Steam raising in a steam boiler
    (ii) Condensation of steam in a condenser
    (iii) Heat transfer from a vacuum flask
    (iv) Heating of water in a bucket with an immersion heater
13. Water at a rate of 4080 kg/h is heated from 35°C to 75°C by the oil of Cp 1.9 kJ/kg.K. The heat exchanger is a double pipe counter flow. Oil enters at 110°C and leaves at75°C. Determine: i) mass flow rate of oil, ii) area of the heat exchanger to handle heat duty if the overall heat transfer coefficient is 320 W/m2K.
14. Water flows at 45°C over a flat plate 1m x 1m size maintained at 22°C with a velocity of 1.5 m/s. Estimate the variation of heat transfer coefficient along the length of heating starts from 0.25 m from the leading edge.
15. A 50 cm x 50 cm copper slab, 6 mm thick at a uniform temperature of 350°C suddenly has its surface temperature lowered to 30°C. Find the time at which the slab temperature becomes 100°C. h = 100 W/m²°C. Also, find the rate of cooling after 60 seconds.
16. A cylinder 5 cm diameter and 50 cm long, is provided with 14 longitudinal straight fins of 1 mm thick and 2.5 mm height. Calculate the heat loss from the cylinder per second if the surface temperature of the cylinder is 200°C. Take h=25W/m²K, k=80W/m0K and ambient temperature=45°C.
17. A large aluminum plate of thickness 200 mm originally at a temperature of 530°C is suddenly exposed to an environment at 30°C. The convective heat transfer coefficient between the plate and the environment if 500 W/(m² K). Determine with the help of Heisler's charts, the temperature at a depth of 20 mm from one of the faces 225 seconds after the plate is exposed to the environment. Also calculate how much energy has been lost per unit area of the plate during this time? Take for aluminum, Thermal Diffusivity = 8 x 10^-5m 2/s and k = 200 W/(m K).
18. Liquid sulphur dioxide in a saturated state flows inside a 5 m long tube and 25 mm internal diameter with a mass flow rate of 0.15 kg/s. The tube is heated at a constant fluid temperature of -10°C and the inlet fluid temperature is -40°C. Determine the exit fluid temperature by making use of Sieder and Tate equation.

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**PC** **20ME606 Computer Aided Machine Drawing** **0031.5**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | |
|---|---|---|---|---|---|---|
| | | PO1 | PO5 | PO10 | PSO1 | DoK |
| 20ME606.1 | Identify the national and international standards pertaining to machine drawing. | 3 | 3 | 3 | 3 | L2 |
| 20ME606.2 | Understand the importance of the linking functional and visualization aspects in the preparation of the part drawings. | 3 | 3 | 3 | 3 | L2 |
| 20ME606.3 | Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies | 3 | 3 | 3 | 3 | L2 |
| 20ME606.4 | Interpret the Machining and surface finish symbols on the component drawings. | 3 | 3 | 3 | 3 | L2 |
| 20ME606.5 | Preparation of the part or assembly drawings as per the conventions. | 3 | 3 | 3 | 3 | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**PART-A** **12 Hours**

Introduction: Review of graphic interface of the software. Review of basic sketching commands and navigational commands. Starting a new drawing sheet. Sheet sizes. Naming a drawing. Drawing units, grid and snap. Conversion of pictorial views into orthographic projections of simple machine parts (with and without section). Hidden line conventions. Precedence of lines. Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids). True shape of sections. Conversion of pictorial views into orthographic projections of simple machine parts. Hidden line conventions. Precedence of lines. Conversion of pictorial views into orthographic projections of simple machine parts (with section planes indicated on the part). Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External) square and Acme. Sellers thread, American Standard thread. Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw.

**PART-B** **12 Hours**

Keys: Parallel key, Taper key, Feather key, Gib-head key and Woodruff key.
Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.
Couplings: Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, and universal coupling (Hooks' Joint)

**PART-C** **12 Hours**

Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in industry.
Assembly Drawings: (Part drawings shall be given)
1. Plummer block (Pedestal Bearing)
2. Lever Safety Valve
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)
5. Tailstock of lathe
6. Machine vice
7. Tool head of shape

**Text Books**

1. Machine Drawing – N.Siddeswar, K.Kannaiah&V.V.S.Sastry– Tata MegrahHill , 2007
2. Machine Drawing –K.L.Narayana, P.Kannaiah& K. Venkata Reddy / New Age/ Publishers,2003
3. Production Drawing- K.L.Narayana, P.Kannaiah& K. Venkata Reddy / New Age/ Publishers ,2000

**Reference Books**

1. Machine Drawing ,Charotar publishing house, 49th edition January 2014
2. Machine drawing, New Age international publishers,6th edition,2019

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## PC 20ME607 Mechanical Measurements & Metrology Lab 0 0 3 1.5

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | |
|---|---|---|---|---|---|
| | | PO1 | PO4 | PSO1 | PSO2 |
| 20ME607.1 | Explain different instruments that are available for linear, angular, roundness and roughness measurements | 2 | 3 | 3 | 3 |
| 20ME607.2 | Select and use the appropriate measuring instrument according to a specific requirement (in terms of accuracy, etc) | 2 | 3 | 3 | 3 |
| 20ME607.3 | Know requirement of calibration, errors in measurement etc. | 2 | 3 | 3 | 3 |
| 20ME607.4 | Perform accurate measurements | 2 | 3 | 3 | 3 |
| 20ME607.5 | Demonstrate principles of modern instruments | 2 | 3 | 3 | 3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

### List of Experiments

#### 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.
4. Measurement using Mechanical comparator.
5. Measurements using Optical Projector.
6. Measurement of alignment using Autocollimator.
7. Angle and taper measurements with bevel protractor, Sine bar, rollers and balls.
8. Use of spirit level in finding the straightness of a bed and flatness of a surface.
9. Thread inspection with two wire/ three wire method & tool makers microscope.
10. Surface roughness measurement with roughness measuring instrument.

#### Mechanical Measurements Lab

1. Calibration of pressure gauge.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge.
5. Calibration of thermocouple.
6. Calibration of capacitive transducer.
7. Study and calibration of photo and magnetic speed pickups.
8. Calibration of resistance temperature detector.
9. Study and calibration of a rotameter.
10. Study and use of a seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of Mcleod gauge for low pressure.

#### References

6. Lab Manual for Manufacturing Process Lab, Department of Mechanical Engineering, NSRIT

**PC 20ME608 Heat Transfer Lab** **0 0 3 1.5**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | |
|---|---|---|---|---|---|
| | | PO1 | PO4 | PSO1 | PSO2 |
| 20ME608.1 | Apply the basic heat transfer mechanisms for various heat transfer phenomenon. | 2 | 3 | 3 | 3 |
| 20ME608.2 | Evaluate the COP of refrigeration system. | 2 | 3 | 3 | 3 |
| 20ME608.3 | Determine the thermal conductivity of different metallic materials. | 2 | 3 | 3 | 3 |
| 20ME608.4 | Examine the rate of heat transfer between solid boundaries. | 2 | 3 | 3 | 3 |
| 20ME608.5 | Select the appropriate dimensional and functional parameters for heat transfer devices. | 2 | 3 | 3 | 3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

**List of Experiments**

23. Determination ofoverallheat transfer co-efficientofa compositeslab
24. Determination ofthermal conductivityofametal rod.
25. Determination ofheat transferratethrough alagged pipe.
26. Determine the heat transfer coefficient of air in tube by forced convection.
27. Determine the heat transfer coefficient of vertical cylinder by natural convection
28. Estimate the effectiveness and fin efficiency by forced convection.
29. Calculate and compare The Stefan Boltzmann constant.
30. Determine the effectiveness and overall heat transfer coefficient in parallel flow heat exchanger.
31. Determine the effectiveness and overall heat transfer coefficient in counter flow heat exchanger.
32. COPofVCRSystem with Capillaryand thermal expansion valve.
33. Determine the emissivity of test plate by using black surface.
34. Determination ofThermal conductivityof Liquids and gases.
35. Determination ofcriticalheat flux.
36. Estimation of heat transfer by unsteady state heat conduction.

**References**

7. Lab Manual for Manufacturing Process Lab, Department of Mechanical Engineering, NSRIT

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Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology
Visakhapatnam-530 041

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Board of Studies (ME)

MC

## 20MCX04 Indian Traditional Knowledge 0 0 3 0

**Course Outcomes**
At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | | DoK |
|---|---|---|---|---|---|---|
| | | PO1 | PO6 | PO7 | PO12 | |
| 20MCX03.1 | Identify the concept of Traditional knowledge and its importance | 1 | 3 | 3 | 2 | L1, L2 |
| 20MCX03.2 | Explain the need and importance of protecting traditional knowledge | 1 | 2 | 3 | 2 | L1, L2 |
| 20MCX03.3 | Illustrate the various enactments related to the protection of traditional knowledge | 1 | 3 | 3 | 2 | L1, L2 |
| 20MCX03.4 | Interpret the concepts of Intellectual property to protect the traditional knowledge | 1 | 2 | 3 | 2 | L1, L2 |
| 20MCX0.35 | Explain the importance of Traditional knowledge in Agriculture and Medicine | 1 | 3 | 3 | 2 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create

**UNIT-I: Introduction to traditional knowledge** **6hours**

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge

**UNIT-2: Protection of traditional knowledge** **6hours**

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

**UNIT-3: Legal framework and TK:** **6hours**

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

**UNIT-4: Traditional knowledge and intellectual property:** **6hours**

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge

**UNIT-5: Traditional Knowledge in Different Sectors:** **6hours**

Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK



**Text Books:**

1. Traditional Knowledge System in India, by Amit Jha, 2009.

**Reference Books:**

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.

2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2.

**Web Links:**

1.https://www.youtube.com/watch?v=LZP1StpYEPM

2.http://nptel.ac.in/courses/121106003/

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## PE 20ME001 Applied Thermodynamics 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME001.1 | Relate the laws of thermodynamics with different cycles. | L1 |
| 20ME001.2 | Demonstrate the principle of boilers, its working and required characteristics. | L1,L2 |
| 20ME001.3 | Explain the function of steam nozzles and turbines with their specifications. | L1,L2 |
| 20ME001.4 | Illustrate the mechanical details of reaction turbines and its classification. | L1,L2,L3 |
| 20ME001.5 | Interpret the application of compressors with their classification. | L1,L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

### Unit I: VAPOUR POWER CYCLES AND COMBUSTION 9 Hours

Carnot, Rankine cycle - schematic layout, thermodynamic analysis, concept of mean temperature of heat addition, methods to improve cycle performance – regeneration & reheating. Fuels and combustion, concepts of heat of reaction, adiabatic flame temperature, Stoichiometry, flue gas analysis.
*Closed control volumes, Dynamic systems*

### Unit II: BOILERS 9 Hours

Classification – working principles of L.P & H.P boilers with sketches – mountings and accessories – working principles, boiler horse power, equivalent evaporation, efficiency and heat balance – Draught: classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced.
*Open control volumes, Gas dynamics*

### Unit III: STEAM NOZZLES 9 Hours

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, criteria to decide nozzle shape: Super saturated flow - its effects, degree of super saturation and degree of under cooling, Wilson line.

**STEAM TURBINES** Classification – impulse turbine; mechanical details – velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-laval turbine - methods to reduce rotor speed-velocity compounding, pressure compounding and velocity & pressure compounding, velocity and pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine, condition for maximum efficiency.
*Departure Functions, Simple vapour*

### Unit IV: REACTION TURBINE 9 Hours

Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson's reaction turbine – condition for maximum efficiency – calculation of blade height

**STEAM CONDENSERS** Requirements of steam condensing plant – classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump, cooling water requirement.
*liquid equilibrium, Multicomponent Phase Equilibrium*

### Unit V: COMPRESSORS 9 Hours

Classification –Reciprocating type, Principle of operation, work required, Isothermal efficiency, volumetric efficiency and effect of clearance, multi stage compression, saving of work, minimum work condition for two stage compression

**Rotary (Positive displacement type)**

Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency

considerations.



**Centrifugal compressors**: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, velocity diagrams.
**Axial Flow Compressors:** Mechanical details and principle of operation, velocity diagrams
*Chemical equilibrium, Legendre transform*

### Text Books

9. Basics & Applied Thermodynamics- P.K.Nag – 4th edition- McGraw Hill 2017
10. Thermal Engineering - RK Rajput- Lakshmi Publications, 8th Edition 2014
11. YunusACenegel,MichaelABoles,Thermodynamics,anEngineeringApproach,8thEdition-MCH- 2014
12. Dr.J.P.HolmanThermodynamics–,McGrawHill-6thEdition,McGrawHill- 2013

### Reference Books

11. Applied Thermodynamics - Eastop& McConkey- Pearson Publications, 5th Edition
12. Thermal Engineering-M.L.Marthur& Mehta- Jain bros. Publishers, 3rd Edition 2017.
13. Dr.Y.V.C.Rao-An Introduction to Thermodynamics– Universities presses publications- 2012.
14. W.Z.Black&J.G.Hartley, Thermodynamics, 3rd Edition- Pearson Publications- 2010.

### Web References

12. https://nptel.ac.in/courses/112/105/112105123/
13. https://nptel.ac.in/courses/112/105/112105266/
14. https://nptel.ac.in/courses/101/104/101104063/

### Internal Assessment Pattern

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 60 | 20 |
| L2 | 40 | 40 |
| L3 | | 40 |
| Total(%) | 100 | 100 |

### Sample Short and Long Answer Questions of Various Cognitive Levels

**L1: Remember**

21. Write a short note on exhaust blowdown?
22. Write the qualities of an ideal ignition system..
23. Write about anti knock additives.
24. What is heat balance sheet?
25. Write the applications of air compressor.
26. Draw the velocity diagram of a centrifugal blower.

**L2: Understand**

18. What is a cycle? What is the difference between an ideal and actual cycle?
19. What is supercharging? How is it achieved?
20. ``Auto-ignition is the cause of detonation''. Justify the statement.
21. What do you mean by performance of IC engine?
22. What do you understand by a slip factor in dynamic compressors?

**L3: Apply**

19. Compare actual cycle and air standard cycle of SI engine IllustrateFirstlawappliedtosteadyflowsystem.
20. Derive the expression for work per kg of air compressed in a single cylinder reciprocating air compressor considering clearance and neglecting clearance..

## PE 20ME002Unconventional Machining Processes 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME002.1 | Get the knowledge of principle of working, mechanism of metal removal in the Ultrasonic machining process and identify the process parameters, their effect and applications of different processes | L1,L2 |
| 20ME002.2 | Learn Abrasive jet machining, Water jet machining and its applications | L1,L2 |
| 20ME002.3 | Impart the knowledge of Electro chemical machining and its Applications | L1,L2 |
| 20ME002.4 | Know the Thermal metal removal processes and selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface | L1,L2 |
| 20ME002.5 | Impart the knowledge of Plasma Machining, Application of plasma for machining and electron beam machining | L1,L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

### Unit I: Introduction- Ultrasonic Machining 9 Hours

History, need, classification, comparison between conventional and nonconventional machining process and selection.
Ultrasonic Machining (USM) - Introduction, equipment details, cutting tool system design, mechanism of metal removal, effect of parameters, USM process characteristics, applications, advantages & disadvantages of USM.
*Advanced contact and Non contact methods*

### Unit II: Abrasive Jet Machining 9 Hours

Abrasive jet machining, Water jet machining and abrasive water jet machining: Basic principles, equipments, process variables, mechanics of material removal, MRR, application and limitations.
*Abrasive materials and its functioning*

### Unit III: Electro Chemical Machining 9 Hours

Fundamentals of electro chemical machining, electro chemical grinding, electro chemical honing and deburringprocess, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM, Simple problems for estimation of metal removal rate, fundamentals of chemical machining, advantages and applications.
*Applications of ECM*

### 9 Hours

General principle and applications of Electric DischargeMachining, Electric Discharge Grinding and wire EDM – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machiningaccuracy, characteristics of spark eroded surface.
*Advance metal removal rate,Main functions on MRR*

### Unit V: Electron And Laser Beam Machining, Plasma Machining 9 Hours

Electron Beam Machining, Laser Beam Machining - Basic principle and theory, mechanics of material removal, process parameters, efficiency & accuracy, applications
Plasma Machining: Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.
*Advanced machining process and its technique's*

### Text Books

4. Hassan Abdel, Fundamentals of Machining Processes-Conventional and non – conventional processeGawadEl-HafyCRC Press-2016.
5. Abdel H. and El-Hofy G., Advanced Machining Processes, McGraw-Hill,USA, 2005.
6. Anup Goel, A. Jacob Moses, Unconventional Machining Processes, Technical Publications, 1st, 2020
7. P C. Pandey, H S. Shan, MODERN MACHINING PROCESSES, mc Graw Hill

**Reference Books**

15. Gary F. Benedict, Non Traditional Manufacturing Processes, CRCPress-2017
16. VK Jain, Advanced machining processes, Alliedpublishers-2007

**Web References**

15. https://nptel.ac.in/courses/112/105/112105212/
16. https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-me15/

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 40 |
| L2 | 60 | 60 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

23. State the need for unconventional machining process.
24. What do you mean by recast layer with reference to the EDM?
25. What is the purpose of deflection coil in EBM process?
26. Write the various types of torches used in plasma arc machining
27. Name different gases used in AJM.

**L2: Understand**

21. Explain the factors that should be considered during the selection of an appropriate unconventional machining process for a given job.
22. With a neat sketch explain shaped tube electrolytic machining.
23. Explain the following in EDM with neat sketch
24. i) Electrode feed control system
    ii) Factors to be considered for EDM machine tool selection

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## PE 20ME003 Rotor Dynamics 3003

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME003.1 | *Explain rotor bearing interaction* | L1, L2 |
| 20ME003.2 | *Identify the types & classifications of components and Bearings,* | L2 |
| 20ME003.3 | *Demonstrate the stability of deformation* | L2 |
| 20ME003.4 | *Describe the principle of Transfer Matrix* | L2 |
| 20ME003.5 | *Use of Measurement Techniques in Rotor dynamics* | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**Unit I: Rotor-Bearing** **9 Hours**

Rotor-Bearing Interaction, Flexural Vibration, Critical Speeds of Shafts, Jeffcott Rotor Model, Unbalance Response, Effect of Damping, Campbell Diagram, Effects of Anisotropic Bearings, Unbalanced Response of an Asymmetric Shaft, Parametric Excitation, Gyroscopic Effects,

**Unit II: Discs** **9 Hours**

Rotor with Non-central Disc, Rigid-rotor of Flexible Bearings, Stodola Model, Effect of Spin Speed on Natural Frequency, Forward and Backward Whirling Motion, Aerodynamic Effects.

**Unit III: Rotor Shafts** **9 Hours**

Instability: Rub, Tangential forces, Rotor-shaft Continuum, Effect of Rotary Inertia and Shear-Deformation within the Shaft, Equivalent Discrete System, Finite Element model for Flexural Vibration, Torsional Vibration, Geared and Branched Systems

**Unit IV: Bearings** **9 Hours**

Transfer Matrix Model, Fluid Film Bearings: Steady State Characteristics of Bearings, Reynolds's Equation, Oil-Whirl, Rigid And Flexible Rotor Balancing,

**Unit V: Vibration** **9 Hours**

Active Vibration Control of Rotor-Bearing System: Active Magnetic Bearing, Condition Monitoring of Rotating Machinery, Measurement Techniques. Rolling element bearings, Fault diagnosis.

**Text Books**

1. Rao J. S, Rotor Dynamics, Third ed., New Age, New Delhi, 1996 (2009 reprint).
2. Goodwin M. J, Dynamics of Rotor-Bearing Systems, Unwin Hyman, Sydney, 1989.
3. Adams M.L, Rotating machinery vibration: from analysis to troubleshooting, Second ed., CRC Press, Boca Raton, 2010.
4. Kicinski J, Rotor dynamics, Tech. Book, New Delhi, 2010. 6. D. Childs, Turbomachinery Rotordynamics: Phenomena, Modeling and Analysis, Wiley, New York, 1993.

**Reference Books**

1. Krämmer E, Dynamics of Rotors and Foundation, Springer-Verlag, New York, 1993.
2. Genta G, Dynamics of Rotating Systems, Springer, New York, 2005.
3. Vance J.M, Rotordynamics of Turbomachinery, Wiley, New York, 1988.

**Web Reference**

1. https://www.youtube.com/watch?v=uvcvudNhsAc&list=PLbMVogVj5nJQuAmYkqn_qpAK1fDpmcT5j&index=2
2. https://www.youtube.com/watch?v=HARypmuVEBQ&list=PLbMVogVj5nJQuAmYkqn_qpAK1fDpmcT5j
3. https://www.youtube.com/watch?v=3z3LtneDQ68

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Rotor-Bearing Interaction
2. Jeffcott Rotor Model
3. Rigid-rotor of Flexible Bearings

**L2: Understand**

1. Derive Effect of Rotary Inertia and Shear-Deformation within the Shaft.
2. Explain Transfer Matrix Model

**L3: Apply**

1. Two-point masses of 0.3kg and 0.7kg are fixed at the ends of a rod which is of length 1.4m and of negligible mass. The rod is set rotating about an axis perpendicular to its length with a uniform angular speed. The point on the rod throughwhich the axis should pass in order that the work required for rotation of the rod is minimum is located at a distance of0.42 m from the mass of 0.3kg
   0.70 m from the mass of 0.7kg
   0.98m from the mass of 0.3kg
   0.98m from the mass of 0.7kg

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## PE 20ME004 Composite Material 3 0 03

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME004.1 | Explain the basic fundamental methods of composite technology | L1,L2, L3 |
| 20ME004.2 | Develop the constituent proportions to make composite materials | L1,L2, L3 |
| 20ME004.3 | Demonstrate the associated Mechanical Properties -Stiffness and Strength of composite materials | L1,L2, L3 |
| 20ME004.4 | Explain the practical difficulties of composite material usage | L1,L2, L3 |
| 20ME004.5 | Apply the concept of composite materials for industrial and other applications | L1,L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**Unit I: Introduction** **9 Hours**

Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal.

*Ceramic and polymer matrix composites.*

**Unit II: Manufacturing methods** **9 Hours**

Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs. Fibre/Matrix Interface, mechanical. Measurement of interface strength. Characterization of systems.

*Carbon fibre/epoxy, glass fibre/polyester*

**Unit III: Mechanical Properties -Stiffness and Strength** **9 Hours**

Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Shortfiber systems, woven reinforcements –Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension.

*compression, flexure and shear.*

**Unit IV: Laminates** **9 Hours**

Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Antisymmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angleply Laminate. Orthotropic Laminat.

*Laminate Moduli, Hygrothermal Stresses.*

**Unit V: Joining Methods and Failure Theories** **9 Hours**

Joining –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures.

*Advanced Joining methods and Failures*

**Text Books**

1. Introduction to Composite Materials Design, Ever J. Barbero, Taylor and Francis, Philadelphia, PA, 1998
2. Materials characterization, Vol. 10, ASM hand book,2000
3. Mechanical Metallurgy by G. Dieter Mc-Graw Hi,2007

**Web References**

17. NPTEL Syllabus - Introduction to Composites
18. www.eng.usf.edu/~kaw/class/composites/syllabus.fall2015.pdf

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 10 | 10 |
| L2 | 30 | 30 |
| L3 | 60 | 60 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

28. Write about composite materials?
29. State the applications of composite materials?
30. List the advantages and disadvantages?
31. Write about manufacturing methods?
32. Define laminates?
33. Write about mechanical properties, strength and stiffness?
34. Identify the joining methods?
35. Write short note on failure theories?

**L2: Understand**

25. Explain about the effect of composite materials?
26. What are the differences between alloy and composite?
27. Derive from various manufacturing methods
28. With a neat sketch, explain the working of a laminates
29. Explain the terms: variation of mechanical properties, strength and stiffness
30. Distinguish the various joining methods and failure analysis

**L3: Apply**

1. The flexural tests are conducted to determine the mechanical properties of resin and laminated fiber composite materials. Further, these tests are used to determine the interlaminar shear strength of a laminate, shear modulus, shear strength, tensile and compression moduli along with flexural and shear stiffness. These tests are not only used for composites but also for sandwich beams.

