SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous Institution under UGC, New Delhi)

(Permanently Affiliated to JNTUH, Approved by AICTE, New Delhi, Accredited by NAAC and Accredited by NBA)
Sheriguda Village, Ibrahimpatnam Mandal, Ranga Reddy Dist. – 501 510

BACHELOR OF TECHNOLOGY
MECHANICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM (CBCS)
ACADEMIC REGULATIONS, COURSE STRUCTURE AND SYLLABI FOR
II, III & IV YEARS
UNDER AUTONOMOUS STATUS FOR THE BATCHES ADMITTED FROM THE ACADEMIC YEAR 2018 - 19

B.Tech. Regular Four Year Degree Programme
(For the batches admitted from the academic year 2018–19)
&
B.Tech. (Lateral Entry Scheme)
(For the batches admitted from the academic year 2019 - 20)

Note: The regulations here under are subject to amendments as may be made by the Academic Council of the College from time to time. Any or all such amendments will be effective from such date and to such batches of candidates (including those already undergoing the program) as may be decided by the Academic Council.

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Vision of the Institute

To be a premier institution in engineering & technology and management for competency, values and social consciousness

Mission of the Institute

IM_1: Provide high quality academic programs, training activities and research facilities.

IM_2: Promote continuous industry – institute interaction aimed at promoting employability, entrepreneurship, leadership and research aptitude among stakeholders

IM_3: Contribute the economic and technological development of the region, state and Nation.

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Vision of the Department

To be a centre of excellence in the field of Mechanical Engineering with professional and ethical responsibilities.

Mission of the Department

DM_1: To provide value added education in Mechanical and allied engineering.

DM_2: To provide conducive environment oriented towards innovation.

DM_3: To impart training on emerging technologies like CAD/CAM with involvement of stake holders.

DM_4: Inculcating ethical values ability towards lifelong learning and social responsibilities.

PROGRAM OUTCOMES (POs):

PO1	**Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design / Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES(PSOs):

PSO1	**Basic Mechanical knowledge: Apply basic knowledge related to Mechanical Design, Manufacturing, Thermal Engineering and CAD/CAM to solve various engineering problems.**
PSO2	**Design methods: Design, verify and Fabricate suitable Mechanical functional elements for Automobile, high speed machinery and thermal applications.**
PSO3	**Experimentation and Analysis: Analyze, plan and prototype Mechanical experiments/projects.**

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1	**Higher Degree and Professional Employment:** Graduates with ability to attract core industries and pursue higher studies in reputed institutions.
PE02	**Domain Knowledge :** Graduates with a solid foundation in basic sciences and Mechanical Engineering.
PEO3	**Engineering Career:** Graduates with effective communication skills, teamwork, multidisciplinary approach to provide professional environment.
PEO4	**Life Long Learning :** Graduates with excellence, leadership and lifelong learning for successful career.

SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous Institution under UGC, New Delhi)

ACADEMIC REGULATIONS 2018 (BR-18) FOR CHOICE BASED CREDIT SYSTEM (CBCS)
B.TECH. DEGREE COURSES

(Applicable for Students admitted from the academic year 2018-2019)

PRELIMINARY DEFINITIONS AND NOMENCLATURES

- "Autonomous Institute / College" means an institute / college designated as autonomous institute / college by the UGC, New Delhi and JNTUH Statutes, 2014.
- "Academic Autonomy" means freedom to a College in all aspects of conducting its academic programs granted by the University for promoting excellence.
- "Commission" means University Grants Commission (UGC), New Delhi.
- "AICTE" means All India Council for Technical Education.
- "University" means the Jawaharlal Nehru Technological University, Hyderabad.
- "College" means SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY, Hyderabad unless indicated otherwise by the context.
- "Program" means: Bachelor of Technology (B.Tech) degree program
- "Branch" means specialization in a program like B.Tech degree program in Electronics and Communication Engineering, B.Tech degree program in Mechanical Engineering etc
- "Course" or "Subject" means a theory or practical subject, identified by its course – number and course-title, which is normally studied in a semester. For example, R18MTH1101: Mathematics - I, R18MED1102 :Engg. Graphics etc.
- T – Tutorial, P – Practical, D – Drawing, L - Theory, C – Credits

SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous Institution under UGC, New Delhi)

ACADEMIC REGULATIONS 2018 (BR-18) FOR CHOICE BASED CREDIT SYSTEM (CBCS) B.TECH. DEGREE COURSES

(Applicable for Students admitted from the academic year 2018-2019)

1.0 Under-Graduate Degree Programme in Engineering & Technology

Sri Indu College of Engineering & Technology (Autonomous) offers a 4-year (8 semesters) Bachelor of Technology (B.Tech.) degree programme, under Choice Based Credit System (CBCS) with effect from the academic year 2018-19.

2.0 **Eligibility for admission**

2.1 Admission to the under graduate (UG) programme shall be made either on the basis of the merit rank obtained by the qualified student