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## PE 20ME005 Product Design 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME005.1 | Demonstrate the technical and business aspects of the product development process | L1, L2 |
| 20ME005.2 | Explain Skilled in implementation of gathering data from customers and establish technical specification | L2 |
| 20ME005.3 | Develop product functional decomposition | L2 |
| 20ME005.4 | Describe engineering problem solving | L2 |
| 20ME005.5 | Apply the product modularisation, to be able to understand intellectual property issues in product development | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

### Unit I: Engineering Design 9 Hours

Need for developing products – the importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research.
*Create Innovative Products and Designs*

### Unit II:Quality 9 Hours

Identifying customer needs –voice of customer –customer populations- hierarchy of human needs-need gathering methods – affinity diagrams – needs importance- establishing engineering characteristics-competitive benchmarking- quality function deployment- house of quality.
*Product Design Specification-Case Studies*

### Unit III: Design Thinking 9 Hours

Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition –functional representation –morphological methods
*TRIZ- axiomatic design*

### Unit IV: Product Architecture 9 Hours

Decision making –decision theory –utility theory –decision trees –concept evaluation methods –Pugh concept selection method-weighted decision matrix –analytic hierarchy process – introduction to embodiment design –product architecture – types of modular architecture.
*Steps In Developing Product Architecture.*

### Unit V: Industrial Product design 9 Hours

Industrial design – human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost – overhead costs – activity based costing –methods of developing cost estimates.
*Manufacturing Cost, Value Analysis In Costing.*

### Text Books

1. Ulrich, K.T., Eppinger, S.D.: Product Design And Development; McGraw-Hill; 2004. ISBN 0-07-247146-8 0 0 Otto, K.N., Wood,2000
2. K.L.: PRODUCT DESIGN – Techniques In Reverse Engineering And New Product Development;

3. Feldhusen J., Grote K.H.: Engineering Design - A Systematic Approach, Springer 2007., ISBN 978-1-84628-318-5,2007
4. ChitaleA.K, Product Design and Manufacturing Paperback – 26 January 2014, Prentice Hall India Learning Private Limited; 6th edition, 2014

**Reference Books**

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development ", 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9
2. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7
3. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9

**Web Reference**

1. https://www.youtube.com/watch?v=HN9GtL21rb4&list=PLSGws_74K018yZOnbSaqWJZ837QyBB7vu
2. https://www.youtube.com/watch?v=QIdu_aULUG8
3. https://www.youtube.com/watch?v=07sZheNRiLc
4. https://www.youtube.com/watch?v=2OSLyFnvpw4

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. What are the different mechanical feeders? Explain working and constructionalfeatures of any two mechanical feeders.
2. List out the parameters considered for effect of quality levels of parts in indexing machines and explain any one of it.
3. Classify the different types of automated assembly system with schematic diagram.
4. Discuss briefly the effect of part thickness and part size on handling time.
5. Sketch and explain spiral elevators.
6. Draw the schematic diagram of a orienting system analysis and explain each term.

**L2: Understand**

1. Derive the expression for maximum feed rate for external gate feeder.
2. Derive an expression of proportion down time for free transfer machines and list out the values of buffer storage capacity be on the basis of factor k.
3. What are objective meet by the product design for assembly handbook.
4. With suitable example, discuss the two kinds of symmetry for a part.

**L3: Apply**

1. Briefly discuss the effect of parts quality on downtime.
2. What are the fundamental strategies employed to smoothen the automation and explain them?
3. List out the simple rules to be considered in designing of produce and parts in automatic assembly.
4. Deduce the empirical expression to estimate the manual insertion time.
5. What are the basic principles of automation and how it improves quantity of production?

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## PE 20ME006 Production Planning and control 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME006.1 | Recognize the objectives, functions, applications of PPC and forecasting techniques | L2 |
| 20ME006.2 | Explain different forecast techniques. | L2 |
| 20ME006.3 | Explain different inventory techniques. | L2 |
| 20ME006.4 | Summarize various routing techniques. | L2 |
| 20ME006.5 | Apply way of integrating different departments to execute Scheduling and dispatchingfunctions | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**Unit I: Introduction** 9 Hours

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** 9 Hours

Forecasting – importance of forecasting – types of forecasting, their uses – general principles of forecasting – forecasting techniques
*qualitative methods and quantitive methods.*

**Unit III: Inventory Control** 9 Hours

Inventory management – functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems. Introduction to MRP I, MRP II, ERP, LOB (Line of Balance),
*JIT and KANBAN system.*

**Unit IV:** Routing 9 Hours

Routing – definition – routing procedure –route sheets – bill of material – factors affecting routing procedure, schedule –definition
*difference with loading.*

**Unit V: Scheduling** 9 Hours

Scheduling policies – techniques, standard scheduling methods. Line Balancing, aggregate planning, chase planning, expediting, controlling aspects.
Dispatching – activities of dispatcher – dispatching procedure – follow up – definition – reason for existence of functions – types of follow up.
*applications of computer in production planning and control.*

### Text Books

1. Elements of Production Planning and Control / Samuel Eilon, 2000.
2. Manufacturing, Planning and Control, Partik Jonsson Stig-Arne Mattsson, Tata Mc Graw Hill.2000
3. Production Planning and Control, Mukhopadyay, PHI.2001
4. Production Control A Quantitative Approach / John E. Biegel.2003

### Reference Books

1. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller

**Web Reference**

1. https://www.youtube.com/watch?v=9qBZyzjogAo
2. https://www.youtube.com/watch?v=y24meNZbUpU
3. https://www.youtube.com/watch?v=9qBZyzjogAo
4. https://www.youtube.com/watch?v=Ic_El2DkpjA&list=RDCMUCdVa6bQpMlyMkG6k6VqXHzQ&index=3

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Explain the scope of production planning and control.
2. Explain different types of production systems and differentiate between them.
3. Distinguish between production planning and production control and state their objectives.
4. Discuss organization of Production planning and control department.
5. Define follow up and explain different types of the follow up in detail.
6. Define follow up and explain different types of the follow up in detail

**L2: Understand**

1. Describe 'Least Square Method' of sales forecasting with its advantages and limitations.
2. Bring out any four differences between scheduling and loading
3. What is aggregate planning? Write its functions, merits and demerits.
4. Discuss in detail the sequential steps involved in dispatching.
5. Describe 'Least Square Method' of sales forecasting with its advantages and limitations. b) Describe the Survey of buyers intention method of sales fore casting with its advantages and limitations.
6. Explain the various elements of JIT.

**L3: Apply**

1. Forecast the production for next two years when the production quantity for last ten years is as follows: 200, 225, 235, 240, 255, 260, 265, 275, 270, 271 Use the following methods and comment on results. (i) Moving average (3 years and 5 years) ii) Exponential smoothing for α=0.3 and 0.7.
2. Alpha industry estimates that it will sell 12000 units of its product for the forthcoming year. The ordering cost is Rs. 100 per order and the carrying cost per unit per year is 20% of the purchase price per unit. The purchase price per unit is Rs.50.Findi) Economic Order quantity, ii) No. of orders per year and iii) Time between successive orders.

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Head of the Department
Mechanical Engineering
N.S. Raju Institute of Engineering &
Visakhapatnam-531173

**PC** **20ME007 Refrigeration and Air- Conditioning** **3 0 0 3**

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME007.1 | Understand the necessity and application of refrigeration system. | L1 |
| 20ME007.2 | Gain the knowledge regarding working and essential components of simple vapour refrigeration cycle. | L1,L2 |
| 20ME007.3 | Understand the desirable properties & classification of refrigerants and explanation on different components of vapour compression refrigeration system. | L1,L2 |
| 20ME007.4 | Discussion on vapour absorption system,its components and its classification. | L1,L2,L3 |
| 20ME007.5 | Familiarize the basic principle psychometric properties of vapour in air-conditioning system and classification pf air-conditioning equipments. | L1,L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**Unit I: INTRODUCTION TO REFRIGERATION** **9 Hours**

Necessity and applications – unit of refrigeration and C.O.P. –Mechanical refrigeration – types of ideal cycles of refrigeration. air refrigeration: bell coleman cycle - open and dense air systems – refrigeration systems used in air crafts and problems.

**Unit II: VAPOUR COMPRESSION REFRIGERATION** **9 Hours**

Working principle and essential components of the plant –simple vapour compression refrigeration cycle – COP – representation of cycle on T-S and p-h charts – effect ofsub cooling and super heating – cycle analysis – actual cycle influence of various parameters on system performance – use of p-h charts – numerical problems.

**Unit III: REFRIGERANTS** **9 Hours**

Desirable properties – classification - refrigerants used – nomenclature – ozone depletion –global warming
**VCR SYSTEM COMPONENTS-** Compressors – general classification – comparison – advantages anddisadvantages. condensers – classification – working principles evaporators – classification – working principlesexpansion devices – types – working principles

**Unit IV: VAPOR ABSORPTION SYSTEM** **9 Hours**

Calculation of maximum COP – description and working of NH3 – watersystem and Li Br –water ( Two shell & Four shell) System, principle of operation three fluid absorption system,salient features.
**STEAM JET REFRIGERATION SYSTEM:** Working Principle and basic components. principle and operationof (i) thermoelectric refrigerator (ii) vortex tube.

**Unit V: INTRODUCTION TO AIR CONDITIONING** **9 Hours**

Psychometric properties & processes – characterization ofsensible and latent heat loads — need for ventilation, consideration of infiltration – load concepts of RSHF,GSHF- problems, concept of ESHF and ADP temperature.Requirements of human comfort and concept of effective temperature- comfort chart –comfort air conditioning –requirements of industrial air conditioning, air conditioning load calculations.
**AIR CONDITIONING SYSTEMS:** Classification of equipment, cooling, heating humidification anddehumidification, filters, grills and registers, fans and blowers. heat pump – heat sources – different heat pumpcircuits.

**Text Books**

1. A Course in Refrigeration and Air conditioning , SC Arora &DomkundwarPublications 2016
2. Refrigeration and Air Conditioning / CP Arora / TataMacGrawHill Publications-2017
3. Refrigeration and Air Conditioning, R.S.Khurmi , S.Chand Publications-2013

**Reference Books**

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age Publications-2017.
2. Principles of Refrigeration /Dossat / Pearson Education-2012
3. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / TMH-2015

**Web References**

19. https://nptel.ac.in/courses/112/105/112105123/
20. https://nptel.ac.in/courses/112/105/112105266/
21. https://nptel.ac.in/courses/101/104/101104063/

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Define Tonne of Refrigeration.
2. Sketch the P-h and T-s diagrams of sub-cooling?
3. Write short note on ozone layer depletion
4. Define Global warming

**L2: Understand**

1. What is the effect of sub cooling and super heating in vapor compression.
2. Distinguish between dry and wet compression?
3. What do you understand by effective room sensible heat factor?
4. List out the advantages and disadvantages of viscous filters over dry filters?
5. How do SHF and GSHF differ from one another?

**L3: Apply**

1. An air refrigeration system working on Bell-coleman cycle operates between 1 bar and 7 bar. The temperature maintained in the cooler is 130 C. The air leaving the compressor is cooled to 370 C. The compression follows the law pv1.3=C and the expansion follows the law pv1.35=C. Find (i) theoretical COP (ii) Mass flow rate of air required to manufacture ice at 00 C when water supplied at 300 C at a rate of 5 tons/day. Take latent heat of ice=335 kJ/kg.

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BoardofStudies(ME)

Head of the Department
Mechanical Engineering
R.S. Rao Institute of Technology (A)
Visakhapatnam-531173

## PE 20ME008 Flexible Manufacturing Systems 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME302.1 | Apply to plan schedule and control of flexible manufacturing system. | L1, L2, L3 |
| 20ME302.2 | Understand the various system modeling techniques in association to flexible manicuring systems | L2 |
| 20ME302.3 | Compare the system modeling issues in terms of Manufacturing approach | L2 |
| 20ME302.4 | Apply the different performance analysis methods to manufacturing systems | L3 |
| 20ME302.5 | Apply the preventive measures in the mass production systems | L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**Unit I: Overview of Flexible Manufacturing Systems** **9 Hours**

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

**Unit II: System Modelling Issues** **9 Hours**

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

**Unit III: System Modelling Tools And Techniques** **9 Hours**

System Modeling Tools and Techniques: Introduction to mathematical modeling, optimization, and simulation; issues related with deterministic and stochastic models.
Continuous and discrete mathematical modeling methods -discrete event, monte carlo method; Basic concepts of Markov chains and processes; The M/M/1 and M/M/m queue; Models of manufacturing systems including transfer lines
*flexible manufacturing systems, introduction to Petri nets.*

**Unit IV: Performance Analysis** **9 Hours**

Performance Analysis: Transient analysis of manufacturing systems, analysis.
*Advanced Manufacturing systems*

**Unit V: Preventative Maintenance** **9 Hours**

Preventive maintenance, Kanban system, implementation issues
*Various issues in maintenance*

**Text Books**

4. N. K. Jha, "Hand Book of Flexible Manufacturing Systems", 1st Edition, Academic Press, 2013.
5. Taiichi Ohno, "Production System beyond Large Scale Production", 1st Edition, Toyota Productivity Press India Pvt. Ltd, 2010.
6. H K Shivanand, "Flexible Manufacturing Systems", 1st Edition, New Age International, 2006.
7. P. Radha Krishnan, "CAD/ CAM/ CIM", 4th Edition, New Age International, 2016

**Reference Books**

1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, 2nd Edition, New Age International, 2004.

**Web References**

1. http://www.ignou.ac.in/upload/UNIT6-55.pdf
2. https://www.elsevier.com/books/surface-modeling-for-cad-cam/choi/978-0-444-88482-4

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. List the basic components ofFMS.
2. Distinguish between continuous and discrete modelingtechniques
3. What is scheduling?
4. Define FMS
5. What are the various system Modeling issues?
6. What is meant by job order production?
7. Identify Basic concepts of Markov chains
8. How the concept of system design procedures is useful in Production?
9. Identify the system modeling issues and controlthem.
10. Explain the concept ofscheduling.

**L2: Understand**

11. Explain the basic concepts of FMS.
12. Describe the concept of system design procedures
13. Demonstrate the system modeling issues and control them.
14. Distinguish between continuous and discrete modeling techniques.
15. Design models of manufacturing systems.

**L3: Apply**

16. Apply the concept of system design procedures to different levels of Production.
17. Apply the concept of scheduling.
18. Understand and Apply system model techniques.
19. Illustrate the continuous and discrete modeling techniques.
20. Adapt the design models of manufacturing systems.

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**PE** **20ME009Optimization Techniques** **3 0 0 3**

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME009.1 | Recognize classification of optimization problem and apply classical optimization techniques | L1,L2, L3 |
| 20ME009.2 | Apply unconstrained optimization techniques using various methods | L1,L2, L3 |
| 20ME009.3 | Recognize the characteristics and approaches of constrained optimization techniques | L1,L2, L3 |
| 20ME009.4 | Analyze optimized solutions using constrained and unconstrained geometric programming | L1,L2, L3 |
| 20ME009.5 | Perceive integer programming methods | L1,L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

**Unit I: Introduction to Optimization and Classical Optimization Techniques** **9 Hours**

Engineering applications of optimization- statement of an optimization problem- classification of optimization problem- optimization techniques.
Single variable optimization- multivariable optimization with equality constraints
*Multivariable optimization with inequality constraints.*

**Unit II: Unconstrained Optimization Techniques** **9 Hours**

Pattern search method- Rosen Brock's method of rotating coordinates- Simplex method- Descent methods- Gradient of function- Steepest Descent method.
*Advance applications to unconstrained optimization techniques*

**Unit III: Constrained Optimization Techniques** **9 Hours**

Characteristics of constrained problem- methods of feasible directions - basic approach in the penalty function method- interior penalty function method.
*Convex programming problem- exterior penalty function method.*

**Unit IV: Geometric Programming** **9 Hours**

Solution of an unconstrained geometric programming, differential calculus method and arithmetic method. Primal dual relationship and sufficiency conditions. Solution of a constrained geometric programming problem (G.P.P).
*Complimentary geometric programming (C.G.P)*

**Unit V:Integer Programming** **9 Hours**

Graphical representation. Gomory's cutting plane method. Bala's algorithm for zero-one programming problem.
*Integer and non linear programming.*

**Text Books**

8. S.S.Rao,"Optimization Theory and Applications",3rdEdition, Wiley Eastern Limited, New Delhi, 1996
9. Kalyanmanai Deb, "Engineering Optimization", 8thEdition, Prentice Hall of India, New Delhi, 2005
10. C.Mohan& Kusum Deep, "Optimization Techniques-Theory and applications", 1st Edition, New Age International, 2013.

**Reference Books**

4. S.D.Sharma, "Operations Research", 6th Edition,MacMillan Publishers,2014.

**Web References**

22. https://nptel.ac.in/courses/111/105/111105039/
23. https://onlinecourses.nptel.ac.in/noc21_me10/preview

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

5. Write the typical applications of optimization in the field of mechanical engineering.
6. What are the various applications of optimization problems?
7. What are the differences between elimination and interpolation methods?
8. State the optimization problem. Explain various types of optimization problems with examples.
9. What are the limitations of integer programming?
10. State the Kuhn–Tucker conditions.

**L2: Understand**

6. Explain the computational procedure used in geometric programming..
7. Explain in detail the principle of optimality
8. Explain Kuhn-Tucker conditions applicable to non-linear programming problem.
9. Explain various types of optimization problems with examples.

**L3: Apply**

1. Use simplex method to solve the following LP problem minimize Z=5x+6y subject to the following constraints: 2x+5y≥1500; 3x+y≥ 1200 and x, y≥0.
2. Using Powel's method Minimize f(x) =$x1-x_2 + 2x_1^2 + 2x_1x_2 + x^2$ from the starting point x1= (0,0)
3. Use dynamic programming technique to solve the following problem. Max $Z = X_1.X_2.X_3.X_4$
   Subject to $X_1 + X_2 + X_3 + X_4 = 12$ , $X_1, X_2, X_3, X_4 \geq 0$
4. Find all the basic solutions corresponding to the system of equations:
   $2x_1 + 3x_2 - 2x_3 - 7x_4 = 1$
   $x_1 + x_2 + x_3 + 3x_4 = 6$
   $x_1 - x_2 + x_3 + 5x_4 = 4$

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**PE** **20ME010 Material Characterization** 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME501.1 | Apply appropriate characterization techniques for microstructure examination at different magnification level and use them to understand the microstructure of various materials | L1,L2, L3 |
| 20ME501.2 | Choose and appropriate electron microscopy techniques to investigate microstructure of materials at high resolution | L1,L2, L3 |
| 20ME501.3 | Determine crystal structure of specimen and estimate its crystallite size and stress | L1,L2, L3 |
| 20ME501.4 | Use appropriate spectroscopic technique to measure vibrational / electronic transitions to estimate parameters like energy band gap, elemental concentration, etc. | L1,L2, L3 |
| 20ME501.5 | Apply thermal analysis techniques to determine thermal stability of and thermodynamic transitions of the specimen. | L1,L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**Unit I: Introduction and Optical microscope** **9 Hours**

Introduction: Need of materials characterization and available techniques. Optical Microscopy: Optical microscope - Basic principles and components, Different examination modes (Bright field illumination, Oblique illumination, Dark field illumination, Phase contrast, Polarised light, Hot stage, Interference techniques), Stereomicroscopy, Photomicroscopy, *Colour metallography, Specimen preparation, Applications.*

**Unit II: Electron microscope** **9 Hours**

Interaction of electrons with solids, Scanning electron microscopy Transmission electron microscopy and specimen preparation techniques, Scanning transmission electron microscopy, Energy dispersive spectroscopy, *Wavelength dispersive spectroscopy.*

**Unit III: Diffraction method** **9 Hours**

Fundamental crystallography, Generation and detection of X-rays, Diffraction of X-rays, X-ray diffraction techniques, *Electron diffraction*

**Unit IV: Surface analysis and Spectroscopy** **9 Hours**

Atomic force microscopy, scanning tunneling microscopy, X-ray photoelectron spectroscopy, Atomic absorption spectroscopy, UV/Visible spectroscopy, *Fourier transform infrared spectroscopy, Raman spectroscopy.*

**Unit V: Thermal Analysis** **9 Hours**

Thermo gravimetric analysis, Differential thermal analysis, Differential Scanning calorimeters, Thermo mechanical analysis and dilatometers *Advanced Thermal Analysis and structures*

**Text Books**

1. Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang: CRC Press, (2008)
2. Cullity, B.D., and Stock, R.S., "Elements of X-Ray Diffraction", Prentice-Hall, (2001)
3. Tyagi, A.K., Roy, Mainak, Kulshreshtha, S.K., and Banerjee, S., Advanced Techniques for Materials Characterization, Materials Science Foundations (monograph series), Volumes 49 – 51, (2009).

**Reference Books**

1. Wachtman, J.B., Kalman, Z.H., Characterization of Materials, ButterworthHeinemann, (1993).
2. Wendlandt, W.W., Thermal Analysis, John Wiley & Sons, (1986).

**Web References**

1. **https://nptel.ac.in/content/syllabus_pdf/115103030.pdf**
2. **https://www.alf.ncsu.edu/mct/**

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 10 | 10 |
| L2 | 30 | 30 |
| L3 | 60 | 60 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Briefly explain and Write about Optical microscope?
2. List the advantages and disadvantages of Scanning electron microscope?
3. Write about various diffraction methods?
4. Briefly explain surface analysis and various methods?
5. Write about spectroscope analysis?
6. Write short note on thermal anaysis?

**L2: Understand**

2. Explain about the Transmission electron Microscope?
3. What are the differences between spectroscope analysis and diffraction analysi?
4. With a neat sketch, explain the working principle of SEM
5. Explain the terms: variation of Differential Scanning calorimeters
6. Distinguish the various thermal analysis

**L3: Apply**

1. The most common type of SEM data is the secondary electron image. The SE image is a map of secondary electron emission as a function of spatial position. SE images generally display the topography of the sample. The number of secondary electrons emitted from a surface generally depends on the angle of incidence between the surface and the beam. Since the electron beam is perpendicular to the sample over the analysis area, the number of secondary electrons emitted from the sample is generally a function of the topography of the sample.

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Head, Department
Mechanical Engineering
N.S. Raju Institute of Technology (A)
Visakhapatnam-531173

## PE 20ME011 CAD/CAM 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME011.1 | Describe basic structure of CAD workstation, Memory types, input/output devices and display devices and computer graphics | L1 |
| 20ME011.2 | Acquire the knowledge of geometric modelling and Execute the steps required in CAD software for developing 2D and 3D models and perform transformations | L1 |
| 20ME011.3 | Explain fundamental and advanced features of CNC machines | L2 |
| 20ME011.4 | Illustrate Group Technology, CAQC and CIM concepts | L2 |
| 20ME011.5 | Ability to develop a product from conceptualization to reality. | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

**Unit I:** **9 Hours**

Computers in industrial manufacturing, product cycle, CAD / CAM Hardware, basic structure, CPU, memory types, input devices, display devices, hard copy devices, storage devices.
**COMPUTER GRAPHICS:** Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections.
*clipping, hidden surface removal.*

**Unit II:** **9 Hours**

**GEOMETRIC MODELING:** Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.
**DRAFTING AND MODELING SYSTEMS:** Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling.
*Design and analysis of an modelling system*

**Unit III:** **9 Hours**

**PART PROGRAMMING FOR NC MACHINES:** NC, NC modes, NC elements, CNC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming: fundamentals, manual part programming methods, Computer Aided Part Programming.Direct Numerical Control, Adaptive Control.
*Advanced numerical control system*

**Unit IV:** **9 Hours**

**GROUP TECHNOLOGY:** Part family, coding and classification, production flow analysis, types and advantages.Computer aided processes planning – importance, types.
**COMPUTER INTEGRATED MANUFACTURING SYSTEMS:** Types of manufacturing systems, machine tools and related equipment, material handling systems, material requirement planning, computer control systems, human labor in manufacturing systems, CIMS benefits
*Advanced CIMS technology*

**Unit V:** **9 Hours**

**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.
*Advanced Computer aided quality control*

**Text Books**

1. CAD / CAM / CAE E Zimmers&M.Groover/Pearson Education. 2000
2. Automation, Production systems & Computer integrated Manufacturing/ Groover/P.E,2001
3. CAD / CAM A Zimmers&P.Groover/PE/PHI, 2003

**Reference Books**

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

**Web References**

1. https://www.brainkart.com/article/Product-cycle_5703/
2. https://www.designtechsys.com/articles/computer-geometric-modeling
3. https://shodhganga.inflibnet.ac.in/bitstream/10603/4512/16/16_chapter%206.pdf
4. https://www.data.org.uk/media/1180/main-applications-of-cad-cam.pdf
5. https://link.springer.com/chapter/10.1007/978-94-009-1063-8_57
6. https://www.revotechnologies.net/uploads/1/8/0/7/16078520/unit_iii-acim.pdf
7. https://www.brighthubengineering.com/cad-autocad-reviews-tips/84482-computer-aided-quality-control-or-caqc/

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Define Bezier surface? Explain various characteristics of this surface.
2. In detail explain the salient features of solid modeling.
3. Differentiate Manual part programming and Computer assisted part programming.
4. Explain the concept of adaptive control of NC machines.
5. What is group technology? When is it suitable in manufacturing? What are its benefits.
6. Draw and explain the CAD/CAM product cycle.
7. What are the input devices more commonly employed for general graphics applications? Present their merits and demerits.
8. What is meant by sweep? Discuss in detail the various types of sweep techniques available for 3D geometric construction.

**L2: Understand**

1. What is CAPP? Explain the any one type of Capp with neat sketches.
2. Briefly explain some of the methods used in computer aided quality control.
3. Explain the integration of CAQC with CAD/CAM
4. Discuss the principle of material handling. Name and describe the five types of material handling devices?
5. Explain the different types of manufacturing systems.

**L3: Apply**

1. Discuss the role of human labor in manufacturing systems.
2. Explain the any one type of Non-contact inspection technique used in computer aided quality control system.
3. How do you overcome the difficulties in traditional process planning by adopting CAPP method?
4. Define computer aided quality control. Explain how it is implemented

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## PE 20ME012Total Quality Management 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME302.1 | Relate the fundamental concepts of total quality management. | L2 |
| 20ME302.2 | Demonstrate the customer focus and satisfaction. | L2 |
| 20ME302.3 | Explain the organisation total quality management. | L2 |
| 20ME302.4 | Illustrate the cost of quality information. | L2 |
| 20ME302.5 | Interpret the international quality standards study and behaviour and its properties. | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

**Unit I: Introduction** **9 Hours**

Introduction: The concept of TQM, Quality and Business Performance, Attitude and Involvement of Top Management, Communication, Culture and Management Systems. Management of Process Quality: Definition of Quality, Quality Control, a Brief History, Product Inspection Vs Process Control, Statistical Quality Control.

*Control Charts and Acceptance Sampling.*

**Unit II: Customer Focus and Satisfaction** **9 Hours**

Customer Focus and Satisfaction: Process Vs Customer, Internal Customer Conflict, Quality Focus, Customer Satisfaction, Role of Marketing and Sales, Buyer – Supplier Relationships. Bench Marking: Evolution of Bench Marking, Meaning of Bench Marking, Benefits of Bench Marketing.

*Bench Marking Procedure, Pitfalls of Bench Marketing.*

**Unit III: Organizing for TQM** **9 Hours**

Organizing for TQM: The Systems Approach, Organizing for Quality Implementation, Making the Transition from a Traditional to a TQM Organization, Quality Circles, Seven Tools of TQM: Stratification, Check Sheet, Scatter Diagram, Ishikawa Diagram.

*Pareto Diagram, Kepner and Tregoe Methodology.*

**Unit IV: The Cost of Quality** **9 Hours**

Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost Information, Accounting Systems and Quality Management.
*Stages of an quality control*

**Unit V: ISO9000** **9 Hours**

Universal Standards of Quality: ISO Around the World, The ISO9000 ANSI/ASQC Q-90, Series Standards, Benefits of ISO9000 Certification the Third Party Audit, Documentation ISO9000 and Services, the Cost of Certification Implementing the System.

*Stages of an ISO System*

**Text Books**

1. Total Quality Management / Joel E. Ross/Taylor and Francis Limited/2000
2. Total Quality Management/P. N. Mukherjee/PHI/2001
3. Quality Management/Kanishka Bedi/Oxford University Press/2011
4. Total Engineering Quality Management/Sunil Sharma/Macmillan/2003

**Reference Books**

1. Total quality management /K.Shridharbhat/ Himalaya Publishing house/2017
2. Total quality management /Dr.K.C.Arora/ S K Kataria and sons/ 2013.
3. Total Quality Management/ Nagarazan.RS,Arivalagar AA/New age International PVT LTD Publishers/2015

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. What is PDSA cycle?
2. What is inspection by variables?
3. Should the buyer-supplier relationship be based on trust or suspicion? Why?
4. What do you understand by delighting the customer?
5. Briefly point out the anatomy 'Quality circles'.
6. What is the purpose served by drawing fish-bone diagram?
7. Should quality be free? Why or why not?

**L2: Understand**

1. Draw a cause effect diagram for painting defects in your house.
2. What is the role of top management in organizing transition to TQM?
3. What are the objectives of ISO 9000?
4. Which are the four tiers of documentation in ISO 9000?

**L3: Apply**

7.10 samples, each of size 50, of pipe were inspected in pressure testing. The results of the inspection are given below: Sample No. 1 2 3 4 5 6 7 8 9 10 No. of defectives 2 3 2 0 2 3 2 1 2 3 Draw a p-chart and state your conclusion.

8. Construct a Pareto diagram for the analysis of internal failures for the following data:

| S.No | Type of cost | Rupees in thousands Purchasing |
|---|---|---|
| 1 | Purchase -ejects | 200 |
| 2 | Design --scrap | 210 |
| 3 | Operationsrework | 321 |
| 4 | Purchasingrework | 21 |
| 5 | All Other | 65 |

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## HO 20MEH01Advanced Thermodynamics 4 0 0 4

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20MEH01.1 | Describe the non-reactive mixtureproperties. | L1,L2 |
| 20MEH01.2 | Comparevapour and Gas power cycles | L2 |
| 20MEH01.3 | Explain importance of Direct Energy Conversion of Fuel Cells | L2 |
| 20MEH01.4 | Apply concept ofthermodynamic laws | L3 |
| 20MEH01.5 | Interpret chemical reaction and combustion of gas- mixtures | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

**Unit I: Review of Thermodynamic Laws & Corollaries:** **12 Hours**

Transient flow analysis, Second law thermodynamics, Entropy, Availability and unavailability, Thermodynamic potential. Maxwell relations, Specific heat relations, Mayer's relation.

*Evaluation of thermodynamic properties of working substance.*

**Unit II: P.V.T Surface:** **12 Hours**

Equation of state. Real gas behavior, Vander Waal's equation, Generalization compressibility factor. Energy properties of real gases. Vapour pressure, Clausius, Clapeyron equation. Throttling, Joule. Thompson coefficient. Non reactive mixtures of perfect gases. Governing laws, Evaluation of properties, Psychometric mixture propertiesandpsychometricchart, Air-conditioning processes.

*Cooling towers. Real gas mixture.*

**Unit III: Combustion:** **12 Hours**

**Combustion Reactions, Enthalpy of formation. Entropy of formation, Reference levels of tables. Energy of formation, Heat reaction, Adiabatic flame temperature generated product, Enthalpies, Equilibrium. Chemical equilibrium of ideal gasses, Effect of non reactinggasesequilibriuminmultiplereactions,TheventHoff'sequation.**

***The chemical potential and phase equilibrium. The Gibbs phase rule.***

**Unit IV: Power Cycles:** **12 Hours**

Reviewbinaryvapourcycle,cogenerationand combined cycles,Secondlawanalystsof cycles Refrigeration cycles. Thermodynamics off irreversible processes. Introduction, Phenomenological laws, Onsaga Reciprocity relation, Applicability of the Phenomenological relations, Heat flux and entropy production,

*Thermodynamic phenomena, Thermo electric circuits.*

**Unit V: Direct Energy Conversion Introduction** **12 Hours**

Fuel cells, Thermo electric energy, Thermo ionic power generation, Thermodynamic devices magneto hydrodynamic generations, and Photovoltaic cells.

*Applications of andirect energy conversion*

**Text Books**

1. Nag.P.K-EngineeringThermodynamics,6thEdition,McGrawHil- 2013
2. Sonntag,Borgnakke,VanWylen,FundamentalsofThermodynamics–6thEdition,Wiley-2015
3. YunusACenegel,MichaelABoles,Thermodynamics,anEngineeringApproach,8thEdition-MCH- 2014
4. Dr.J.P.HolmanThermodynamics–,McGrawHill-6thEdition,McGrawHill- 2013

**Reference Books**

1. PrasannaKumar, Thermodynamics,PearsonPublishers- 6thEdition,McGrawHill- 2011
2. Jones&Dugan, EngineeringThermodynamics–PHI- 6thEdition,McGrawHill- 2012.
3. Dr.Y.V.C.Rao-An Introduction to Thermodynamics– Universities presses publications- 2012.
4. W.Z.Black&J.G.Hartley, Thermodynamics, 3rd Edition- Pearson Publications- 2010.

**Web References**

3. https://nptel.ac.in/courses/112/105/112105123/
4. https://nptel.ac.in/courses/112/105/112105266/
5. https://nptel.ac.in/courses/101/104/101104063/

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

8. Whataretheltypesofthermodynamicsystems?
9. Definequasi-staticprocess.
10. Whatissecondlawofthermodynamics?
11. Listtheentropycategorieswithrespecttothermodynamicrelations.
12. Write theenthalpyfunctionsofthermodynamicsproperties.
13. Whatareavailabilityandirreversibility?
14. DefineCarnot'stheorem.
15. Describethetriplepointandcriticalpoint.
16. Whatisidealgas?
17. Definedrybulbtemperatureandwetbulbtemperature.

**L2: Understand**

7. Describetheconceptofthermometryanditsreferencepoints
8. Whatarethedifferencesbetweenpointfunctionandpathfunction?
9. Describethecorollariesoffirstlawofthermodynamics
10. DemonstrateKelvinPlanckandClausiusstatementwithexample
11. Whatdomeanbythetermsrelativehumidityandspecifichumidity?

**L3: Apply**

9. A pump discharges a liquid into a drum of rate of the 0.032 $m^3$/sec .Thedrum constitute the diameter of 1.5m and 4.2 in length, which can hold 3000kg of theliquid. Find the density of the liquid at the mass flow rate of the liquid handled by thepump.
10. IllustrateFirstlawappliedtoaflowsystem.
11. An engine cylinder has a piston of area 0.12sq.m and contains gas at a pressure of1.5Mpa,thegasexpandsaccordingtotheprocessWhichrepresentedbyastraight lineon a pressure volume. The final pressure is 0.15MPa. Calculate the work done on a gasbythepiston.
12. DesignP-V-TsurfacesandT-S,h-s diagrams.
13. Find the enthalpy and entropy of a steam, When the pressure is 2 MPaand specificvolumeis0.09 $m^3$/kg

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## HO 20MEH02Advanced Heat Transfer

| 4 | 0 | 0 | 4 |
|---|---|---|---|

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20MEH02.1 | Develop heat conduction equation for various conditions and able to solve 1D and 2D problems | L1,L2,L3 |
| 20MEH02.2 | Apply the conservation equations on forced convection | L1,L2,L3 |
| 20MEH02.3 | Compare the effect of various parameters on the convective heat transfer | L1,L2,L3 |
| 20MEH02.4 | Estimate the effect of various geometries on free convection and Explain the phenomenon of boiling and condensation | L1,L2,L3 |
| 20MEH02.5 | Compute the heat transfer rate through radiation and Discuss the phenomenon of convective mass transfer. | L1,L2,L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: Introduction** **12 Hours**

Brief Introduction To Different Modes Of Heat Transfer: Conduction: General heat Conduction equation, initial and boundary conditions. Transient Heat Conduction: Lumped system analysis, Heisler charts, semi infinitesolid,use of shape factors in conduction, 2D transient heat conduction,

*product solutions*

**Unit II: Finite Difference Methods For Conduction & Convection** **12 Hours**

**Finite Difference Methods For Conduction:** ID & 2D steady state and simple transient heat conduction problems, implicit and explicit methods. Forced Convection: Equations of fluid flow, concepts of continuity, momentum equations, derivation of energy equation, methods to determine heat transfer coefficient: Analytical methods, dimensional analysis and concept of exact solution.

*Approximate method, integral analysis.*

**Unit III: External & Internal Flows** **12 Hours**

**External Flows:** Flow over a flat plate: Integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to variation geometries for laminar and turbulent flows.

**Internal Flows:** Fully developed flow: Integral analysis for laminar heat transfer coefficient,types of flow, constant wall temperature and constant heat flux boundary conditions, hydrodynamic &thermal entry lengths;

*Use of empirical correlations.*

**Unit IV: Free & Forced Convection** **12 Hours**

**Free Convection:** Approximate analysis on laminar free convective heat transfer, boussinesqueapproximation ,different geometries, combined free and forced convection.

**Boiling and Condensation:** Boiling curve, correlations, Nusselts theory of film condensation on a vertical plate, assumptions & correlations of film condensation for different geometries.

*Heat Exchangers Types of Heat Exchangers, LMTD and NTU methods*

**Unit V: Radiation Heat Transfer** **12 Hours**

**Radiation Heat Transfer:** Radiant heat exchange in grey, non, grey bodies, with transmitting, Reflecting and absorbing media, specular surfaces, gas radiation, from flames.

**Mass Transfer:** Concepts of mass transfer, diffusion & convective mass transfer analogies.

*Significance of non- dimensional numbers.*

**Text Books**

1. R.C.Sachdeva, "Fundamentals of Engg. Heat and Mass Transfer",5thEdition, New Age International Publications, 2013
2. P.K.Nag "Heat Transfer", 3rd Edition, TMH, 2015
3. R.K. Rajput, "Heat and Mass Transfer",RevisedEdition, S.Chand Publications, 2014

## Reference Books

1. F.P.Incropera, D.P.Dewitt, T.L.Bergman, A.S.Lavine, K.S. Seetharamu, T.R.Seetharam, "Fundamentals of Heat and Mass Transfer", Wiley India, 1st Edition, McGraw Hill, 2013.
2. Frank Kreith, R. M. Manglik& M. S. Bohn, "Principles of Heat Transfer" , Special Edition, Cengage learning publishers, 2012.
3. D.S .Kumar, "Heat and Mass Transfer", 3rd Edition, S.K. Kataria& Sons Publications, 2012.
4. J. P. Holman, "Heat Transfer", Indian Edition, TMH Publications, 2014.
5. Cengel, "Heat and Mass Transfer", 5th Edition, McGraw Hill Publications, 2015.

## Web References

1. https://nptel.ac.in/courses/112101097/
2. http://web.mit.edu/lienhard/www/ahttv212.pdf/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-051-introduction-to- heat-transfer-fall-2015/

## Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| L4 | - | - |
| Total (%) | 100 | 100 |

## Sample Short and Long Answer Questions of Various Cognitive Levels

**L1: Remember**

1. Differentiate between thermodynamics and heat transfer.
2. What are Fourier and Biot numbers?
3. State the assumptions on which Fourier's law is based.
4. What log mean area is as applied to hollow cylinder?
5. Describe efficiency and effectiveness of fin.
6. Why thermal conductivity of metals higher than that of fluids?
7. Define thermal conductance and thermal resistance.
8. State Lambert's cosine law

**L 2: Understand**

1. Explain the "Relaxation Method" in solving two dimensional heat conduction problems.
2. What is a radiation shield? Derive the expression for heat transfer through "n "number of shields between two plates.

**L 3: Applying**

1. Derive an expression for the shape factor in case of radiation between two surfaces.
2. The inside dimensions of a furnace are 3 m x 2.5 m x 2 m. The walls are 0.2 m thick and have thermal conductivity of 1.3 w/m°C. If the temperatures at the inner and outer surfaces are 300°C and 100°C respectively, calculate the rate of heat loss.
3. A 50 cm x 50 cm copper slab, 6 mm thick at a uniform temperature of 350°C suddenly has its surface temperature lowered to 30°C. Find the time at which the slab temperature becomes 100°C. h = 100 W/m²°C. Also, find the rate of cooling after 60 seconds.
4. A cylinder 5 cm diameter and 50 cm long, is provided with 14 longitudinal straight fins of 1 mm thick and 2.5 mm height. Calculate the heat loss from the cylinder per second if the surface temperature of the cylinder is 200°C. Take h=25W/m²K, k=80W/m0K and ambient temperature=45°C.

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## HO 20MEH03Jet Propulsion and Rocket Engineering 4 0 0 4

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20MEH03.1 | Explain the working of jet engines and rocket propulsion systems | L2 |
| 20MEH03.2 | Describe liquid propellant rocket engines. | L2 |
| 20MEH03.3 | Discuss solid propellant rocket engines and explain rocket motor design approach. | L2 |
| 20MEH03.4 | Classify solid propellants and discuss the characteristics | L2 |
| 20MEH03.5 | Explain the working of hybrid propellant rockets and select the process for rocket propulsion systems. | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

### Unit I: Turbine 12 Hours

Fundamentals of Gas Turbine theory-Then-no dynamic Cycles, open closed and semi-closed — parameters of performances — cycle modifications for improvement of performance. JET PROPULSION: Historical sketch-reaction principle — essential features of propulsion devices-Thermal Engines, Classification of— Energy flow thrust,

*Thrust power and propulsion efficiency-Need for Thermal Jet Engines and applications*

### Unit II: TURBOPROP AND TURBOJET: 12 Hours

Thermo dynamic cycles, plant layout, essential components, principles of operation — performance evaluation. Thrust Augmentation and Thrust reversal
*Contrasting with piston Engine Propeller plant.*

### Unit III: RAMJET 12 Hours

RAMJET: Thermo dynamic Cycle, plant lay-out, essential components — principle of operation – performance evaluation — comparison among atmospheric thermal jet engines

*scram jet and pulse jet, elementary treatment.*

### Unit IV: Solid propellants 12 Hours

Solid propellants-classification, propellant characteristics, propellant ingredients, smokeless propellant, igniter propellants, physical and chemical processes, ignition process.
*extinction or thrust termination, combustion instability.*

### Unit V: Hybrid propellant rockets 12 Hours

Hybrid propellant rockets - applications and propellants, performance analysis and grain configuration, combustion instability. Rocket propulsion systems
*selection process, criteria for selection, interfaces.*

**Text Books**

1. V Ganesan, "Gas Turbines", Tata McGraw-Hill, 2nd Edition, 2003.
2. Sutton P and Oscar Biblaz," Rocket Propulsion Elements", Wiley India Pvt.Ltd. 2010
3. Dr. M.L. Mathur And R.P. Sharma," Gas Turbines And Jet And Rocket Propulsion", Standard Publishers Distributors

**Reference Books**

1. Khajuria and Dubey, "Gas Turbines & Propulsive System", DhanpatRai Publications, 2012.
2. Hill and Peterson, "Mechanics and Dynamics of Propulsion", 2nd Edition, Prentice Hall, 1991.

**Web Reference**

https://www.youtube.com/watch?v=QLcxx6MJnbA&list=PLbMVogVj5nJSCWZNo0sUSxanAp4TN2G-x

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. What is dynamic.
2. What is **Thrust reversal.**
3. What are the Solid propellants

**L2: Understand**

1. Explainpropellant characteristics
2. ExplainRocket propulsion systems

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## HO 20MEH04 Powder Metallurgy

4 0 0 4

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20MEH04.1 | Compare the various ways of producing metal powders. | L1,L2, L3 |
| 20MEH04.2 | Describe the procedural of metal powder characterization. | L1,L2, L3 |
| 20MEH04.3 | Describe the various powder compaction process | L1,L2, L3 |
| 20MEH04.4 | Select appropriate sintering techniques based on the requirement. | L1,L2, L3 |
| 20MEH04.5 | Explain the role of powder metallurgy component in various fields. | L1,L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

### Unit I: Introduction

12 Hours

Powder Production, Chemical Methods, Electrolytic Methods, Atomization, Mechanical Methods, Powder Characterization (Chemical Composition and Structure, Particle Size and Surface Topography.
*Pyrophorocity and Toxicity*

### Unit II: Characteristics and Testing of Metal Powders

12 Hours

Sampling, chemical composition purity, surface contamination etc. Particle size. and its measurement, Principle and procedure of sieve analysis, microscopic analysis: sedimentation, elutriation, permeability. Adsorption methods and resistivity methods: particle shape, classifications, microstructure. specific surface area. apparent and tap density. green density. green strength.

*sintered compact density, porosity, shrinkage*

### Unit III:Powder Compaction

12 Hours

Pressure less compaction: slip casting and slurry casting. pressure compaction- lubrication, single ended and double ended compaction, isostatic pressing, powder rolling, forging and extrusion.

*Explosive compaction.*

### Unit IV: Sintering

12 Hours

Liquid Phase Sintering, Stages of Liquid Phase Sintering, Super solidus Sintering, Activated Sintering, Pressure Assisted Sintering.
*Microwave Sintering, Select Case Studies.*

### Unit V: Applications

12 Hours

Major applications in Aerospace, Nuclear and Automobile industries- Bearing Materials-types, Self lubrication and other types, Methods of production, Properties, Applications. Sintered Friction Materials-Clutches, Brake linings, Tool Materials- Cemented carbides, Oxide ceramics.

*Cermets- Dispersion strengthened material*

**Text Books**

1. Powder Metallugy Science, 2nd ed R.M. German.
2. Powder Metallurgy: Science, Technology and Materials by A. Upadhyaya, G.S. Upadhyaya,
3. ASM Handbook, Volume 7: Powder Metal Technologies & Applications (1998)
4. Introduction to Ceramics by Kingery W.D, Bowmen H. K., Uhlmann D.R

**Reference Text books**

1. ASM Handbook. Vol. 7, Powder Metallurgy, Metals Park, Ohio, USA, 1990.
2. Animesh Bose., Advances in Particulate Materials, Butterworth – Heinemann. New Delhi, 1995.
3. Erhard Klar., Powder Metallurgy Applications, Advantages and Limitations, American Society for Metals, Ohio, 1983.
4. Kempton. H Roll., Powder Metallurgy, Metallurgical Society of AMIE, 1988.
5. R.M. German, Powder Metallurgy and Particulate Materials Processing, Metal Powder Industries Federation, Princeton, NJ, 2005.

**Web References**

https://nptel.ac.in › content › syllabus

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 10 | 10 |
| L2 | 30 | 30 |
| L3 | 60 | 60 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Write about introduction of powders metallurgy?
2. State the applications of powder metallurgy?

**L2: Understand**

1. Stages of Liquid Phase Sintering
2. Powder Production, Chemical Methods
3. Slip casting and slurry casting.
4. Comparing of pressure compaction- lubrication, single ended and double ended compaction

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## H0 20MEH05 Advanced Manufacturing Methods 4 0 0 4

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20MEH05.1 | Explain the working principle of Electron beam, laser beam and laser hybrid welding processes. | L2 |
| 20MEH05.2 | Summarize different types of composite material characteristics, types of micro & macro machining processes. | L2 |
| 20MEH05.3 | Compare the e-manufacturing & nano materials. | L2 |
| 20MEH05.4 | Describe the economical characteristics of manufacturing operations and methods | L3 |
| 20MEH05.5 | Utilize modern tools and techniques to effectively communication methods | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

### Unit I: 12 Hours

Surface treatment: Scope, Cleaners, MetH0ds of cleaning, Surface coating types, and ceramic and organic metH0ds of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating. *Diamond coating and cladding.*

### Unit II: 12 Hours

Non-Traditional Machining: Introduction, need ,AJM, Parametric Analysis, Process capabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle, equipment ,process characteristics , performance, EDM – principles, equipment, generators, analysis of R-C circuits.
*MRR , Surface finish, WEDM.*

### Unit III: 12 Hours

Laser Beam Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Plasma Arc Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electron Beam Machining - Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electro Chemical Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.
*Advanced machining techniques*

### Unit IV: 12 Hours

Processing of ceramics : Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying , sintering, H0t compaction, Area of application.
*finishing of ceramics.*

### Unit V: 12 Hours

Fabrication of Microelectronic devices: Crystal growth and wafer preparation, Film Deposition oxidation, lith0graphy, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, integrated circuit economics. E-Manufacturing, nanotechnology.
*micromachining, High speed Machining*

### Text Books

1. Manufacturing Engineering and Technology, Kalpakjian, Adisson Wesley, 1995.
2. Process and Materials of Manufacturing, R. A. Lindburg, 4th edition, PHI 1990.
3. Foundation of MEMS/ Chang Liu/Pearson, 2012.
4. Advanced Machining Processes, V.K.Jain, Allied Publications.

**Reference Books**

1. Benedict G. F. – 'Non-Traditional Manufacturing Processes' – Marcell Dekker Inc., NY – 1987
2. Krar S. F. and Gill A. – 'Exploring Advanced Manufacturing Technologies' -Industrial Press – 2003

**Web Reference**

1. https://www.youtube.com/watch?v=6ysDAmtF_uU
2. https://www.youtube.com/watch?v=sDadl2KX55Y

NSRIT | Academic Regulation 2020 | ME | 20MEH05 Advanced Manufacturing Methods | Approved in 3rd BOS

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample SH0rt and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Explain Surface treatment
2. What is diffusion
3. H0t compaction
4. Explain Crystal growth and wafer preparation

**L2: Understand**

3. Explain Laser Beam Machining
4. Explain Processing of ceramics
5. Explain Fabrication of Microelectronic devices
6. Explain Non-Traditional Machining

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## HO 20MEH06 Rapid Prototyping 4 0 0 4

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20MEH06.1 | Demonstrate the Additive Manufacturing and Rapid Prototyping technologies. | L1,L2 |
| 20MEH06.2 | Illustrate different Rapid Prototyping techniques | L2 |
| 20MEH06.3 | Discuss fundamentals of Reverse Engineering. | L2 |
| 20MEH06.4 | Demonstrate the Rapid Tooling | L2 |
| 20MEH06.5 | Apply the Rapid Prototype technique for biomedical and aeronautical applications | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

### Unit I: INTRODUCTION: 12 Hours

Prototyping fundamentals, historical development, fundamentals of rapid prototyping,advantages and limitations of rapid prototyping, commonly used terms, classification of RP process. LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology
*laser and laser scanning, applications, advantages and disadvantages*

### Unit II: SOLID-BASED RAPID PROTOTYPING SYSTEMS: 12 Hours

Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modeling (FDM) - models and specifications, process, working principle, applications,

*Solid based Systems advantages and disadvantages, case studies.*

### Unit III: POWDER BASED RAPID PROTOTYPING SYSTEMS 12 Hours

Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

*three dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.*

### Unit IV: RAPID TOOLING: 12 Hours

Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting,

spin casting, die casting, sand casting, 3D Keltool process. Direct rapid tooling: direct AIM, LOM Tools, DTM Rapid Tool Process,

*EOS Direct Tool Process and Direct Metal Tooling using 3DP.*

**Unit V: RP APPLICATIONS:** **12 Hours**

Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, arts and architecture. RP medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis, design and production of medical devices.

*forensic science and anthropology, visualization of bimolecular.*

**Text Books**

1. Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications.
2. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer.
3. Chua C. K., Leong K. F., and Lim C. S., "Rapid Prototyping: Principles and Applications", Second Edition, World Scientific Publishers (2003),.
4. Patri K. Venuvinod, Weiyin Ma "Rapid Prototyping: Laser-Based and Other Technologies" Springer , 2004

**Reference Books**

1. Wholers Report 2000 – Terry Wohlers, Wohlers Associates.
2. Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press.

**Web Reference**
https://www.youtube.com/watch?v=KJj8CfnC0Ek

**Internal Assessment Pattern**

| CognitiveLevel | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. What is Stereo lithography
2. What is Laminated object manufacturing
3. What is Selective laser sintering

**L2: Understand**

1. Explain Application in engineering
2. Explain indirect rapid tooling methods

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology
Visakhapatnam-530 027

## HO 20MEH07 Advanced Strength of Materials

4 0 0 4

At the end of the course, students will be able to

| Code | Course Outcomes |
|---|---|
| 20MEH07.1 | .Determined the point of location of applied load to avoid twisting in thin sections used in aerospace applications. |
| 20MEH07.2 | .Understand the concept torsion in concentrated loads neutral and centroidal axes in curved beams. |
| 20MEH07.3 | Understanding the analogy models developed for analyzing the non circular bars subjected to torsion |
| 20MEH07.4 | Understand the concept oftheory of beams and boundary conditions |
| 20MEH07.5 | Analyzing the stresses developed between rolling bodies and stress in three dimensional bodies. |

**Unit I: Shear Centre** **12 Hours**

Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections. Unsymmetrical bending: Bending stresses in Beams subjected to Nonsymmetrical bending.*Deflection of straight beams due to nonsymmetrical bending.*

**Unit II: Curved beam theory** **12 Hours**

Winkler Bach formula for circumferential stress – Limitations – Correction factors –Radial stress in curved beams – closed ring subjected to concentrated and uniform loads.*Stresses in chain links.*

**Unit III: Torsion** **12 Hours**

Torsion of a cylindrical bar of Circular cross Section; Saint-Venant's semi-inverse methods; Linear elastic solution; Prandtl elastic membrane ( Soap-Film) Analogy; Narrow rectangular cross Section; Hallow thin wall torsion members, Multiply connected Cross section, Thin wall torsion members with restrained ends Axi-Symmetric Problems: Rotating Discs–Flatdiscs,Discs of uniform thickness.*Discs of Uniform Strength, Rotating Cylinders.*

**Unit IV: Theory of plates** **12Hours**

Introduction; Stress resultants in a flat plate; Kinematics: Strain- Displacement relations for plates; Equilibrium equations for small displacement theory of flat plates; Stress – Strain – Temperature relation for Isotropic plates: Strain energy of a plate; Boundary conditions for plate; Solution of rectangular plate problem; Solution of circular plate problem. Beams on Elastic Foundation: General theory; Infinite Beam subjected to concentrated load; boundary conditions; Infinite beam subjected to a distributed lad segment; Semi-infinite
*beam with concentrated load near its end; Short Beams.*

**Unit V:Contact stresses** **12 Hours**

Introduction, problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Methods of computing contact stresses; Deflection of bodies in point contact;Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for twobodiesin line contact. *Normal and Tangent to contact area.*

1.

**TEXTBOOKS:**

1. Advanced strength of materials by Den Hortog J.P.
2. Theory of plates – Timoshenko.
3. Strength of materials & Theory of structures (Vol I & II) by B.C Punmia

**REFERENCES:**

1. Advanced Mechanics of materials/Seely and Smith/ John Willey
2. Advanced Mechanics of materials / Boresi & Sidebottom/wiley international
3. Advanced strength of materials / Den Hortog J.P /Torrent
4. Theory of Plates /Timoshenko/
5. Strength of materials / Sadhu singh/ Khanna Publishers
6. Mechanics of Materials / Beer & Jhonson / McGraw Hill
7. Theory of Plates & Shells / Timoshenko/ McGraw Hill/ 2nd Edition

**Web Links:**

1. https://www.youtube.com/watch?v=_2d8YsXwm7M&list=PL35EBF66D99E7A0EC&index=1
2. https://www.youtube.com/watch?v=E6bPBhZsMUI&list=PL35EBF66D99E7A0EC&index=2

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## HO 20MEH08 Advanced Finite Element Analysis

4 0 0 4

At the end of the course, students will be able to

| Code | Course Outcomes |
|---|---|
| 20MEH08.1 | Illustrate the Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods |
| 20MEH08.2 | Identify the application and characteristics of FEA elements such as Bar, trusses, beams and frames. |
| 20MEH08.3 | Solve the 2-D Stress Analysis with CST element and Axi-Symmetric Formulation |
| 20MEH08.4 | Make use of 2-D Isoparametric elements and Numerical Integration for solving problems. |
| 20MEH08.5 | Apply Steady state Heat Transfer Analysis and Dynamic Analysis to solve problems |

### Unit I: Formulation of Techniques — 12 Hours

Methodology, Engineering problems and governing differential equations, finite elements., Variational methods-potential energy method, Raleigh Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of variations.
*Essential and natural boundary conditions.*

### Unit II: One Dimensional Elements — 12 Hours

Bar trusses, beams and frames, displacements, stresses and temperature effects.
*Applications of an one-dimensional applications*

### Unit III: Two-Dimensional & Axisymmetric Problems — 12 Hours

CST, LST, Lagrange basis for triangles, serendipity interpolation functions. Axisymmetric formulations, Element matrices
*Two dimensionalboundary conditions.*

### Unit IV: Isoparametric Formulation — 12 Hours

Concepts, sub parametric, super parametric elements, four nodded and eight nodded rectangular elements, Lagrange basis for rectangles, numerical integration, Requirements for convergence, h-refinement and p-refinement, complete and incomplete interpolation functions.
*Pascal's triangle, Patch test.*

### Unit VHeat Transfer — 12 Hours

Conduction and convection, examples: - two dimensional fin.Finite Elements in Structural Analysis: Static and dynamic analysis, Eigen value problems, and their solution methods.
*case studies using commercial finite element packages.*

### Text Books

4. Chandraputla,Ashok&Belegundu,"Introduction to Finite Elements in Engineering",3rdEdition, Prentice Hall, 2018
5. SS Rao, "The Finite Element Methods in Engineering", 5thEdition, / Pergamon,2014
6. chennakesava R alavala, "Finite Element Methods", 1StEdition, PHI Learning,2008.

**Reference Books**

1. JN Reddy,"An introduction to Finite Element Method",3rdEdition,McGrawHill, 2005.

**Web References**

4. https://nptel.ac.in/courses/112/104/112104116/
5. https://nptel.ac.in/courses/112/104/112104193/
6. https://nptel.ac.in/courses/112/106/112106135/

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## HO 20MEH09 Advanced Optimization Techniques

4 0 0 4

At the end of the course, students will be able to

| Code | Course Outcomes |
|---|---|
| 20MEH09.1 | Explain the fundamental knowledge of Linear Programming and Dynamic Programming problems. |
| 20MEH09.2 | Use classical optimization techniques and numerical methods of optimization. |
| 20MEH09.3 | Describe the basics of different evolutionary algorithms. |
| 20MEH09.4 | Enumerate fundamentals of integer programming technique and apply different techniques |
| 20MEH09.5 | solve various optimization problems arising from engineering areas. |

**Unit I: LINER PROGRAMMING (L.P):** **12 Hours**

Revised Simplex Method, Duel simplex Method, Sensitivity Analysis DYNAMIC PROGRAMMING (D.P): Multistage decision processes. Concepts of sub optimization, Recursive Relation-calculus method
*tabular method*

**Unit II: CLASSICAL OPTIMIZATION TECHNIQUES:** **12 Hours**

Single variable optimization without constraints, Multi variable optimization without constraints, multivariable optimization with constraints – method of Lagrange multipliers
*Kuhn-Tucker conditions.*

**Unit III: MODERN METHODS OF OPTIMIZATION: GENETIC ALGORITHM (GA):** **12 Hours**

Differences and similarities between conventional and evolutionary algorithms, working principle, Genetic Operators-reproduction*crossover, mutation*

**Unit IV: INTEGER PROGRAMMING:** **12 Hours**

Graphical Representation, Gomory's Cutting Plane Method, Balas' Algorithm for Zero–One Programming.
*Branch-and-Bound Method.*

**Unit V: APPLICATIONS OF OPTIMIZATION IN DESIGN AND MANUFACTURING SYSTEMS:** **12Hours**

Formulation of model- optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, general optimization model of a machining process, optimization of arc welding parameters.
*general procedure in optimizing machining operations sequence.*

**Text Books**

1. Engineering Optimization (4th Edition) by S.S.Rao, New Age International,
2. Optimization for Engineering Design by Kalyanmoy Deb, PHI Publishers
3. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
4. Operations Research by Hillar and Liberman, TMH Publishers

**Reference Books**

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers

**Web Reference**
**https://www.youtube.com/watch?v=rDRZU3eEuLU**

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Engineering &
Visakhapatnam-531173

## HO 20MEH10 Integrated Computer Aided Design

4 0 0 4

At the end of the course, students will be able to

| Code | Course Outcomes |
|---|---|
| 20MEH10.1 | Get the knowledge of Design process, Application of computer for design and Benefits of CAD and draw the 3D models by using Computer Aided Drafting |
| 20MEH10.2 | Learn the different types of Geometric modelling techniques |
| 20MEH10.3 | Develop the Knowledge on Computer Animation |
| 20MEH10.4 | Impart the knowledge of Visual Realism techniques |
| 20MEH10.5 | Know the Mechanical Assembly modelling and analysis |

**Unit I: Fundamentals of CAD** **12 Hours**

Introduction, Design process, Application of computer for design, Creating the manufacturing database, Benefits of CAD, Design work station, CAD hardware. AutoCAD tools, 3D model building using solid primitives and Boolean operations, 3D model building using extrusion, Editing tools.
*Multiple views: Orthogonal, Isometric.*

**Unit II: Geometric Modeling** **12 Hours**

Geometric modelling techniques - Multiple view 2D input, Wire frame geometry, Surface models, Geometric entities - Curves and Surfaces
*Solid modelers, Feature recognition.*

**Unit III: Computer Animation** **12Hours**

Computer animation: Conventional animation, Computer animation - Entertainment animation, Engineering Animation
*Animation types, Animation techniques.*

**Unit IV: Visual Realism** **12 Hours**

Visual realism: Shading solids, Coloring, Color models, Using interface for shading and coloring. Graphic aids: Geometric modifiers, Naming scheme, Layers, Grids, Groups.
*Dragging and rubber banding.*

**Unit V: Mechanical Assembly** **12 Hours**

Mechanical assembly: Assembly modeling, Part modeling, Mating conditions, Generation of assembling sequences, Precedence diagram
*Liaison-sequence analysis.*

**Text Books**

4. Ibrahim Zeid , CAD/CAM Theory and Practice McGraw-Hill, 1991
5. P.N. Rao, CAD/CAM Principles and Applications, Tata McGraw Hill Publishing Company Ltd.,2010.
6. Mario Hirz-Wilhelm Dietrich, Anton Gfrerrer-Johann lang, Integrated Computer-Aided Design inAutomotiveDevelopment: Development Processes, Geometric Fundamentals, Methods of CAD, Knowledge-Based Engineering Data Management, Springer, 2013th Edition
7. S.A. Meguid, Integrated Computer-Aided Design of Mechanical Systems, June 30th 1987 by Springer

**Reference Books**

6. Mikell P. Groover and Emory W. Zimmer,CAD/CAM Computer Aided Design and Manufacturing,2008.
7. David D. Bedworth, Mark R. Henderson, Philip M. Wolfe Computer Integrated Design and Manufacturing McGraw-Hill,1991.

**Web References**

7. https://nptel.ac.in/courses/112/102/112102102/
8. https://nptel.ac.in/courses/112/102/112102103/

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## HO 20MEH11 Industrial Robotics

4 0 0 4

At the end of the course, students will be able to

| Code | Course Outcomes |
|---|---|
| 20MEH11.1 | Identify various robot configuration and components |
| 20MEH11.2 | Select appropriate actuators and sensors for a robot based on specific application |
| 20MEH11.3 | Carry out kinematic and dynamic analysis for simple serial kinematic chains |
| 20MEH11.4 | Perform trajectory planning for a manipulator by avoiding obstacles. |
| 20MEH11.5 | Perform trajectory planning for a manipulator by avoiding obstacles. |

**Unit I: Introduction** **12Hours**

Automation and Robotics, types of automation, assembly automation equipment, material handling systems, feed systems, Automated Guided Vehicles, Automated storage and retrieval systems, Flexible Manufacturing Systems, Computer Aided Process Planning Systems, Computer Aided manufacturing. CAD/CAM and Robotics

**COMPONENTS OF THE INDUSTRIAL ROBOTICS:** Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors.

*comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.*

**Unit II: Manipulator Kinematics** **12 Hours**

Homogeneous transformations as applicable to rotation and translation –problems.

Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

*Advance Manipulator kinematics and dynamics*

**Unit III: Motion Analysis** **12 Hours**

Differential transformation and manipulators, Jacobians – problems

**Unit IV: Trajectory planning** **12 Hours**

General considerations in path description and generation. Trajectory planning and avoidance ofobstacles, path planning, Skew motion, joint integrated motion.

*Software packages-description of paths with a robot programming language.*

**Unit V: Robot Actuators And Feed Back Components** **12 Hours**

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors.Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors.

*Assembly and Inspecti*

**Text Books**

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K &Nagrath I J / TMH.
3. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.
4. Robotics and Control / Mittal R K &Nagrath I J / TMH

**Reference Books**

1. Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.
2. Robotics / Fu K S/ McGraw Hill.
3. Robotic Engineering / Richard D. Klafter, Prentice Hall
4. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.

**Web Reference**

1. https://www.youtube.com/watch?v=7Y0JbBwzpM8&list=PLCEGN3cLEboBpr14mUy2Ln QeMY4IKQNjA&index=2

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## HO 20MEH12 Design of Smart Technologies

4 0 0 4

At the end of the course, students will be able to

| Code | Course Outcomes |
|---|---|
| 20MEH12.1 | Understand internet of Things and its hardware and software components |
| 20MEH12.2 | Interface I/O devices, sensors & communication modules |
| 20MEH12.3 | Remotely monitor data and control devices |
| 20MEH12.4 | Develop real life IoT based projects |
| 20MEH12.5 | Study about Virtual Hardware and Software |

### Unit I:Introduction to smart manufacturing — 12 Hours

What is "smart manufacturing" really and how does it differ from conventional/legacy manufacturing, Computer Integrated Manufacturing Systems Structure and functional areas of CIM system, - CAD, CAPP, CAM, CAQC, ASRS. Advantages & Disadvantages of CIM.

### Unit II: Industry 4.0 — 12 Hours

Industry 4.0, IIoT, and digitisation are currently some of the most-discussed and yet least understood topics within manufacturing today. With still a lot of confusion surrounding Industry 4.0, today we'll be exploring the key technologies behind Industry 4.0, as well as real-world applications.

### Unit III: Internet/Web — 12 Hours

Internet/Web and Networking Basics OSI Model, Data transfer referred with OSI Model, IP Addressing, Point to Point Data transfer, Point to Multi Point Data transfer & Network Topologies, Sub-netting, Network Topologies referred with Web, Introduction to Web Servers, Introduction to Cloud Computing

### Unit IV: Back-end Application Designing — 12 Hours

Back-end Application Designing Apache for handling HTTP Requests, PHP & MySQL for data processing, MongoDB Object type Database, HTML, CSS & jQuery for UI Designing, JSON lib for data processing, Security & Privacy during development, Application Development for mobile Platforms: Overview of Android / IOS App Development tools

### Unit V: Advanced IoT applications: — 12 Hours

Case Study & advanced IoT Applications: IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipment's. Use of Big Data and Visualization in IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino)

### Text Books

1. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers
2. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann

### Reference Books

1. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010.
2. Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4 th Edition
3. Data and Computer Communications; By: Stallings, William; Pearson Education Pte. Ltd., Delhi, 6th Edition
4. F. Adelstein and S.K.S. Gupta, "Fundamentals of Mobile and Pervasive Computing," McGraw Hill, 2009

**Web References**

1. https://www.youtube.com/watch?v=ZIC5JFIHnI4&list=PLFW6IRTa1g83XaMJ630bKOm5Xid4ZQybU
2. https://www.youtube.com/watch?v=GAKwYtDbn6M&list=PLFW6IRTa1g83XaMJ630bKOm5Xid4ZQybU&index=2
3. https://www.youtube.com/watch?v=7Tg4Gnf6jVg&list=PLFW6IRTa1g83XaMJ630bKOm5Xid4ZQybU&index=3
4. https://www.youtube.com/watch?v=sTIpDHhaD8Q&list=PLFW6IRTa1g83XaMJ630bKOm5Xid4ZQybU&index=5

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## CE 20CEO01 Urban Environmental Services 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs PO6 | PO7 | PO12 | DoK |
|---|---|---|---|---|---|
| 20CEO01.1 | Identify urban – health relationships | 3 | 3 | 1 | L1, L2 |
| 20CEO01.2 | Demonstrates the connection between urban built form and health outcomes | 3 | 3 | 1 | L1, L2 |
| 20CEO01.3 | Discuss the distribution of health risks of urban transportation grid | 3 | 3 | 1 | L1, L2 |
| 20CEO01.4 | Assess and plan for community needs in health-care infrastructure | 3 | 3 | 1 | L1, L2 |
| 20CEO01.5 | Identify preliminary opportunities for advancing urban health outcomes | 3 | 3 | 1 | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

### Unit I: Health and Planning 9 Hours

Introduction, The Historical Link, Dividing Health and Planning, Urban Health – Basic Conceptions in the Literature, Urban Form, Physical Activity.

*Health Promotion*

### Unit II: Built Urban Form and Health 9 Hours

Renewing the Health-Urban Link, The Urban form, The Metropolitan Sprawl Index, Using Measured Urban Forms to Assess Health Effects, Environmental Factors and Physical Activity

*Alternatives to Metropolitan Sprawl Index*

### Unit III: Transportation Systems 9 Hours

Transport Planning, Private Motor Vehicles as Health Risks, Private Motor Vehicles and Obesity, Public Transport, Mixed-use Medium-density and Pedestrian Travel, Proximity and Individual Factors.

*Residential and Travel Preferences*

### Unit IV: Spatial Access to Health Services 9 Hours

Introduction, The Concept of Access, Dimensions of Spatial Access, Primary Care Supply and Access, Spatial Access and Travel Behaviour, Access and Mortality.

*Access to health care Aligned with Transport*

### Unit V: Challenges and Opportunities 9 Hours

Introduction, Challenges, Conceptual Frameworks, Investigative Methods and Data Collection, Limited Policy Capacity, Fragmented Initiatives, Opportunities, Interdisciplinary Engagement, Major Conceptual Programs, Priorities for future Research.

*Promotion of physical activity in daily routines*

### Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. George Luber and Jay Lemery, 'Global Climate Change and Human Health', 1st Edition Jossey-Bass, 2015

### Reference Books

1. Pataki, Diane E., et al. "Coupling biogeochemical cycles in urban environments: ecosystem services, green solutions, and misconceptions" Frontiers in Ecology and the Environment, 2011
2. Frank, L., Engelke, P., and Schmid, T., "Health and Community Design: The Impact of The Built Environment on Physical Activity", Islsnd Press, Washington, D.C., 2003
3. Eiichi Taniguchi, Tien Fang Fwa and Russell G Thompson, "Urban Transportation and Logistics", CRC Press, 2014

### Web References

1. https://www.oecd.org/health/health-systems/32006565.pdf
2. https://www.pdfdrive.com/urban-environment-proceedings-of-the-10th-urban-environment-symposium-e157051203.html

### Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 50 | 50 |
| L2 | 50 | 50 |
| Total (%) | 100 | 100 |

### Sample Short and Long Answer Questions of Various Cognitive Levels

### L1: Remember

1. How is natural environment different from urban environment?
2. How does the urban environment affect health and well-being?
3. How can urban areas improve health?

### L2: Understand

1. Explain the most important problem related to health in urban area
2. Describe the differences between physical activity for transportation and physical activity for recreation
3. Consider a study that evaluates the health of people in two communities, one with sidewalks and one without. The study authors find that the rate of lung cancer is higher in the community without sidewalks, and conclude that sidewalks protect against lung cancer. What concerns would you have about accepting this conclusion?

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Chairman
Board of Studies (CE)

## OE 20CSO01 Data Structures and Algorithms

**3 0 0 3.0**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20CSO01.1 | Understand the advanced data structures and algorithms | - | L1, L2, L3 |
| 20CSO01.2 | Demonstrate through abstract properties of various data structures such as stacks, queues and lists to implement efficient programs using data structures. | - | L1, L2, L3 |
| 20CSO01.3 | Demonstrate through various searching & sorting techniques | - | L1, L2, L3 |
| 20CSO01.4 | Apply data structures and algorithms to solve real world problems. | - | L1, L2, L3 |
| 20CSO01.5 | Apply algorithm analysis techniques to evaluate the performance of an algorithm. | - | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: Introduction to Data Structures & Algorithms** **9 hours**

Introduction to Data Structure, Data Organization, Abstract Data Types, Elementary data types; Basic concepts of data Structures; performance measures for data structures, Time and Space Complexity. Introduction to Algorithms, Asymptotic notations and common functions, Algorithm Specifications: Performance Analysis and Measurement

*Efficiency of an Algorithm*

**Unit II: Arrays and Linked Lists** **9 hours**

Arrays- Definition, Different types of Arrays, Application of arrays, Sparse Matrices and their representations. Linked lists- Definition, Implementation of Singly Linked Lists, Doubly Linked List, Operations on a Linked List, Insertion, Deletion and Traversal. Stack-Basic Concept of Stack, Stack as an ADT and operations in stack. Queue-Basic Concept of Queue, Queue as an ADT and Operations in Queue

*Generalized Linked List, Applications of Stack and Queue* **9 hours**

**Unit III: Trees and Graphs**

Trees- Basic concept of Binary tree, Operations in Binary Tree, Tree Height, Level and Depth, Binary Search Tree, Insertion, Deletion, Traversals, Search in BST, 2-4 trees. Graph-Matrix Representation Of Graphs, Elementary Graph operations(Breadth First Search, Depth First Search, Spanning Trees, Shortest path, Minimal spanning tree )

*Applications of Tress and Graph*

**Unit IV: Algorithm Design Techniques I** **9 hours**

Divide and Conquer-General method, Merge sort, Quick sort. Brute force- approach, bubble sort, Linear Search techniques.

*Preferences of Merge and quick sort techniques.*

**Unit V: Algorithm Design Techniques II** **9 hours**

Greedy Technique, General method, Knapsack problem, Job sequencing with deadlines, Minimal cost spanning tree algorithms (Prim's and Kruskal's), Dynamic Programming: General method, 0/1 knapsack problem, All pair shortest path algorithm

*Usages of Greedy algorithms*

**Text Books**

1. Reema Thareja, "Data Structures Using C", Second Edition, Oxford, 2014
2. Horowitz, Sahni and Anderson Freed, "Fundamentals of Data Structures in C", Second Edition, 2008
3. Mark Allen Weis , "Data Structures and Algorithm Analysis in C", Second edition, Pearson, 1997

**Reference Books**

1. Salaria R.S., "Data Structures and Algorithms using C", Fifth Edition, Khanna Publishing, 2018
2. Richard F Gilberg, "Data Structures: A PseudoCode Approach With C++" Fifth edition, Thomson Press(India), 2004
3. Amitava Nag and Jyothi Prakash Singh, "Data Structures and Algorithms Using C", Second Edition, Vikas Publishing, 2009

**Web References**

1. https://www.springboard.com/library/software-engineering/data-structures-and-algorithms/
2. https://www.geeksforgeeks.org/data-structures/
3. https://www.programiz.com/dsa

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 40 | 20 |
| L2 | 40 | 40 |
| L3 | 20 | 40 |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Describe Data Structure and Algorithm
2. Illustrate some applications of stack
3. Describe about a Queue
4. List two applications of Data Structures

**L2: Understand**

1. Classify data structures
2. Explain about asymptotic notations
3. Differentiate Linked List, Stack and Queue
4. Explain about different sorting algorithms

**L3: Apply**

1. Implement the append method, which should add a new element onto the tail of the linked list
2. Implement stack using arrays and linked lists
3. Implement Queue using arrays and Linked Lists
4. Illustrate the importance of recursion

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## OE 20AIO01 Machine Learning for Engineers 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20AIO01.1 | Describe different types of learnings | | L1, L2 |
| 20AIO01.2 | Explain different supervised learning algorithms | | L1, L2 |
| 20AIO01.3 | Explain different unsupervised learning algorithms | | L1, L2 |
| 20AIO01.4 | Describe various types of machine learning models | | L1, L2 |
| 20AIO01.5 | Choose appropriate machine learning model and algorithm for given task | | L1, L2 |

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: Introduction to learning** **9 hours**

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression

*Examples of regression*

**Unit II: Linear Models** **9 hours**

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

*Applications of perceptron*

**Unit III: Trees and Probabilistic Models** **9 hours**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbour Methods – Unsupervised Learning – K means Algorithms – Vector Quantization

*Self-Organizing Feature Map*

**Unit IV: Dimensionality Reduction and Evolutionary Models** **9 hours**

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms

*Markov decision process*

**Unit V: Graphical Models** **9 hours**

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models

*Tracking Methods*

**Text Books**

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2013

**Reference Books**

1. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", 1st Edition, Cambridge University Press, 2012.
2. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", 1st Edition, Wiley, 2014

3. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", 3rd Edition, MIT Press, 2014

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 50 | 50 |
| L2 | 50 | 50 |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Define Machine Learning.
2. List the types of Machine Learning.
3. State Bayes Theorem.
4. What is Regularization?

**L2: Understand**

1. Demonstrate Linear Regression.
2. Explain Back Propagation Algorithm.
3. Illustrate Decision Tree Induction process
4. Explain Genetic Operations with examples

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**Board of Studies (CSE- AIML)**

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology (S)
Visakhapatnam-531173

## OE Introduction to Database Management Systems 3 0 0 3.0

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with Pos | DoK |
|---|---|---|---|
| 20DSO01.1 | Describe the basic concepts of DBMS And different data models | | L1,L2 |
| 20DSO01.2 | Apply Constrains on relations | | L2,L2,L3 |
| 20DSO01.3 | Apply SQL commands on relations | - | L1,L3 |
| 20DSO01.4 | Understand PL/SQL operations | | L1,L2,L3 |
| 20DSO01.5 | Understand the principles of database normalization and Transaction management system. | | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create DoK: Depth of Knowledge

**Unit I: Introduction to Databases** **9 Hours**

Overview of Data Base Systems, Database System Applications, File System VS Database System, Data Abstraction, Levels of Abstraction, Data Independence Instances and Schemas, Different Data Models, Database Languages, Data Base Users and Administrator, Database System Structure, N-tier Architecture, Database design and ER diagrams, Design Entities, Attributes and Entity sets, Relationships and Relationship Sets, Advanced Features of ER Model

*History of DBMS*

**Unit II: Relational Model, Relational Algebra and Relational calculus** **9 Hours**

Relational Model: Introduction to the Relational Model, Integrity Constraint and key constraints over relations, Logical data base Design, Views, Destroying / Altering Tables and Views - Relational Algebra: Selection and Projection, Set Operations, Aggregate Operations, Renaming, Joins,
Division, Additional Relational Algebraic operations - Relational calculus: Tuple Relational Calculus, Domain Relational Calculus

*Expressive Power of Algebra and Calculus*

**Unit III: Structured Query Language** **9 Hours**

SQL: Concept of different Database Languages over SQL - DDL, DML, DCL., Set operations, SQL Commands, Nested queries, Aggregate Functions, Null Value, Referential Integrity Constraints, views.

*Compare all Database Languages*

**Unit IV: Schema Refinement and Normalization** **9 Hours**

Understand PL/SQL block, components of PL/SQL block, Control statements and conditional statements in PL/SQL Embedded SQL, Triggers, Cursors, Stored procedures packages

*Compare all Normal Forms*

**Unit V: Normalization** **9 Hours**

Understand the principles for Relational Database Design, Functional Dependencies, Trivial and Nontrivial Dependencies, Closure Set of
Functional Dependencies, Closure Set of Attributes. - Normalization: 1NF, 2NF, 3NF, BCNF, Lossless Join and Dependency Preserving decomposition,
4NF and 5N. Transaction Concept, ACID Properties, States of Transaction, Implementation of Atomicity & Durability, Schedules,

*Concurrency Control without Locking*

**Text Books**

1. Abraham Silber Schatz, Henry F Korth, S Sudarshan, "Database System Concepts", 6th Edition, McGraw-Hill International Edition, 2013
2. Date CJ, Kannan A, Swamynathan S, "An Introduction to Database Systems", 8th Edition, PearsonEducation, 2006
3. Raghurama Krishnan, Johannes Gehrke, "Data base Management Systems", 3rd Edition, TATA McGraw Hill, 2008

**Reference Books**

1. Elmasri Navrate, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016
2. Peter Rob & Carlos Coronel, "Data base Systems design, Implementation, and Management", 10th Edition, Pearson Education, 2013

**Web References**

1. https://www.javatpoint.com/dbms-tutorial
2. https://www.geeksforgeeks.org/introduction-of-dbms-database-management-system-set-1/?ref=lbp

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 30 | 30 |
| L2 | 30 | 40 |
| L3 | 40 | 30 |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. List types of database users
2. List out all types of data models present
3. Give syntaxes to Create and Alter a table
4. What is Redundancy?
5. List out the properties of transactions

**L2: Understand**

1. Compare the database system with conventional file system
2. Demonstrate the use of DISTINCT keyword in SQL select statement
3. Explain the following SQL constructs with examples:

(1) Order by (2) group by and having (3) as select (4) schema

4. Explain the difference among Entity, Entity Type & Entity Set
5. Illustrate ACID properties

**L3: Apply**

1. Choose a relation R with 5 attributes ABCDE and the following FDs: A ->B, BC->E, and ED ->A. Is R in 3NF? Justify?
2. Apply Normalization technique for the following relation up to 3NF:

Bank (acno, cust_name, ac_type, bal, int_rate, cust_city, branchId, branch_nm, br_city)

3. Construct a transaction state diagram and describe each state that a transaction goes through during its execution?
4. Demonstrate serializabulity concept

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Board of Studies (CSE - DS)

## OE 20ECO01 Architectures and Algorithms of IoT

3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20ECO01.1 | Demonstrate the Architecture and applications of IoT | | L1, L2 |
| 20ECO01.2 | Explain the protocol concept and data bases of IoT | | L1, L2, L3 |
| 20ECO01.3 | Construct the IoT device design space and Platform design | | L1, L2, L3 |
| 20ECO01.4 | Explain the IoT network model and Event analysis | | L1, L2, L3 |
| 20ECO01.5 | Demonstrate the Industrial Internet of Things and its Architecture | | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: The IoT Landscape** **12 Hours**

What Is IoT?, Applications , Architectures , Wireless Networks, Devices, Security and Privacy , Event-Driven Systems.

*Ethernet*

**Unit II: IoT System Architectures** **10 Hours**

Introduction, Protocols Concepts, IoT-Oriented Protocols, Databases, Time Bases, Security.

*Message Queuing Telemetritransport (MQTT)*

**Unit III: IoT Devices** **12 Hours**

The IoT Device Design Space, Cost of Ownership and Power Consumption, Cost per Transistor and Chip Size, Duty Cycle and Power Consumption.

*Platform Design*

**Unit IV: Event-Driven System Analysis** **14 Hours**

IoT Network Model - Events, Networks, Devices and Hubs, Single-Hub Networks, Multi-hub Networks, Network Models and Physical Networks, IoT Event Analysis - Event Populations, Stochastic Event Populations, Environmental Interaction Modeling.

*Event Transport and Migration*

**Unit V: Industrial Internet of Things** **12 Hours**

Introduction, Industrie 4.0, Industrial Internet of Things (IIoT), IIoT Architecture, Basic Technologies, Applications and Challenges.

*Integrated IIoT*

**Textbooks**

1. Dimitrios Serpanos and Marilyn Wolf, "Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies", Springer, Cham, 2018
2. Vijay Madisetti and Arshdeep Bahga, " Internet of Things (A Hands-on Approach)", Universities Press, 2015

**Reference Books**

1. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley and Sons Ltd, UK, 2014
2. Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", John Wiley and Sons Ltd., UK, 2012

**Web Resources**

1. https://books.google.co.in/books?isbn=1119969093
2. https://books.google.co.in/books?isbn=135123093X

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 30 | 30 |
| L2 | 35 | 35 |
| L3 | 35 | 35 |
| Total (%) | 100 | 100 |

Sample Short and Long Answer Questions of Various Cognitive Levels

**L1: Remember**

1. What is IoT?
2. List any three applications of IoT
3. Define protocol concept of IoT
4. Define data base
5. What is Duty cycle?

**L2: Understand**

1. Explain the Architecture of IoT
2. Explain the Security and privacy of IoT
3. Illustrate the Protocol Concept of IoT
4. Explain the Date bases of IoT
5. Demonstrate the IoT Device Design Space

**L3: Apply**

1. Identify the Wireless Networks for IoT
2. Model the Event-Driven Systems for IoT
3. Construct the IoT-Oriented Protocols
4. Construct the Platform Design for IoT

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**Chairman**
**Board of Studies (ECE)**

## OE 20EEO01 Introduction to Renewable Energy Sources 3 0 0 3.0

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with PO's PO1 | PO7 | DoK |
|---|---|---|---|---|
| 20EEO01.1 | Understand the significance of solar energy | 2 | 2 | L1, L2 |
| 20EEO01.2 | Provide the importance of Wind Energy | 2 | 2 | L1, L2 |
| 20EEO01.3 | Understand the role of ocean energy in the Energy Generation | 3 | 2 | L1, L2 |
| 20EEO01.4 | Explain the utilization of Biogas plants and geothermal energy | 2 | 2 | L1, L2 |
| 20EEO01.5 | Explain the concept of energy Conservation | 2 | 2 | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

### Unit I: Solar Energy 12 Hours

Solar Radiation, Measurements of Solar Radiation, Flat Plate And Concentrating Collectors, Solar Direct Thermal Applications, Solar Thermal Power Generation, Fundamentals of Solar , Photo Voltaic Conversion, PV Characteristics Solar Cells, Solar PV Power Generation, Solar PV Applications.

*Thermal analysis of flat plate collectors*

### Unit II: Wind Energy 12 Hours

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Wind Turbine Generator

*Betz Criteria*

### Unit III: Ocean Energy 12 Hours

Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants

*Open and closed OTEC Cycle*

### Unit IV: Bio Mass 12 Hours

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gasdigesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

*I.C Engine Operation*

### Unit V: Geo Thermal Energy and Energy Conservation 12 Hours

Resources, types of wells, methods of harnessing the energy, scope in India. Principles of energy conservation, the different energy conservation appliances, cooking stoves, Benefits of improved cooking stoves over the traditional cooking stoves

*Hydro Thermal, Geo-pressured, Hot dry rocks*

## Text Books

1. R K Gupta and S C Bhatia "Renewable Energy" Woodhead publishing India Pvt. Ltd.,2019
2. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Second Edition, IEEE Press, Wiley, 2013
3. Ranjan Rakesh, Kothari D. P.& Singal K. C., "Renewable Energy Sources And Emerging Technologies", 2 nd Edition, PHI, 2013
4. Mukund R. Patel, "Wind and Solar Power Systems – Design, Analysis and Operation", 2nd Edition, Taylor & Francis, 2006

## Reference Books

1. S Sukhatme, J Nayak, "Solar Energy: Principles of Thermal Collection and Storage", 3rd Edition, Tata Mcgraw Hill , 2003.
2. Tiwari and Ghosal, "Renewable energy resources", 2nd edition, Narosa Publishing house, 2001
3. B H Khan, "Non conventional energy resources", 2 nd Edition, Tata Mcgraw Hill, 2001

## Web References

1. https://nptel.ac.in/courses/121/106/121106014/
2. https://www.edx.org/learn/renewable-energy
3. https://www.coursera.org/learn/renewable-energy-resources-and-technologies

## Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 60 | 70 |
| Total (%) | 100 | 100 |

## Sample Short and Long Answer Questions of Various Cognitive Levels

### L1: Remember

1. What is meant by Solar Thermal Energy?
2. Give the classification of small hydro power stations.
3. What are the various losses occurring in the fuel cell?
4. List various Biomass resources.
5. What is the basic principle of Tidal Power?

### L2: Understand

1. Explain in detail about flat plate collectors and give its advantage and disadvantages.
2. Explain the principle of working of a H2 - O2 fuel cell.
3. Explain about Dry, Wet and Hot water Geo thermal systems.
4. Compare between Geo thermal power plant and Conventional thermal power plant.
5. Explain about the site requirements to construct a Tidal Power Plant.

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Board of Studies (EEE)

## OE 20MEO01 Nano Technology

3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20MEO01.1 | Describe the fundamental science of nanomaterials | L2 |
| 20MEO01.2 | Demonstrate the preparation of nanomaterials | L1,L2 |
| 20MEO01.3 | Explain of the challenges on safe nanotechnology | L1,L2 |
| 20MEO01.4 | Develop knowledge in characteristic nanomaterial | L1,L2,L3 |
| 20MEO01.5 | Apply Nanoscience for industrial applications | L1,L2,L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

### Unit I: Introduction — 11+1 Hours

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties.

*Introduction to properties and motivation for study (qualitative only)*

### Unit II: General Methods Of Preparation — 11+1 Hours

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation.

*Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE*

### Unit III: Nano materials — 11+1 Hours

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires.

*Quantum dots-preparation, properties and applications*

### Unit IV: Characterization Techniques — 11+1 Hours

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA.

*SIMS-Nano-indentation*

### Unit V: Applications — 11+1 Hours

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition.

*Nanoparticles for sunbarrier products - in Photostat, printing, solar cell, battery*

**TEXT BOOKS:**

1. Edelstein A.S and Cammesrata R.C, Eds., "Nanomaterials: Synthesis, Properties And Applications", Institute Of Physics Publishing, Bristol And Philadelphia, 1996.
2. John Dinardo N, "Nanoscale Characterization Of Surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000
3. Murthy B.S and Shankar P, " Nanoscience and NanoTechnology" , 1st Edition, Springer Publications,2013
4. Louis Hornyak and Tibbals H F, " Introduction to Nanoscience and NanoTechnology" , 1stEdition,Tailor Francis CRC Press,2008

**REFERENCE BOOKS:**

1. Timp G, "Nanotechnology", AIP press/Springer, 1999.
2. Akhilesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

**Web references:**

1.http://www.nano.gov
2.http://mrsec.wisc.edu/edetc/IPSE/links.html
3.http://nptel.ac.in/courses/112105182/9
4.IOPSCIENCE—Nanotechnology

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 60 | 20 |
| L2 | 40 | 40 |
| L3 | - | 40 |
| L4 | - | - |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. What is Nano technology?
2. How does Nano Technology Works?
3. What are Nano Materials?
4. Who is Developing Nano technology?

**L 2: Understand**

1. What Are Some Of The Most Interesting Nanoparticles Found In Nature (Not Manufactured In The Lab)?
2. Given The Nano-Size Of The Particles, Are There Any Effective Respirator Filters To Guard Against Inhalation?
3. What Do You Feel The Repercussions Are For Extended Life Through Utilization Of Nanotechnology?
4. What Is The Risk Of Not Developing Nanotech (In Health Care, Environmental Protection, Economic Development)?

**L 3: Applying**

1.How are safety tests carried out in nano tech?

2. Seems that (nano)tech is moving fast. Is there a risk that results of safety testing will be out-of-date as soon as printed? How to keep up pace?

3. Discuss about targeted drug delivery using nanoparticles.

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**Chairman**
**Board of Studies (ME)**

## OE 20SHO01 Women and Society

3 0 0 3

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20SHO01.1 | This course aims to generate awareness on various factors that constructs and shapes gender identity and perpetuates gender discrimination. | | L1,L2 |
| 20SHO01.2 | This course aims to generate awareness on various factors that constructs and shapes gender identity and perpetuates gender discrimination. | | L1,L2 |
| 20SHO01.3 | The course will examine how feminist analysis & methodology redefines traditional categories and disciplinary concepts through its attention to gender as a social category | | L1,L2 |
| 20SHO01.4 | The course further aims to sensitize students on emerging areas of gender discrimination and its possible resolution | | L1,L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Objectives:**

This course aims to generate awareness on various factors that constructs and shapes gender identityand perpetuates gender discrimination.

### UNIT -I WOMEN AND SOCIETY — 9 Hours

Understanding Sex- Gender, Gender shaping Institutions, Theories of Gender construction Understanding Sexism and Androcentrism, Understanding Patriarchy and Theories of Patriarchy, Privateand Publicdichotomy, Sexual Division of Work, Patriarchy practices in different institutions and Text Books.

### UNIT -II FEMINIST THEORY — 9 Hours

Rise of Feminism, Introduction to various stands of Feminism- Liberal Feminism, Radical Feminism, Marxist Feminism, Socialist Feminism, Cultural Feminism, Eco-Feminism, Post-Colonial Feminism, and Post Modern Feminism. Waves of Feminism.

### UNIT -III WOMEN'S MOVEMENT — 9 Hours

The socio-economic conditions of women during the age of Industrial revolution the Call for Women's Rights 1848, Women's rights movement 1848-1920, Historical Developments of Social Reform Movements in India, Women's groups and organizations, Women's Movement Movements for UniformCivil code and ShahBano case, Dalit women and the question of double marginality.

### UNIT –IV GENDER ROLES AND PSYCHOLOGY OF SEX — 9 Hours

Difference Conceptualization of gender roles and gender role attitudes, Gender: Aggression, Achievement, Communication, Friendship and Romantic, Relationships Sex Differences in Mental Health Trauma relating to Rape, Taboo, Childhood Sexual Abuse, Domestic Violence, Sexual Harassment at Work Place, Educational Institutions, Eve Teasing etc.

### UNIT – V GENDER AND REPRESENTATION — 9 Hours

Gender and Mass Media- Print Media, Gender and Mass Media-Electronic Media, Gender and Films, Advertisements, Mega Serials, Stereotyping and breaking the norms of women's roles Women's Representation in Literary Texts.

**Suggested reading:**

1. Basabi Chakrabarti, Women's Studies: Various Aspects. Urbi Prakashani, 2014
2. Arvind Narrain.Queer:Despised Sexuality Lawand Social Change.Book for Change.2005
3. Chandra Talpade Mohanty, Feminism without Borders:DecolonizingTheory, Practicing Solidarity. Duke University Press.
4. Flavia Agnes.Lawand Gender Inequality:The Politics of Women's Rights in India.Oxford University Press,2001
5. Sonia Bathla, Women, Democracy and the Media: Cultural and Political Representations in the Indian Press,Sage,NewDelhi,1995.

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Chairman
**Board of Studies CSE (S&H)**

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology (A)
Visakhapatnam-531173

## OE 20CEO02 Ecology, Environment and Resource Management 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | | DoK |
|---|---|---|---|---|---|
| | | PO6 | PO7 | PO12 | |
| 20CEO02.1 | Discuss the role that humans play in affecting the characteristics of the environment | 3 | 3 | 1 | L1, L2 |
| 20CEO02.2 | Understand the interrelationships between land, sea, the atmosphere and the living things that occupy these environments | 3 | 3 | 1 | L1, L2 |
| 20CEO02.3 | Distinguish between economic growth and economic development and outline the nature of a sustainable economy | 3 | 3 | 1 | L1, L2 |
| 20CEO02.4 | Identify the environmental attributes to be considered for the EIA study | 3 | 3 | 1 | L1, L2 |
| 20CEO02.5 | Develop a thorough understanding of Environmental Policies and legislations practiced in India | 3 | 3 | 1 | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

### Unit I: Introduction — 9 Hours

Meaning, scope and evolution of ecology. Man, environment and ecosystem. Components of nature, Structue and Function, Flow of material, Ecological Succession, Trophic levels, Food chain, Food web, Ecological pyramids.

*Adaptation, Environmental Zones*

### Unit II: Ecosystem and its relevance to Environment — 9 Hours

Resources and human settlements impact of advanced agricultural methods, Impact of urbanization and industrialization on nature. Urban ecosystem approach evolution and significance. Settlement planning.

*Energy Conservation*

### Unit III: Resource Management and Sustainable Development — 9 Hours

Sustainable Development, Fundamentals concerning Environment and Sustainable Development, Economy, Poverty, Human Settlement Issues, Land Resources, Forests, Mountains, Agriculture, Biodiversity, Protection of Oceans, Industry and Business.

*Planning for environmentally sensitive areas*

### Unit IV: Environmental Impact Assessment — 12 Hours

Meaning, Significance and framework, Methodologies, Checklist, Matrices, Network and social cost-benefit analysis. Sources and acquisition of environmental information. Environment impact studies of development projects.

*EIA Case Studies*

### Unit V: Environmental Policies and Legislations in India — 9 Hours

Major environment policies and legislations in India - The Ministry of Environment & Forests, The Central Pollution Control Board. Policies to protect environment in India – Environment Protection Act, 1986, National Conservation Strategy and Policy Statement on Environment and Development, 1992, Policy Statement for the abatement of Pollution, 1992, National Environment Policy, 2006, Vision Statement on Environment and Health. Legislations and Rules for the protection of Environment in India.

*Five year plans in relation to environmental aspects*

### Text Books

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 3rd Edition, University Grants Commission, 2021
2. Walter E. Westman, "Ecology, Impact Assessment and Environmental Planning", John Wiley & Sons, 1985
3. Chadwick A., "Introduction to Environmental Impact Assessment", Taylor & Francis, 2007

### Reference Books

1. Charles H. Southwick D., "Ecology and the Quality of Our Environment", Van No strand Co New York, 1976
2. Barthwal, R.R., "Environmental Impact Assessment", New Age International, New Delhi, 2002

### Web References

1. http://ced.cag.gov.in/?page_id=256
2. http://econdse.org/wp-content/uploads/2016/07/chapter-1-gupta.pdf
3. https://www.researchgate.net/publication/341621590_Chapter_5_Environmental_Policy_in_India
4. https://www.preventionweb.net/files/15417_nationalenvironmentpolicyandstrateg.pdf

### Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 50 | 50 |
| L2 | 50 | 50 |
| Total (%) | 100 | 100 |

### Sample Short and Long Answer Questions of Various Cognitive Levels

#### L1: Remember

1. What is Ecology?
2. List any three ways in which humans directly influence environmental conditions
3. What is the goal of sustainable development?
4. List the three sequential phases of EIA
5. Enlist any four principles of National Environmental Policy of India

#### L2: Understand

1. Explain the key principles of the ecosystem approach to conserving natural resources
2. Explain the impact of urbanization on nature
3. How does sustainable development make economic sense for society?
4. Discuss the importance of EIA activities for developing countries
5. Discuss the objectives and founding principles of India's National Environmental Policy

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Board of Studies (CE)

## OE 20CSO02 Designing the Internet of Things

**3 0 0 3.0**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20CSO02.1 | Illustrate the IoT in different contexts | - | L1, L2 |
| 20CSO02.2 | Outline the Design Principles for Connected Devices | - | L1, L2 |
| 20CSO02.3 | Explain the Internet Principles & Application Layer Protocols | - | L1, L2 |
| 20CSO02.4 | Apply the Prototyping concepts in IoT | - | L1, L2 |
| 20CSO02.5 | Analyse the Prototyping Embedded Devices | - | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: Overview of Internet of Things** **9 hours**

The flavour of the Internet of Things, The "Internet" of "Things", Technology of IoT, Enhanced Objects, Who is making the Internet of things.

*Applications of IoT*

**Unit II: : Design Principles for Connected Devices** **9 hours**

Calm & Ambient Technology, Magic as Metaphor, Privacy: Keeping secrets, Web Thinking for Connected Devices

*Examples of Connected Devices*

**Unit III: : Internet Principles** **9 hours**

Internet Communications-IP,TCP, The IP protocol suite(TCP/IP), UDP, IP Addresses-DNS, static IP Address assignment, Dynamic IP Address assignment, IPV6, MAC Addresses, TCP & UDP Ports, Application Layer Protocols

*HTTPS: Encrypted HTTP*

**Unit IV: Thinking About Prototyping** **9 hours**

Sketching, Familiarity, Costs versus Ease of prototyping, Prototypes & Production, Open Source versus Closed Source

*Embedded Platforms*

**Unit V: Prototyping Embedded Devices** **9 hours**

Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, BeagleBone Black, Electric Imp

*Aurdino Components*

**Textbooks**

1. Adrian, McEwen & Hakim Casimally, "Designing The Internet of Things", John Wiley and Sons, 2014
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", Wiley, 2019

**Reference Books**

1. Rajkumar Buyya, Amir Vahid Dastjerdi, "Internet of Things Principles and Paradigms", Morgan Kaufmann,2016
2. Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain, "Internet Of things With Raspberry Pi And Arduino", CRC Press/Taylor & Francis Group, 2019

**Web Resources**

1. https://www.geeksforgeeks.org/introduction-to-internet-of-things-iot-set-1/
2. https://tutorialspoint.dev/computer-science/computer-network-tutorials/the-new-internet-internet-of-everything
3. https://www.javatpoint.com/iot-internet-of-things

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 30 | 20 |
| L2 | 30 | 40 |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. Define IoT
2. What are the Enhanced objects for IoT?
3. What is a Prototype?
4. Define Sketching
5. Define DNS

**L2: Understand**

1. Explain the following terms related to Protocols: UDP, TCP
2. Discuss in detail about MAC Addresses
3. Define Prototyping? Describe the Embedded Computing Basics
4. Explain Application Layer Protocols
5. Discuss the Costs versus Ease of prototyping

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Board of Studies (CSE)

## OE 20AIO02 Fundamentals of Deep Learning 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20AIO02.1 | Describe the fundamental concept of artificial neural networks | | L1, L2 |
| 20AIO02.2 | Describe the function of different deep neural networks | | L1, L2 |
| 20AIO02.3 | Explain different deep learning algorithms | - | L1, L2 |
| 20AIO02.4 | Describe the functioning of convolution and recurrent neural networks | | L1, L2 |
| 20AIO02.5 | Choose appropriate deep neural network for given application | | L1, L2 |

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit 1: Introduction to Deep Learning** **9 hours**

Basics: Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

*Logic gates with perceptron*

**Unit 2: Feedforward Networks** **9 hours**

Feedforward Networks: Multilayer Perceptron, Gradient Descent, Backpropagation, Empirical Risk Minimization – Regularization, autoencoders

*Applications of multilayer perceptron*

**Unit 3: Convolution Networks** **9 hours**

Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs – Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet

*Applications of CNN*

**Unit 4: Recurrent Neural Networks** **9 hours**

Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks –The Long Short-Term Memory

*Applications of RNN*

**Unit 5: Applications of Deep Neural Networks** **9 hours**

Applications: Large-Scale Deep Learning - Computer - Speech Recognition - Natural Language Processing

*Healthcare applications*

**Text Books**

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, UK, 2017
2. Antonio Gulli and Sujit Pal, "Deep Learning with Keras ", Packt Publishing Ltd, Birmingham, UK, 2017

**Reference Books**

1. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013.
2. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

**Web References**

1. https://www.coursera.org/specializations/deep-learning

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 50 | 50 |
| L2 | 50 | 50 |
| Total (%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. List any 4 benefits of artificial neural networks
2. List any 4 features of ANN
3. What are deep neural networks?
4. Define supervised and unsupervised learning
5. Define generalization

**L2: Understand**

1. Explain the design parameters of deep neural networks
2. Describe the dimensionality reduction techniques
3. Explain backpropagation algorithm
4. Describe any 2 applications of deep networks for image processing
5. Write about any 5 applications of deep networks

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**Chairman**
**Board of Studies (CSE- AI & ML)**

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology (A)
Visakhapatnam-530 041

## OE 20DSO02 Introduction to Data Science

3 0 0 3.0

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20DSO02.1 | Understand Fundamentals of Data Science Terminology. | | L1, L2 |
| 20DSO02.2 | Demonstrate different computing tools involved in data handling. | | L1, L2 |
| 20DSO02.3 | Understand Knime Tool. | - | L1, L2 |
| 20DSO02.4 | Understand Machine Learning Concepts | | L1, L2 |
| 20DSO02.5 | Apply domain expertise to solve real world problems using data science | | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: Introduction to Data Science** **9 Hours**

Analysing the Pieces of the Data Science Puzzle, Exploring the Data Science Solution Alternatives, Defining Big Data by the Three Vs, Grasping the Difference between Data Science and Data Engineering, Making Sense of Data in Hadoop, Identifying Alternative Big Data Solutions, Converting Raw Data into Actionable Insights with Data Analytics, Distinguishing between Business Intelligence and Data Science, Defining Business-Centric Data Science

*Identifying Data Science Users; Data Engineering in Action: A Case Study*

**Unit II: Computing for Data Science - 1** **9 Hours**

Using Python for Data Science, Using Open Source R for Data Science.

*Sorting Out the Python Data Types; R's Basic Vocabulary*

**Unit III: Computing for Data Science - 2** **9 Hours**

Using SQL in Data Science, Doing Data Science with Excel and Knime

*Basic SQL Commands; Knime Basics*

**Unit IV Machine Learning, Probability and Statistical Modelling** **9 Hours**

Defining Machine Learning and its Processes, Considering Learning Styles, Seeing What You Can Do, Exploring Probability and Inferential Statistic, Quantifying Correlation, Reducing Data Dimensionality with Linear Algebra, Modeling Decisions with Multi-Criteria Decision Making, Introducing Regression Methods

*Linear Regression*

**Unit V Applying Domain Expertise to Solve Real-World Problems Using Data Science** **9 Hours**

Data Science in Journalism,Delving into Environmental Data Science, Data Science for Driving Growth in E-Commerce, Using Data Science to Describe and Predict Criminal Activity

*Applying statistical modeling to natural resources in the raw; Deploying web analytics to drive growthh*

**Text Books**

1. Lillian Pierson and Jake Porway,"Data Science For Dummies", 2nd Edition,For Dummies, 2017

**Reference Books**

1. Joel Grus, "Data Science from Scratch", 2nd Edition, O'Reilly Media, 2015
2. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020

**Web Resources**

1. https://www.simplilearn.com/tutorials/data-science-tutorial/
2. https://www.w3schools.com/datascience/

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 50 | 50 |
| L2 | 50 | 50 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. What is data science? Identify three areas or domains in which data science is being used
2. Give three examples of structured data formats
3. Name three measures of centrality and describe how they differ
4. What is supervised learning? Give two examples of data problems where you would use Supervised learning

**L2: Understand**

1. How do data analysis and data analytics differ?
2. Relate likelihood of a model given data, and probability of data given a model. Are these two the same? Different? How?

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Board of Studies (CSE-DS)

## OE 20ECO02 IoT for Smart Grids

3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20ECO02.1 | Demonstrate the Smart Grid concept ,Need for smart grid | | L1, L2 |
| 20ECO02.2 | Explain the Energy Management System functions | | L1, L2, L3 |
| 20ECO02.3 | Describe how modern power distribution system functions | | L1, L2 |
| 20ECO02.4 | Explain the Advanced metering infrastructure and AMI protocols | | L1, L2, L3 |
| 20ECO02.5 | Identify suitable communication networks for Smart Grid applications | | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

**Unit I: Introduction to Smart Grid** **12 Hours**

Introduction - Evolution of Electric Grid, Smart Grid Concept - Definitions and Need for Smart Grid – Functions – Opportunities – Benefits and challenges, Difference between conventional & Smart Grid.

*Technology Drivers*

**Unit II: Energy Management System** **12 Hours**

Energy Management System (EMS) - Smart substations - Substation Automation – Feeder Automation, SCADA – Remote Terminal Unit – Intelligent Electronic Devices – Protocols, Phasor Measurement Unit – Wide area monitoring protection and control, Smart integration of energy resources – Renewable, intermittent power sources.

*Energy Storage*

**Unit III: Distribution Management System** **12 Hours**

Distribution Management System (DMS) – Volt / VAR control – Fault Detection, Isolation and Service Restoration, Outage management System, Customer Information System, Geographical Information System, Effect of Plug in Hybrid Electric Vehicles.

*Network Reconfiguration*

**Unit IV: Smart Meters** **12 Hours**

Introduction to Smart Meters – Advanced Metering infrastructure (AMI), AMI protocols – Standards and initiatives, Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing.

*Peak Time Pricing*

**Unit V: Communication Networks & IoT** **12 Hours**

Elements of communication and networking – architectures, standards, PLC, Zigbee, GSM, BPL, Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) – Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing.

*Cyber Security for Smart Grid*

**Textbooks**

1. Stuart Borlase, "Smart Grid: Infrastructure, Technology and Solutions", CRC Press, 2012
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu and Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley, 2012

**Reference Books**

1. Mini S. Thomas and John D McDonald, "Power System SCADA and Smart Grids", CRC Press, 2015
2. Kenneth C. Budka, Jayant G. Deshpande and Marina Thottan, "Communication Networks for Smart Grids", Springer, 2014

**Web Resources**

1. https://books.google.co.in/books?isbn=1119969093
2. https://books.google.co.in/books?isbn=135123093X

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 30 | 30 |
| L2 | 35 | 35 |
| L3 | 35 | 35 |
| Total (%) | 100 | 100 |

Sample Short and Long Answer Questions of Various Cognitive Levels

**L1: Remember**

1. Define a Smart grid
2. List any three Benefits of Smart grid
3. What is SCADA?
4. List any three Intelligent Electronic Devices
5. Define a Fault Detection

**L2: Understand**

1. Explain the need of Smart Grid
2. Demonstrate the Smart Grid Concept
3. Explain the Energy Management System (EMS)
4. Classify and explain the Smart integration of energy resources
5. Illustrate Effect of Plug in Hybrid Electric Vehicles

**L3: Apply**

1. Identify the Outage management System
2. How to utilize the Distribution Management System (DMS)? explain

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**Board of Studies (ECE)**

## OE 20EEO02 Electrical Safety and Management 3 0 0 3.0

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with PO's | DoK |
|---|---|---|---|
| 20EEO02.1 | Understand the Indian electricity rules and their significance | | L1, L2 |
| 20EEO02.2 | Explain the safety standard in residential, commercial, and agricultural | | L1, L2 |
| 20EEO02.3 | Learn about electrical safety installation, testing and commission | | L1, L2 |
| 20EEO02.4 | Understand about electrical safety in distribution system | | L1, L2 |
| 20EEO02.5 | Explain flash-overs and corona discharge | | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

### Unit I: Indian Electricity Regulations and Acts and their Significance 12 Hours

Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage – earthing of system neutral – Rules regarding first aid and fire fighting facility.

*The Electricity Act2003 (Part 1,2,3,4 & 5) and Control Authority Safety Regulations*

### Unit II: Electrical Safety in Residential, Commercial and Agriculture Installations 12 Hours

Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

*System grounding and Equipment grounding*

### Unit III: Safety During Installation, Testing and Commissioning, Operation and Maintenance 12 Hours

Preliminary preparations – safe sequence – risk of plant and equipment –safety documentation – field quality and safety - personal protective equipment – safety clearance notice – safety precautions – safeguards for operators – safety

*Magnetic Hot sticks, protective clothing and industrial clothing*

### Unit IV: Electrical Safety in Hazardous Areas 12 Hours

Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipments for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours.

*Hazards associated with currents and voltages*

### Unit V: Electrical Safety Shocks and their Prevention 12 Hours

Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, residential buildings and shops.

*Objectives of Safety and Security Measures*

## Text Books

1. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
2. Pradeep Chaturvedi, "Energy Management Policy, Planning and Utilization", Concept Publishing Company, 1997
3. John M Madden, "Electrical Safety and Law, Planning and Utilization", 5th Edition, Routledge, 2017

## Reference Books

1. Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1998.
2. Martha J Boss and Gayle Nicoll, "Electrical Safety", 1st Edition, CRC Press, 2014
3. Gupta, B.R., "Electrical Safety", 1st Edition, American Technical Publishers, 2018

## Web References

1. https://nptel.ac.in/courses/108/104/108104087/
2. https://ocw.mit.edu/courses/physics/8-311-electromagnetic-theory-spring-2004/syllabus/
3. https://www.edx.org/course/electricity-and-magnetism-maxwells-equations

## Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 30 | 40 |
| L2 | 70 | 60 |
| Total (%) | 100 | 100 |

## Sample Short and Long Answer Questions of Various Cognitive Levels

### L1: Remember

1. Give the classification of electrical installations.
2. State the disadvantages of low power factor.
3. What is safety documentation system?
4. State preliminary preparations before commencing the installation.

### L2: Understand

1. Write the objectives and scope of Indian Electricity Act and Indian Electricity Rule.
2. Explain the importance of earthing system neutral.
3. Write a note on Do's and Don't for safety in the use of domestic electrical appliances.
4. Explain the classification of equipment/enclosure for hazardous locations.

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Board of Studies (EEE)

## OE 20MEO02 Fundamentals of Automobile Engineering 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | DoK |
|---|---|---|
| 20ME302.1 | Introduction to fundamentals of automobiles, lubrication, Tires and safety. | L1, L2 |
| 20ME302.2 | Classify and identify the steering system | L2, L3 |
| 20ME302.3 | Classify and identify the Transmission system | L2, L3 |
| 20ME302.4 | Define and compare the suspension, breaking and electrical system. | L2,L4 |
| 20ME302.5 | Identify and Interpret the specifications and safety precautions. | L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

### Unit I: Introduction 11+1 Hours

Componentsoffourwheelerautomobile–chassisandbody–powerunit–typesofautomobileengines,engineconstruction, turbo charging and super charging – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps–crank case ventilation–. Types – wheels and tyres. Safety Introduction, safety systems-seat belt, airbags, bumper, anti lock brake system (ABS), windshield, suspension sensors, traction control, mirrors, central locking and electric.

*windows, speed control.*

### Unit II: TRANSMISSION SYSTEM 11+1 Hours

Power transmission–rear wheel drive, front wheeldrive,4wheeldrive Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, construct mesh, synchromesh gear boxes, epicyclic gear box, over drive torque converter. propeller shaft – Hotch – Kiss drive.

*Torque tube drive, universal joint, differential rear axles.*

### Unit III: STEERING SYSTEM 11+1 Hours

Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism ,steering gears, –types

*Steering linkages.*

### Unit IV: SUSPENSION, BREAKING AND ELECTRICAL SYSTEM 11+1 Hours

SUSPENSION SYSTEM: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system. BRAKING SYSTEM: Mechanical brake system, hydraulic brake system, master cylinder, wheel cylindertandemmaster cylinder requirement of brake fluid

ELECTRICAL SYSTEM: Charging circuit, generator, current – voltage regulator – starting system, bendixdrivemechanismsolenoidswitch,lightingsystems,horn,wiper,fuelgauge–oilpressuregauge,enginetemperatureindicatoretc.

*Pneumatic and vacuum brakes.*

### Unit V: ENGINESPECIFICATION AND MAINTENANCE 11+1 Hours

Introduction-engine specifications with regard to power, speed, torque, no.of cylinders and arrangement, lubrication and cooling etc. engine service, reboring, decarburization ,Nitriding of crankshaft. service details of engine cylinder head, valves and valve mechanism, piston-connecting rod assembly, cylinder block, crank shaft and main bearings, engine reassembly-precautions. Types of pollutants, mechanism of formation, concentration measurement, methods of controlling-enginemodification,exhaustgastreatment-thermalandcatalyticconverters-useof alternative fuels for emission control

*National and International pollution standards .*

**Text Books**

1. Automotive Mechanics–Vol.1&Vol.2/KirpalSingh/standardpublishers
2. Automobile Engineering/WilliamCrouse/TMHDistributors
3. Automobile Engineering/P.SGill/S.K.Kataria&Sons/NewDelhi.
4. Automobile Engineering/CSrinivasan/McGrawHill

**Reference Books**

1. AutomotiveEnginesTheoryandServicing/JamesD.HaldermanandChaseD.MitchellJr.,/Pearsoneducationinc.
2. AutomotiveEngineering/KNewton,W.Steeds&TKGarrett/SAE
3. AutomotiveMechanics: PrinciplesandPractices/ JosephHeitner/VanNostrandReinhold

**Web References**

1. https://nptel.ac.in/noc

**Internal Assessment Pattern**

| Cognitive Level | Internal Assessment#1(%) | Internal Assessmen#2(%) |
|---|---|---|
| L2 | 40 | 30 |
| L3 | 40 | 30 |
| L4 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. What are the differences between two and four stroke engines.
2. Define the Octane number & Cetane number
3. Explain the significance of governor in automobiles?
4. What is an automotive differential and how does it work?
5. Why are car steering wheels round?
6. Why entropy decreases with the increase in temperature?

**L2: Understand**

1. Describe the Atkinson cycle..
2. Explain the flywheel with neat sketch.
3. What is an injector pressure in heavy vehicles? Why it is used?
4. Discuss the service the piston – connecting rod assembly with neat sketch.
5. Discuss the magneto ignition.
6. What is 3-way converter?

**L3: Classify**

1. .Name the different cooling methods with neat sketches.
2. Describe with P-V diagrams the two used cycles for internal combustion engines.

**L4: Interpret**

1. In a 4-stroke, 4-stroke cylinder diesel engine running 5000 r.p.m., how many times the fuel will be injected per second.
2. Name the car with engine having 4-valves and 5- valves per cylinder.gas at a pressure of1.5Mpa,the gas expands according to the process Which represented by a straight line on a pressure volume. The final pressure is 0.15MPa. Calculate the work done on a gas by the piston

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**Chairman**
**Board of Studies (ME)**

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology (A)
Visakhapatnam-530 213

## CE 20CEO03 Disaster Risk Mitigation and Management

3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20CEO03.1 | Identify various types of disasters, their causes, effects & mitigation measures | | L1, L2 |
| 20CEO03.2 | Understand various phases of disaster management cycle and create vulnerability and risk maps | | L1, L2 |
| 20CEO03.3 | Understand the approaches of risk and vulnerability | | L1, L2 |
| 20CEO03.4 | Explain the concept of disaster management and emerging approaches | | L1, L2 |
| 20CEO03.5 | Understand the mitigation measures | | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

### UNIT I: Natural Disasters

9 Hours

Natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.
Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation.

*Ozone Depletion*

### Unit II: Disaster Management Principles

9 Hours

Evolution of disaster risk management concept Disaster management cycle – Prevention, Preparedness, Mitigation, Rescue and Recovery Integrated and Comprehensive disaster risk reduction approach, Strategies and Policies.

*Disaster management cycle*

### Unit III: Risk and vulnerability

9 Hours

Hazard, risk and vulnerability: Physical, social and economic dimensions, Vulnerability in changing climate, Climate change and Disasters, Risk Analysis Techniques, Risk Identification, reduction and transfer, Approaches to mapping social vulnerability, Participatory disaster risk assessment, Action plans, Strategy for survival.

*Vulnerability in changing climate*

### UNIT IV: Disaster Management

9 Hours

Preparedness through (IEC) Information, education & communication, pre-disaster stage (mitigation), Effect to mitigate natural disaster at national and global levels. International strategy for disaster reduction.
Emerging approaches in Disaster Management-Concept of disaster management, national disaster management framework, financial arrangements, role of NGOs, community –based organizations and media.

*National disaster management framework*

### UNIT V: Risk Mitigation

9 Hours

Definition, Concept, Importance, Guiding Principles, Tools, Approaches, Strategies Sustainable Development, Sustainable Land Use Planning, Technology and the Environment. Emerging Technologies in Disaster Mitigation, Remote Sensing, GIS, Disaster Mapping, Aerial Photography, Land Use Zoning

*Emerging technologies in disaster mitigation*

### Text Books

1. Khanna, B. K., "Disasters: All you wanted to know about", New India Publishing Agency,New Delhi, 2005
2. Edwards, B., " Natural Hazards", Cambridge University Press, U.K., 2005
3. Chakraborty, S. C., "Natural Hazards and Disaster Management", Pargatishil Prokashak,Kolkata, 2007

## Reference Books

1. Sahni, P., "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, NewDelhi, 2002
2. Prashant K. Srivastava, Sudhir Kumar Singh, Mohanty, U. C., Ted Murty, "Techniques for Disaster Risk Management and Mitigation", 2020

## Web References

1. https://books.google.com
2. http://cbseacademic.nic.in

## Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 50 | 50 |
| L2 | 50 | 50 |
| Total (%) | 100 | 100 |

## Sample Short and Long Answer Questions of Various Cognitive Levels

### L1: Remember

1. Define climatic change
2. List any four effects of natural disasters
3. Define disaster Management

### L2: Understand

1. Explain about risk assessment
2. Outline the principles of disaster management
3. Differentiate between hazard, risk and vulnerability

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Board of Studies (CE)

## PC 20CS404 Operating Systems

**3 0 0 3.0**

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20CS404.1 | Describe the structure, components and functionalities of operating system | | L1, L2 |
| 20CS404.2 | Describe the process management activities of operating system | | L1, L2 |
| 20CS404.3 | Illustrate the use of process synchronization tools | - | L1, L2 |
| 20CS404.4 | Describe the various memory management and allocation techniques | | L1, L2 |
| 20CS404.5 | Demonstrate different secondary storage management strategies and file system | | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

### Unit I: Introduction to Operating System Concepts — 9 Hours

What Operating System Do, Operating System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments, Operating Systems Services, System Call, Types of System Call, Operating System Generation, System Boot

*The Shell, Mobile Operating System, Choice of Interface*

### Unit II: Process Management — 9 Hours

Process Concept: The Process, Process State, Process Control Block, Threads, Process Scheduling: Scheduling Queues, Schedulers, Context Switch, Operations on Processes, Inter Process Communication, Multithread Programming: Overview, Benefits, Multithreading Models, Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms.

*Process Termination, Multiprocess Architecture*

### Unit III: Synchronization — 9 Hours

Background, The Critical-section problem, Peterson's Solution, Synchronization hardware, Semaphores, Classic Problems of Synchronization, Monitors, Deadlocks: System Model, Deadlock Characterization, Methods for Handling Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

*Transactional Memory, Two Phase Locking*

### Unit IV: Memory Management — 9 Hours

Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table, Virtual Memory Management: Background, Demand paging, Page replacement, Thrashing, Mass-Storage Structure: Overview of Mass-Storage Structure, Harddisk Drives, Volatile Memory, HDD Scheduling-FCFS Scheduling, SCAN Scheduling of a Disk-Scheduling Algorithm.

*Buddy System, Prepaging*

### Unit V: File system Interface — 9 Hours

File Concept, Access Methods, Directory and Disk Structure, File System Mounting, File Sharing, Protection, Implementing File Systems: File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

*Consistency Checking, Malware, Denial of service*

### Text Books

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", Tenth Edition, John Wiley and Sons Inc., 2018
2. William Stallings, "Operating Systems - Internals and Design Principles", Ninth Edition, Pearson, 2018

### Reference Books

1. Andrew S. Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson, 2015
2. Charles Crowley, "Operating Systems: A Design-Oriented Approach", First Edition, Tata McGraw Hill Education, 2001

3. Dhananjay M. Dhamdhere, "Operating Systems: A Concept-Based Approach", Third Edition, McGraw Hill Higher Education, 2017

## Web Resources

1. http://nptel.ac.in/downloads/106108101/
2. https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems
3. https://www.geeksforgeeks.org/operating-system-introduction-operating-system-set-1/
4. https://www.unf.edu/public/ccp4610/ree/Notes/PPT/PPT8E/CH12-OS8e.pdf
5. https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923

## Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 50 | 40 |
| L2 | 50 | 60 |
| Total (%) | 100 | 100 |

## Sample Short and Long Answer Questions of Various Cognitive Levels

### L1: Remember

1. Define Operating System
2. What are operating system services?
3. List any four types of system calls
4. What is a process? List any four fields of process control block
5. What are the necessary conditions for a deadlock?
6. Differentiate between binary and counting semaphore.
7. What are the various attributes that are associated with an opened file?

### L2: Understand

1. Discuss the essential properties of operating systems -Batch, Interactive, Timesharing Real time and Distributive
2. Explain how multiprogramming increases the utilization of CPU
3. Why system calls are needed in operating system?
4. Distinguish between logical address and physical address
5. What is the difference between a process and thread?
6. How does the system detect thrashing? What can the system do to eliminate this problem?
7. Consider the following four processes represented as (Process, Arrival Time, Burst Time) with the length of CPU burst in milliseconds.
   ( ( P1, 0, 10), (P2, 1, 7), (P3, 2, 13), (P4, 3, 11) ). Using preemptive SJF scheduling: (i) Draw Gantt chart (ii) Calculate average waiting time.
8. Why semaphores are important? Suggest the solution for bounded buffer problem with semaphores
9. Explain the steps involved in handling a page fault with a neat sketch

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## OE 20AIO03 Fundamentals of AI

3 1 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20AIO03.1 | Describe the foundational principles of artificial intelligence | - | L1, L2 |
| 20AIO03.2 | Formalise the given problem using different AI methods | - | L1, L2 |
| 20AIO03.3 | Explain different concepts of logic | - | L1, L2 |
| 20AIO03.4 | Describe the different methods of knowledge representation | - | L1, L2 |
| 20AIO03.5 | Explain the principles and applications of expert systems | - | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

### Unit 1: Introduction to Artificial Intelligence

**9+3 Hours**

Introduction – History - Intelligent systems - Foundations of AI – Applications – Tic-Tac-Tie game playing - Development of AI languages - Current trends in AI

### Unit II: Problem Solving

**9+3 Hours**

Problem solving: State-Space search and Control strategies: Introduction - General problem solving - Characteristics of problem - Exhaustive searches - Heuristic search techniques – Iterative deepening A* - Constraint satisfaction - Problem reduction and game playing: Introduction - Problem reduction - Game playing – Alpha beta pruning - Two-player perfect information games

### Unit III: Logic concepts

**9+3 Hours**

Introduction -Propositional calculus - Proportional logic - Natural deduction system - Axiomatic system - Semantic tableau system in proportional logic - Resolution refutation in proportional logic

### Unit IV: Knowledge Representation

**9+3 Hours**

Introduction - Approaches to knowledge representation - Knowledge representation using semantic network - Extended semantic networks for KR - Knowledge representation using frames - Advanced knowledge representation techniques: Introduction - Conceptual dependency theory - Script structure - Cyctheory - Case grammars

### Unit V: Expert Systems

**9+3 Hours**

Expert system and applications: Introduction - Phases in building expert systems - Expert system versus traditional systems - Rule-based expert systems - Blackboard systems - Truth maintenance systems - Application of expert systems

### Text Books

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007

### Reference Books

4. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
5. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
6. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013

### Web Resources

6. https://nptel.ac.in

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## OE 20DSO03 Introduction to Big Data

3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20DSO03.1 | Identify the Knowledge of Big Data | | L1, L2 |
| 20DSO03.2 | Demonstrate Hadoop Framework for handling Big Data | | L1, L2 |
| 20DSO03.3 | Illustrate the Architectural Concepts of HDFS in Hadoop Ecosystem | - | L1, L2 |
| 20DSO03.4 | Illustrate MapReduce Framework | | L1, L2 |
| 20DSO03.5 | Explain Spark & RDD | | L1, L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

### Unit I: Introduction to Big Data — 9 Hours

What is Big Data, Evolution of Big Data, Types of Big Data, Sources of Big Data,5Vs of Big Data, Big Data Analytics, Big Data Applications, Google File System

*Uses of Big Data in Retail Industry*

### Unit II: Introduction to Hadoop — 9 Hours

Introducing Hadoop, Hadoop History, Hadoop-definition, Comparing SQL Databases and Hadoop, Hadoop Cluster, Hadoop Modes, Hadoop Features, The building blocks of Hadoop, NameNode, DataNode, Secondary NameNode, Job Tracker, Task Tracker

*Hadoop Cluster*

### Unit III: Hadoop Ecosystem &HDFS — 9 Hours

Hadoop and its Ecosystem, Hadoop Ecosystem Components, Hadoop Ecosystems Tools, Hadoop Distributed File System, Concept of Block in HDFS Architecture, Features of HDFS, HDFS Read and Write Mechanism, Rack awareness in HDFS, Introducing HBase, Hive, Pig

*HDFS ReadWrite*

### Unit IV: Introduction to MapReduce — 9 Hours

Hadoop MapReduce Framework, Architecture, Phases, MapReduce Job Types, Uses of MapReduce, Techniques to Optimize MapReduce Jobs, Limitations of MapReduce.

*MapReduce Phases*

### Unit V: Introduction to Spark and RDD — 9 Hours

Introduction to Spark, DataFrames - DataFrames role in Spark, Introduction to RDD, RDD operations, Creating RDDs, RDD Operations, Working with Key/Value Pairs.

*DataFrames*

### Text Books

1. DT Editorial Services, "Big Data – Hadoop2, MapReduce, Hive, YARN, Pig, R and Data Visualization", Black Book, DreamTech Press, 2019.
2. Sridhar Alla, "Big Data Analytics with Hadoop 3" - Packt Publications, 2018.
3. Holden Karau, Andy Konwinski, Patrick Wendell & MateiZaharia, "Learning Spark" O'reilly Publications, 2015.

### Reference Books

1. Chuck Lam, "Hadoop in Action", 1st Edition, MANNING Publications, 2016.
2. Balamurugan Balusamy, Nandhini Abirami R, SeifedineKadry, Amir H. Gandomi, "Big Data: Concepts, Technology, and Architecture" 1st Edition, Wiley Publications, 2021.
3. Thomas Erl, Wajid Khattak, Paul Buhler, "Big Data Fundamentals: Concepts, Drivers &Techniques", 1st Edition, Pearson Publications, 2016.

### Web Resources

1. https://hadoop.apache.org/
2. https://spark.apache.org/

### Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 50 | 50 |
| L2 | 50 | 50 |
| Total (%) | 100 | 100 |

### Sample Short and Long Answer Questions of Various Cognitive Levels

**L1: Remember**

1. Define Big Data.
2. List the characteristics of Big Data.
3. Define Hadoop.
4. What are Hadoop components?
5. What are RDD operations?

**L2: Understand**

1. Explain HDFS Read & Write mechanism.
2. Explain Rack awareness in HDFS.
3. Explain MapReduce workflow in detail.
4. Describe the working with Key/value pairs in RDDs.

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## OE 20ECO03 Privacy and Security in IoT

3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20ECO03.1 | Understand the basic knowledge of cryptography, networking and web security | | L1, L2, L3 |
| 20ECO03.2 | Explain Architecture of IoT and its Applications | | L1, L2, L3 |
| 20ECO03.3 | Understand the Attacks against IoT System | | L1, L2, L3 |
| 20ECO03.4 | Explain Secure Bootstrapping for IoT System | | L1, L2, L3 |
| 20ECO03.5 | Understand the IoT system security and Trust zone | | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

### Unit I: Introduction to Cryptography and Network Securities — 9 Hours

Cryptography , networking, Web Security: Secure socket layer and transport layer security, System Security: Intruders , Viruses and related threads, trusted systems.

*Secure Shell (SSH)*

### Unit II: Introduction to IoT — 9 Hours

Internet of Things (IoT), Need of IoT, Applications, Architecture, Enabling technologies, IoT security and privacy.

*IoT protocols*

### Unit III: Attacks against IoT — 9 Hours

Attacks against IoT system (hardware + software), Attacks against IoT network protocols, Attacks against industry IoT

*Attacks against Web systems*

### Unit IV: Secure Bootstrapping for secure IoT system — 9 Hours

Trusted boot, Secure boot, TPM and its usages, Remote attestation, tamper resistant-proof-response hardware and its usage

*Bootstrapping for IoT*

### Unit V: IoT System Security and TrustZone — 9 Hours

System security, TrustZone hardware architecture, TrustZone software architectures.

*Web security*

### Text Books

1. Syed Rameem Zahra, Mohammad Ahsan Chishti ,"Security and Privacy in the Internet of Things " 1st Edition ,Chapman & Hall, 2020
2. Fei Hu ,"Security and Privacy in Internet of Things (IoTs) Models, Algorithms, and Implementations", 1st Edition CRC Press

### Reference Books

1. Ravi Ramakrishnan, Loveleen Gaur "Internet of Things Approach and Applicability in Manufacturing " , 1st Edtion ,Chapman & Hall, 2019
2. Vijay Madisetti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", UniversityPress,2015

### Web Resources

1. https://lss.at.ufl.edu/help.shtml
2. http://cms.uflib.ufl.edu/ask

### Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 20 | 20 |
| L2 | 40 | 30 |
| L3 | 40 | 50 |
| Total (%) | 100 | 100 |

### Sample Short and Long Answer Questions of Various Cognitive Levels

**L1: Remember**

1. What is cryptography ?
2. List the applications of IoT
3. What is Attacks against IoT system ?

**L2: Understand**

1. Explain about networking
2. Explain Enabling technologies of IoT
3. Explain Attacks against IoT network protocols

**L3: Apply**

1. Discus about web security
2. Write about Architecture of IoT
3. Explain Attacks against industry IoT

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**Board of Studies (ECE)**

## OE 20EEO03 Low Cost Automation

3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20EEO03.1 | Understanding automation of assembly lines | - | L2 |
| 20EEO03.2 | Automation Using Hydraulic Systems | | L2 |
| 20EEO03.3 | Describe Automation Using Pneumatic Systems | | L2 |
| 20EEO03.4 | Explain Automation Using Electronic Systems | | L2 |
| 20EEO03.5 | Explain Assembly Automation | | L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Kn owledge

### UNIT I :Automation Of Assembly Lines

**9 Hours**

Concept of automation-mechanization and automation - Concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms -Transfer line-monitoring system (TLMS) using Line Status - Line efficiency - Buffer stock Simulation in assembly line

*Transfer line-monitoring system (TLMS) using Line Status ,Line efficiency*

### UNIT II: Automation Using Hydraulic Systems

**9 Hours**

Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - Servo valves, electro hydraulic valves, proportional valves and their applications.

*Servo valves, electro hydraulic valves, proportional valves and their applications.*

### UNIT III: Automation Using Pneumatic Systems

**9 Hours**

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic equipments - selection of components - design calculations -application - fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

*Low cost automation - Robotic circuits*

### UNIT IV: Automation Using Electronic Systems

**9 Hours**

Introduction - various sensors – transducers - signal processing - servo systems - programming of microprocessors using 8085 instruction - programmable logic controllers

*Programming of microprocessors using 8085 instruction - programmable logic controllers*

### UNIT V: Assembly Automation

**9 Hours**

Types and configurations - Parts delivery at workstations - Various vibratory and non-vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - Product design for automated assembly.

*Product design for automated assembly.*

### Text Books

1. Anthony Esposito, "Fluid Power with applications", Prentice Hall international, 2009.
2. Mikell P Groover-"Automation, Production System and Computer Integrated Manufacturing", Prentice Hall, Publications, 2007

## Reference Books

1. Kuo .B.C, "Automatic control systems", Prentice Hall India, New Delhi, 2007.
2. Peter Rohner, "Industrial hydraulic control", Wiley Edition, 1995.
3. Mujumdar.S.R, "Pneumatic System", Tata McGraw Hill 2006.

## Internal Assessment Pattern

| Cognitive Level | Internal Assessment #1 (%) | Internal Assessment #2 (%) |
|---|---|---|
| L1 | 50 | 50 |
| L2 | 50 | 50 |
| Total (%) | 100 | 100 |

## Sample Short and Long Answer Questions of Various Cognitive Levels

### L1: Remember

1. What is automation?
2. What is Pneumatic fundamentals?
3. What is transducers?
4. What is switching circuits?
5. What is Buffer stock Simulation?

### L2: Understand

1. Explain Line efficiency.
2. Explain Selection of hydraulic fluid.
3. Explain Pneumatic equipments
4. Explain programmable logic controllers.
5. Explain Parts delivery at workstations.

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Board of Studies (EEE)

## OE 20MEO03 Industrial Automation 3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20MEO03.1 | Identify various concepts of automation and work part transport mechanisms. | - | L2 |
| 20MEO03.2 | Illustrate the assembly systems and their applications. | - | L3 |
| 20MEO03.3 | Describe the importance of handling systems and identification systems. | - | L3 |
| 20MEO03.4 | Apply the concepts of part families and machine cells into various production systems | - | L2 |
| 20MEO03.5 | Recognize the importance of automated inspection and to distinguish the various control systems | - | L2 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create,DoK: Depth of Knowledge

### Unit I: Manufacturing and Automation-Over View 9 Hours

Production systems, Automation in production systems, Automation principles and strategies, Reasons for Automation, Manufacturing operations, Functions in Manufacturing, Information processing in Manufacturing plant layout, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers. Automation for machining operations.

### Unit II: Assembly Systems and Line Balancing 9 Hours

Process-Assembly lines-manual single stations assembly, Manual assembly line, automated assembly system-Line balancing. Automated Assembly Systems – Design for automated assembly-Types of automated assembly systems-Parts feeding devices

### Unit III: Automated Material Handling Systems 9 Hours

Automated Material Handling and storage system: Material Handling and Identification Technologies: Material handling, equipment, Storage systems, performance and location strategies, Automated storage systems, AS/RS, types. Functions, material handling equipment-Conveyors, AGVS, Industrial Robots-Anatomy, Robot configurations, work volume-AS/RS. Automatic identification methods, Barcode technology, RFID

### Unit IV: Manufacturing Cells 9 Hours

Manufacturing Systems and Automated Production Lines: Manufacturing systems: components of a manufacturing system, Single station manufacturing cells, Automated production lines, Applications, Transfer lines

### Unit V: Control Systems 9 Hours

Control Systems-Process Industries Versus Discrete Manufacturing Industries, Continuous Versus Discrete Control: Continuous Control Systems, Discrete Control Systems, Computer Process Control: Control Requirements, Capabilities of Computer Control.

### Text Books

1. Milkell P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Kindle Edition, Prentice Hall of India, 2016.

### Reference Books

1. C. Roy, "Robots and Manufacturing Automation", Asfahl John Wiley & Sons
2. Krishna Kant, "Computer Based Industrial Control", EEE-PHI, 2nd edition, 2010

### Web References

1. www.nptel.iitm.ac.in
2. www.btechguru.com

**Internal Assessment Pattern**

| Cognitive Level | InternalAssessment#1(%) | InternalAssessment#2(%) |
|---|---|---|
| L1 | 40 | 30 |
| L2 | 40 | 30 |
| L3 | 20 | 40 |
| Total(%) | 100 | 100 |

**Sample Short and Long Answer Questions of Various Cognitive Levels**

**L1: Remember**

1. What is industrial automation?
2. What are the different costs included in industry in designing the particular product ?
3. What is production volume?
4. List the categorization of production system.
5. What are the types of automation?
6. What are the features of Flexible Automation?
7. What is factory type of Integral automation?
8. Define process.
9. What are process variables?
10. What is meant by control system in automation?

**L2: Understand**

1. Explain Automation principles and strategies
2. Compare Manual assembly line, automated assembly system
3. Illustrate Material handling, equipment, Storage systems, performance and location strategies
4. Demonstrate components of a manufacturing system
5. Compare Continuous Control Systems, Discrete Control Systems

**L3: Apply**

1. Apply the basic elements of an automated system for industrial automation
2. Apply different types of automated assembly systems for moderate plants
3. Apply the Barcode technology, RFID for industrial automation
4. Discuss Automated production lines, Applications, Transfer lines
5. Design the capabilities of computer control systems

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**Chairman**
**Board of Studies (ME)**

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology (A)
Visakhapatnam-531173

## OE 20SHO02 Design Thinking

3 0 0 3

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | DoK |
|---|---|---|---|
| 20SHO02.1 | Explain the fundamentals of Design Thinking and innovation | | L2 |
| 20SHO02.2 | Empathize and analyse model action plan | | L2 |
| 20SHO02.3 | Describe the principles of innovation and idea generation for product design | - | L2 |
| 20SHO02.4 | Apply design thinking techniques for given tasks | | L2 |
| 20SHO02.5 | Apply the design thinking techniques for solving problems in various sectors | | L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

### Unit I: Introduction to Design Thinking

9 Hours

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, history of Design Thinking, New materials in Industry

### Unit II: Design Thinking

9 Hours

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brain storming, product development

### Unit III: Innovation

9 Hours

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations. Creativity to Innovation. Teams for innovation, Measuring the impact and value of creativity. Product Design: problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications

### Unit IV: Design Thinking for Strategic Innovation

9 Hours

An exercise in design thinking – implementing design thinking for better process. Implement design thinking process in various Industries. Design thinking for Start-ups

### Unit V: Design thinking in Various Sectors

9 Hours

Case studies in Information Technology, Finance, Education, Management and Retail sector. Analyze and Prototyping, Usability testing, Organizing and interpreting results

**Case study learning outcomes:**

1. Make use of practical design thinking methods in every stage of problem with the help of method templates
2. Apply design thinking to a problem in order to generate innovative and user-centric solutions
3. Empathize with end user and initiate a new working culture based on user-centric approach
4. Prototype and run usability tests for unbiased examination of the product in order to identify problem

### Text Books

1. Tim Brown, Harper Bollins, Change by Design, 2009
2. David Lee, Design Thinking in the Class Room, Ulysses Press

### Reference Books

1. Design the Future, Shrutin N Shetty, Norton Press
2. William Lidwell, Kritina Holden, Jill Butler, Universal Principles of Design
3. Chesbrough H., The Era of Open Innovation
4. Chitale A. K. and Gupta R. C., Product Design and Manufacturing, Prentice Hall

### Web References

1. https://nptel.ac.in/courses/110106124
2. https://onlinecourses.nptel.ac.in/noc19_mg60/preview
3. www.tutor2u.net/business/presentations/. /product/lecycle/default.html
4. https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf
5. www.bizfilings.com › Home › Marketing › Product Development
6. https://www.mindtools.com/brainstm.html
7. https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit
8. www.vertabelo.com/blog/documentation/reverse-engineering https://support.microsoft.com/en-us/kb/273814
9. https://support.google.com/docs/answer/179740?hl=en
10. https://www.youtube.com/watch?v=2mjSDlBaUlM
11. thevirtualinstructor.com/foreshortening.html
12. https://dschool.stanford.edu/.../designresources/.../ModeGuideBOOTCAMP2010L.pdf
13. https://dschool.stanford.edu/use-our-methods/ 6.
14. https://www.interactiondesign.org/literature/article/5-stages-in-the-design-thinking-process 7.
15. https://www.nngroup.com/articles/design-thinking/ 9.
16. https://designthinkingforeducators.com/design-thinking/ 10.
17. www.designthinkingformobility.org/wp-content/.../10/NapkinPitch_Worksheet.pdf

### Activity Based Learning (Suggested Activities in Class) / Practical Based learning

http://dschool.stanford.edu/dgift/

### Internal Assessment Pattern

| Cognitive Level | Internal Assessment # 1 (%) | Internal Assessment # 2 (%) |
|---|---|---|
| L1 | 20 | 20 |
| L2 | 50 | 50 |
| L3 | 30 | 30 |
| Total (%) | 100 | 100 |

### Sample Short and Long Answer Questions of Various Cognitive Levels

#### L1: Remember

1. What do you mean by design thinking?
2. How design thinking works within a product development process

#### L2: Understand

1. Explain the elements and principles of design
2. Differentiate between creativity and innovation

#### L3: Apply

1. How design thinking helped financial sector to gain the consumer 'trust'?

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Chairman
Board of Studies

## ICC 20ICC01 Competitive Programming

**2 0 8 6**

**Version: 01.00**

| | |
|---|---|
| Duration | 240 hours (2 hours theory and 14 hours practical per week) as specified above |
| Industry Collaborator | M/s. Demy Software Solutions, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC01.1 | Understand the basics of Programming | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC01.2 | Explain various types of Operators, operations, relations, and techniques in programming | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC01.3 | Demonstrate gaming basics | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC01.4 | Execute various Operations on Linked lists | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC01.5 | Explore various applications of the techniques. | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC01.6 | Solving various problems of Binary Trees, insertion, deletion and updation. | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

**Deliverables**

WEEK 1 - Introduction- Execution of a program, Decimal - Binary conversion, Ranges of Data Types and constraints, Complexity Analysis of Algorithms, Big-O Notation, Time & Space Analysis and Constraints, Importance of constraints

WEEK 2 - Bit-Manipulation, Bitwise operators, Bit-masking, Modular Arithmetic, Recursion, Thinking Recursively, Recurrence Relations, Sorting Techniques, Two Pointer Technique

WEEK 3 - Binary Search, Applications of Binary Search, Lower Bound & Upper Bound, Finding Frequency, Optimization problems, Hashing, Hashing Techniques, Collision Resolutions, Inbuilt Libraries

WEEK 4 - Maps and Sets, Subarrays and Sub sequences, String matching, Sieve of Eratosthenes, Segmented Sieve, Game Theory, Nims Game, Counting Game

WEEK 5 - Prefix and Suffix concepts, Collecting water, Stacks, Balanced Parentheses, Largest Histogram Area, Queues, Sliding Window Maximum

WEEK 6 - Linked Lists, Various Operations on linked lists, LRU Cache, Cloning Linked list with random pointer, Doubly-linked list

WEEK 7 - Binary Trees, BT and FBT, Traversals, Various operations on Binary Trees, Binary Search Trees, Insertion, Updating and Deletion

WEEK 8 - More Problems on Binary Trees, Iterative Traversals, Least Common Ancestor, Heaps, Quick Select, Running Median, Trie, Introduction and Implementation

WEEK 9 - Problems on Tries, Maximum XOR pair, Partitioning of string, 1D Dynamic Programming, Approaching DP problem, Problems on Overlapping subproblems, Problems on Optimal Substructure, Longest Increasing Subsequence

WEEK 10 - 2D Dynamic Programming, Compute NCR, Knapsack, Matrix chain multiplication, Graphs, Introduction and Implementation, Dijkstra, Topological sort.

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 9 (Nine) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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**Chairman**
**Board of Studies**

## ICC 20ICC02 Web Technologies – Transferring to Practice

**2 0 8 6**

**Version: 01.00**

| | |
|---|---|
| Duration | 150 hours (2 hours theory and 8 hours practical per week) as specified above |
| Industry Collaborator | M/s. Demy Software Solutions, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC02. 1 | Learn the basics and application of HTML | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC02. 2 | Understand the CSS3 module operation | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC02. 3 | Explain JAVA script and its application | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC02. 4 | Demonstrate the basics of jQuery | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC02. 5 | Study the basics of Bootstrap and its application | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC02. 6 | Understand the basics of Angular JS | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

**Deliverables**

**Module 1**

Introduction HTML, HTML Basics, HTML Elements, HTML5 Semantic, HTML Attributes, HTML Headings, HTML Paragraph, HTML Styles, HTML Formatting, HTML Quotations, HTML Computer Code, HTML Comments & Colours, HTML CSS, Links and Images, HTML Lists, HTML Blocks, HTML Classes, HTML Layout, HTML Responsive, HTML I frames, HTML JavaScript, HTML Head, HTML Entities and URI Code, HTML Symbols and XHTML, HTML Charset and Forms

**Module 2**

Introduction CSS3, CSS3 Syntax, CSS3 How To, CSS3 Colours, CSS3 Backgrounds, CSS3 Boarders, CSS Padding, CSS Height/Width, CSS3 Gradients, CSS3 Shadows, CSS3 Text, CSS3 Fonts, CSS3 2D Transforms, CSS3 3D Transforms, CSS Links, CSS Lists, CSS Tables, CSS Box Model, CSS Outline, CSS Display, CSS Max-width, CSS Position, CSS Float, CSS Inline-block, CSS Align, CSS Combinators, CSS Pseudo-class, CSS Pseudo-element, CSS Navigation Bar, CSS Dropdowns, CSS Tooltips, CSS3 Images, CSS Attr Selectors, CSS Forms, CSS Counters, CSS3 Animations, CSS3 Buttons, CSS3 Pagination, CSS3 Multiple Columns, CSS3 User Interface, CSS3 Box Sizing, CSS3 Filters, CSS3 Media Queries, CSS3 Responsive

**Module 3:**

Introduction to JavaScript, Java Script Language Basics, JavaScript Objects, JavaScript Scope, JavaScript Events, JavaScript Strings, JavaScript Numbers, JavaScript Math, JavaScript Arrays, JavaScript Boolean, JavaScript Comparisons, JavaScript Conditions, JavaScript Switch, JavaScript Loops, JavaScript Type Conversion, JavaScript RegExp, JavaScript Errors, JavaScript Debugging, JavaScript Hoisting, JavaScript Strict Mode, JavaScript Functions, JavaScript Objects, JavaScript Forms, JavaScript HTML DOM, JavaScript BOM

**Module 4:**

Introduction to jQuery, jQuery Syntax, jQuery Selectors, jQuery Events, jQuery Effects, jQuery HTML, jQuery Traversing, jQuery AJAX, jQuery Misc.

**Module 5:**

Introduction to Bootstrap, Bootstrap Basics, Bootstrap Grids, Bootstrap Themes, Bootstrap CSS, Bootstrap JS

**Module 6:**

Introduction to AngularJS, AngularJS Expressions, AngularJS Modules, AngularJS Data Binding, AngularJS Scopes, AngularJS Directives & Events, AngularJS Controllers, AngularJS Filters, AngularJS Services, AngularJS HTTP, AngularJS Tables, AngularJS Select, Fetching Data from MySQL, AngularJS Validation, AngularJS API, AngularJS Animations, AngularJS i18n and i10n

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 6 (Six) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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**Board of Studies**

## ICC 20ICC03 Java Spring boot

**2 0 8 6**

**Version: 01.00**

| | |
|---|---|
| Duration | 150 hours (2 hours theory and 8 hours practical per week) as specified above |
| Industry Collaborator | M/s. Demy Software Solutions, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC03.1 | Understand the JAVA programming. | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC03.2 | Execute various methods in JAVA programming | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC03.3 | Study and execute the OOPS concept | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC03.4 | Demonstrate the debugging and testing of units | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC03.5 | Learn the basics of Spring Boot | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC03.6 | Explore the applications of Spring Boot and JAVA | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

**Deliverables**

**Java**

Introduction to the course, software tools set up, Introduction about programming, Hello World Project and defining the main method. Variables, Starting with out expressions, Primitive data types, byte short, float, char, Boolean, double, casting.

Operators, operands, expressions. If else statement, Bit wise Operator, Ternary operator, Operator precedence and operator challenge. Keywords and expressions, statements white space and Indentation, code blocks, if then else statement.

Methods in Java, final Method. Code problems on JAVA – HACKERRANK. Method Overloading and Over riding, Control flow statements – if else, while do while, Problems on coding – Prime Number, Even Number, Fibonacci series

OOPS concept – classes, constructors and inheritance, composition, encapsulation, polymorphism, Arrays, Java list, Auto boxing and unboxing. Inner and Abstract classes and interfaces, Java Generics, Naming conventions and package, static and final keywords.

Java Collections, Debugging and unit testing, Data Bases. Basic input and output including Java.util, Concurrency in Java, Lambda expression, regular expressions

**Spring Boot:**

Introduction to Spring Boot – Build a hello world API, Understanding Spring boot project, Auto configuration. Create a Spring boot web application development, overview of spring boot project. Annotations, step by step code and debugging

Introduction to Junits, Mockito. Spring boot deep dive with rest API

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 6 (Six) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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## ICC 20ICC04 Robotic Process Automation

**2 0 8 6**

**Version: 01.00**

| | |
|---|---|
| Duration | 240 hours (2 hours theory and 14 hours practical per week) as specified above |
| Industry Collaborator | M/s. HMI Engineering Services, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC04.1 | Explore the Robotic Automation Process | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC04. 2 | Understand the Process Flow and basic inputs and outputs | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC04. 3 | Demonstrate the functioning of Business Objects | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC04. 4 | Demonstrate the application of Object Studio attributes | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC04. 5 | Explain the Case management and additional features | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC04. 6 | Understand the functioning of Error management | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

**Deliverables**

**Module: 1 – Robotic Automation Process Studio**

Running a Process, Basic Skills, Process Validation, Decision Stage, Calculation Stage, Data Items

**Module: 2 – Process Flow**

Decisions, Circular Paths, Controlling Play, Set Next Stage, Breakpoints, Collections and Loops, Layers of Logic, Pages for Organization

**Module: 3 – Inputs and outputs**

Input Parameters, Stepping and Pages, Data Item Visibility, Data Types, Output Parameters, Start-up Parameters, Control Room, Process Outputs

**Module: 4 – Business Objects**

Object Studio, Business Objects, BLUE PRISM CONTENT, Action Stage, Inputs and Outputs, The Process Layer

**Module: 5 – Object Studio**

Creating a Business Object, Application Modeler, Spying Elements, Attributes, Attribute Selection, Launch, Wait, , Timeouts, Terminate, Write, Press, Attach and Detach, Read, Actions, Action Inputs and Outputs, Data Items as Inputs

**Module: 6 – Error Management**

Exception Handling, Recover and Resume, Throwing Exceptions, Preserving the Current Exception, Exception Bubbling, Exception Blocks, Exception Handling in Practice.

**Module: 7 – Case Management**

Queue Items Commercial in Confidence, BLUE PRISM CONTENT, Work Queue Configuration, Defer, Attempts, Pause and Resume, Filters Reports

**Module: 8 – Additional Features**

Safe Stop, Collection Actions, Choice Stage, Logging, Log Viewer, System Manager, Process/Business Object, Grouping, Process and Object References, Export and Import

**Module: 9 – Consolidation Exercise**

Order System Process

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 6 (Six) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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**Chairman**
**Board of Studies**

## ICC 20ICC05 Information Security and Forensics

**2 0 8 6**

**Version: 01.00**

| | |
|---|---|
| Duration | 150 hours (2 hours theory and 8 hours practical per week) as specified above |
| Industry Collaborator | M/s. HMI Engineering Services, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC05. 1 | Understand the basic terminology of various servers, networking, security and hacking. | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC05. 2 | Explore the web applications, testing, debugging, hacking, etc. | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC05. 3 | Understand the coding techniques | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC05. 4 | Demonstrating the usage of tools for testing, hacking, etc. | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC05. 5 | Execute the code using various algorithms | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC05. 6 | Perform various case studies to dive deep. | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

**Deliverables**

**Domain 1 – Introduction & Terminology**

Global Anonymous: Proxy Server, TOR Browser, VPN, SOCKS, RDP, Psiphon, Surface Web, Deep Web, Dark Web, etc., Terminology about Web, Servers, Systems, Network Programming Languages, Hacking, IT Security, Intro to OWASP Top 10 Vulnerability. Intro to Bug Bounty & Enterprise Security and Risk Management with IT Security Life Cycle, Case Studies of Hacking, IT Security & C Forensics. Phishing + Live Hacking Impact Demonstration

**Domain 2 – Hacking to Explore**

Web Application Penetration Testing based in OWASP TOP 10 Vulnerabilities with Live Ex. Live Demonstration of SQLi, XSS, CSRF, and other bugs with tools and with Manual Testing. Bug Bounty, Latest CMS Exploitation, Cryptography & Practical Implementation, SSL Vulnerabilities & Live Testing, Mobile Hacking, Sniffing, Virus, Ransomware, Intro to Carding & Luhn algorithm

**Domain 3 – Defence in Depth**

Secure Code Review & Code Brabbing Techniques, Enterprise Security, Risk Management & Report, Tools & Web Apps Penetration Testing, Hacking Attacks & Case Studies, WAF, Firewall, Honeypots, UTM, Introduction to Security Compliance, Introduction to Mobile Apps Pen testing, Defence for Vulnerabilities

**Domain 4 – Hacking Automation**

Virtualization, Tools for Penetration Testing & Hacking, Kali Linux & It's Applications with Uses, Cloud Security & It's Fundamentals, SQLMAP, Metasploit, nmap etc, Exploits & Incident Response Analysis, Intro to Exploit Development & Research.

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 6 (Six) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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**Chairman**
**Board of Studies**

Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology (UGC)
Visakhapatnam-530027

## ICC 20ICC06 Battery System – Design Engineering

**2 0 8 6**

**Version: 01.00**

| | |
|---|---|
| Duration | 150 hours (2 hours theory and 8 hours practical per week) as specified above |
| Industry Collaborator | M/s. Vihaan Electrix, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC06. 1 | Determine specifications of the Battery system | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC06.2 | Design the Battery system | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC06.3 | evaluate each design option based on parameters such as safety, performance and cost | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC06.4 | Testing and validation of the design | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC06.5 | perform safety test to minimize overcharging and overheating | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC06.6 | perform failure mode and effect analysis of the Battery System | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

**Deliverables**

**Determining specifications of the Battery system**

Electric Vehicle level specifications, EV specifications into Battery System level specifications, Battery potential and load requirement based on Electric Vehicle specification, list various design options / specifications available at each component level of the Battery system, selection of battery system specifications to suit specifications of cells and modules, Battery system circuit based on Battery application, electrical, mechanical or thermal interface requirements, statistical modelling and state diagrams for the battery operations.

**Designing the Battery system:**

Cross-functional partners to integrate the battery into the final system, designing, building, and testing code to satisfy design requirements, hardware, and software systems for battery protection, charging and gauging, design connections between anode / cathode terminals through use of suitable busbars, simulations of the designed circuit, charging and discharging of the battery in a controlled manner.

**Testing and validation of the design:**

design areas where checking and testing is essential, requirements for continuous automation test case, correct application for activation, using technologies of traction battery and battery charger.

**Performing safety test:**

test plans for batteries at the component and system level, safety test to minimize overcharging and overheating.

**Performing cycle test:**

failure mode and effect analysis (FMEA) of the battery system, SoC for determining electrolyte's specific gravity in each cell

by using hydrometer.

**Performing load test:**

load testing to remove AMPS from a battery, electrical worst-case (circuit performance), rigorous failure /root cause on battery related problems.

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 6 (Six) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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**IDC 20ICC07 Block Chain Technology** **2 0 8 6**

**Version: 01.00**

| | |
|---|---|
| Duration | 150 hours (2 hours theory and 14 hours practical per week) as specified above |
| Industry Collaborator | M/s. HMI Engineering Services, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC07.1 | Learn basics of Blockchain | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC07.2 | Understand various Types of Blockchain | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC07.3 | Demonstrate the concepts of Blockchain | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC07.4 | Study the basics of Ethereum | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC07.5 | Learn Solidity | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC07.6 | Implement the Dapp | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

**Deliverables**

**Introduction to Blockchain**

Definition of Blockchain, History of Blockchain, Explaining Distributed Ledger, Blockchain ecosystem, Explaining Distributed Ledger

**Types of Blockchain**

Private/Consortium/Permission-less, Public/Permissioned implementation difference, What Blockchain has to offer across Industry? Companies currently using Blockchain, Overview of what we are going to study in this course,

**Key Concepts of the Blockchain**

Mining -Mining algorithm, Node, peer, and block explanation, Merkle tree and Blockchain, Consensus Mechanisms- proof of work, proof of stake, How Bitcoin Blockchain works? What is Transaction?

**Introduction to Ethereum**

Ethereum: Blockchain with smart contract, What is Ether? Bitcoin vs Ethereum Blockchain, What is Ethereum wallet? What is Smart Contract? Ethereum clients, Geth Introduction, Setting up Private Blockchain using Geth.

**Learn Solidity**

Introduction to solidity, Hands on solidity, Understand and implement different use cases, Implement and deploy smart contract on Blockchain.

**Implement Dapp**

Setting up the environment, Tools to install – Truffle, MetaMask ,Testrpc, Implement and deploy your first Dapp, Different use cases for implementation of Dapp.

**Future Scope**

Talk about the future of the Blockchain, What is Hyperledger? What is Hash graph? Discussion on current

research on Blockchain, Understand current industry challenges and needs.

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 6 (Six) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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## ICC 20ICC08 Network Administration

**2 0 8 6**

**Version: 01.00**

| | |
|---|---|
| Duration | 150 hours (2 hours theory and 8 hours practical per week) as specified above |
| Industry Collaborator | M/s. HMI Engineering Services, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC08.1 | Understand the processes of updation, Installation of Operating System. | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC08.2 | Understand the mapping of Hardware devices | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC08.3 | Demonstrate the management of group and Computer accounts | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC08.4 | Explain the File System Management | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC08.5 | Study the server administration | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC08.6 | Explore the disaster recovery | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs

L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

**Deliverables**

**Overview of Networking.**

Installing or Upgrading a Network Operating System, Preparing for installation, Installing from different installation mediums, Upgrade process, Identifying setup errors

**Managing Hardware Devices**

Understanding device drivers and PnP. Adding new devices. Hardware resource settings and driver signing, Hardware profiles

**Creating and Managing Accounts**

User authentication. User profiles. Creating, managing and troubleshooting user accounts.

**Implementing Group and Computer Accounts**

Creating group objects. Group types and scopes. Build-in groups. Creating and managing computer accounts.

**Managing File Access**

Introduction to file systems. Creating and managing shared folders. Managing shared folder permissions. NTFS permissions

**Managing Disks and Data Storage**

Disk management concepts. Managing partitions and volumes. Fault tolerant disk strategies. Monitoring disk health. Disk utilities.

**Advanced File System Management**

File and folder attributes. Advanced attributes. Disk quotas The distributed file system.

**Implementing and Managing Printers**

Installing and sharing printers, Configuring and managing printer resources.

**Using Group Policy**

Creating and editing group policy objects. Group policy inheritance.

**Server Administration**

Procedures and standards. Terminal services and remote administration. Delegating administrative authority. Software update services.

**Monitoring Server Performance and Disaster Recovery**

Task manager, event viewer and performance console. Planning disaster recovery. Backing up data. Automated system recovery.

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 6 (Six) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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Head of the Department
Mechanical Engineering
N.S. Raju Institute of Engineering & Technology
Visakhapatnam-531 173

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## ICC 20ICC09 Product Engineering

**2 0 14 9**

**Version: 01.00**

| | |
|---|---|
| Duration | 240 hours (2 hours theory and 14 hours practical per week) as specified above |
| Industry Collaborator | M/s. HMI Engineering Services, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC09.1 | Understand the basics of Manufacturing Process | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC09.2 | Explain the Manufacturing Design | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC09.3 | Explore various Production Processes | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC09.4 | Demonstrate various Production Machine Operations | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC09.5 | Study the Product monitoring | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC09.6 | Execute the Product Logistics | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

**Deliverables**

**Manufacturing Process Overview**

Product concepts, Market feasibility, Engineering design, Prototyping, Production, Marketing/sales

**Manufacturing Design**

Product analysis: Materials, Cost
Production methods: Assembly lines, Work cells, Inventory, Work flow
Quality control: Production monitoring, Product testing

**Production Processes**

Machine and process overviews: Boring and machining, Presses, Molding/Casting, Welding, Finishing, Assembly
Materials: Applicable types, Cost, Availability

**Production Machine Operations**

Presses, Molding/Casting, Drilling/Boring, Machining, Welding, Finishing, Advanced Intelligence, Automation, Programmable Logic Controllers

**Production Monitoring**

Monitoring production processes: Baselines, Environmental control
Quality improvement: Production improvement

**Finished Product Logistics**

Delivery methods, Delivery options, Customer interaction

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 6 (Six) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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## ISC 20ICC10 Machine Learning Engineer

**2 0 8 6**

**Version: 01.00**

| | |
|---|---|
| Duration | 150 hours (2 hours theory and 8 hours practical per week) as specified above |
| Industry Collaborator | M/s. Vihaan Electrix, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC10.1 | Evaluate the existing Machine Learning (ML) processes | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC10.2 | Analyse large and complex datasets to extract insights and select the appropriate technique to be used | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC10.3 | Develop models to achieve the business objectives | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC10.4 | Analyses the machine learning algorithms that could be used to solve a given problem | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC10.5 | Perform statistical analysis to resolve data set problems | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC10.6 | Train models and optimize their hyper-parameters | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge

**Deliverables**

**Prepare to Develop Machine Learning (ML) Systems:**

Machine Learning (ML) processes, appropriate datasets and data representation methods, large and complex datasets to extract insights, need of retraining the existing machine programs based on objectives, data validation strategies, pre-processing or feature engineering for a given dataset, data augmentation pipelines, models to achieve the business objectives, along with the relevant metrics to track.

**Develop and Assist in the Implementation of Machine Learning (ML) Systems:**

Machine learning algorithms, Logistic Regression, and Naive Bayes, based on statistical modelling procedures, data cleaning to remove the irrelevant data and ensure its quality and accuracy, data acquisition process, prepare the data by transforming textual and graphical data into numbers for use in the machine learning system, create data pipeline depending on the machine learning application needs Linear Regression, , differences in data distribution, statistical analysis to resolve data set problems, solve complex problems with multi-layered data sets, use data modelling and evaluation strategy to find patterns and predict unseen instances, evaluate and transform data science prototypes.

**Perform machine learning tests:**

Design machine learning systems/applications and self-running Artificial Intelligence (AI) software to automate predictive models, carry out machine learning tests, interpret the test results and make appropriate adjustments based on test results, carry out research and implement best practices to improve the existing machine learning infrastructure, optimize existing machine learning libraries and frameworks based on testing, create useful information from unstructured data by auto-tagging images and text-to-speech conversions.

**Train and retrain models:**

Train models and optimize their hyper-parameters, analyses the errors of the model and develop appropriate strategies to rectify them, retrain the existing systems based on new machine learning model, document the machine learning processes as per the organizational policy, follow the latest machine learning developments and technologies.

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 6 (Six) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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## ICC 20ICC11 Data Scientist

2 0 8 6

**Version: 01.00**

| | |
|---|---|
| Duration | 150 hours (2 hours theory and 8 hours practical per week) as specified above |
| Industry Collaborator | M/s. Vihaan Electrix, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC11. 1 | Determine specifications of the Battery system | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC11. 2 | Design the Battery system | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC11. 3 | evaluate each design option based on parameters such as safety, performance and cost | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC11. 4 | Testing and validation of the design | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC11. 5 | perform safety test to minimize overcharging and overheating | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |
| 20ICC11. 6 | perform failure mode and effect analysis of the Battery System | 1, 2, 3, PSO #1 | 3 | L1, L2, L3 |

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective POs
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK:Depth of Knowledge

**Deliverables**

**Determining specifications of the Battery system**

Electric Vehicle level specifications, EV specifications into Battery System level specifications, Battery potential and load requirement based on Electric Vehicle specification, list various design options / specifications available at each component level of the Battery system, selection of battery system specifications to suit specifications of cells and modules, Battery system circuit based on Battery application, electrical, mechanical or thermal interface requirements, statistical modelling and state diagrams for the battery operations.

**Designing the Battery system:**

Cross-functional partners to integrate the battery into the final system, designing, building, and testing code to satisfy design requirements, hardware, and software systems for battery protection, charging and gauging, design connections between anode / cathode terminals through use of suitable busbars, simulations of the designed circuit, charging and discharging of the battery in a controlled manner.

**Testing and validation of the design:**

design areas where checking and testing is essential, requirements for continuous automation test case, correct application for activation, using technologies of traction battery and battery charger.

**Performing safety test:**

test plans for batteries at the component and system level, safety test to minimize overcharging and overheating.

**Performing cycle test:**

failure mode and effect analysis (FMEA) of the battery system, SoC for determining electrolyte's specific gravity in each cell by using hydrometer.

**Performing load test:**

load testing to remove AMPS from a battery, electrical worst-case (circuit performance), rigorous failure /root cause on battery related problems.

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 6 (Six) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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## ICC 20ICC12 Industrial IOT

**2 0 8 6**

**Version: 01.00**

| | |
|---|---|
| Duration | 150 hours (2 hours theory and 8 hours practical per week) as specified above |
| Industry Collaborator | M/s. HMI Engineering Services, Visakhapatnam |

At the end of the course, students will be able to

| Code | Course Outcomes | Mapping with POs | | DoK |
|---|---|---|---|---|
| | | POs / PSOs | Weight | |
| 20ICC12.1 | Understand the basics of IIOT & IOT | 1, 2, 3 & PSO1 | 3 | L1-L3 |
| 20ICC12.2 | Demonstrate the components of IIOT & IOT | 1, 2, 3 & PSO1 | 3 | L1-L3 |
| 20ICC12.3 | Describe the Communication Technologies of IIoT | 1, 2, 3 & PSO1 | 3 | L1-L3 |
| 20ICC12.4 | Analyze the Visualization and Data Types of IIoT | 1, 2, 3 & PSO1 | 3 | L1-L3 |
| 20ICC12.5 | Describe the methods of Retrieving the data | 1, 2, 3 & PSO1 | 3 | L1-L3 |
| 20ICC12.6 | Explain the Control & Supervisory Level of Automation | 1, 2, 3 & PSO1 | 3 | L1-L3 |

**Deliverables**

**MODULE 1: Introduction & Architecture**

Theory

IIoT and connected world, the difference between IoT and IIoT, Architecture of IIoT, IOT node, Challenges of IIOT.

Practice

Introduction to Arduino, ESp8266, Introduction to raspberry PI.

**MODULE 2: IIOT Components**

Theory

Fundamentals of Control System, introductions, components, closed loop & open loop system.

Introduction to Sensors (Description and Working principle): Sensor, Types of sensors, working principle of basic Sensors - Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11). Digital switch, Electro Mechanical switches.

Practice

Measurement of temperature & pressure values of the process using raspberry pi/node mcu.

Modules and Sensors Interfacing (IR sensor, Ultrasonic sensors, Soil moisture sensor) using Raspberry pi/node mcu.

Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry pi/node mcu.

**MODULE 3: Communication Technologies of IIoT**

Theory

Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID

Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and Profibus technology, wireless network communication.

Practice

Demonstration of MQTT communication.

Demonstration of LoRa communication.

**MODULE 4: Visualization and Data Types of IIoT**

Theory

Front-end EDGE devices, Enterprise data for IIoT, Emerging descriptive data standards for IIoT, Cloud data base, Cloud computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

Practice

Visualization of diverse sensor data using dashboard (part of IoT's 'control panel')

Sending alert message to the user. ways to control and interact with your environment)

**MODULE 5: Retrieving Data**

Theory

Extraction from Web: Grabbing the content from a web page, Sending data on the web, Troubleshooting basic Arduino issues, Types of IoT interaction, Machine to Machine interaction (M2M).

Practice

Device control using mobile Apps or through Web pages.

Machine to Machine communication.

**MODULE 6: Control & Supervisory Level of Automation**

Theory

Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). HMI in an automation process, ERP & MES.

Practice

Digital logic gates programming using ladder diagram.

Implementation of Boolean expression using ladder diagram.

Simulation of PLC to understand the process control concept.

**MODULE 7: Application of IIOT**

Case study: Health monitoring, Iot smart city, Smart irrigation, Robot surveillance.

**Assessment**

| | |
|---|---|
| **Mode of Delivery** | Offline / Online |
| **No. of transferable credits for redemption** | 6 (Six) |
| **Credits validity** | 7 years from the date of registration of the program and remains NIL after redemption for the award of the degree. |
| **Dedicated certificate by the collaborating industries** | Yes |

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Head of the Department
Mechanical Engineering
N.S. Raju Institute of Technology (A)
Visakhapatnam-531173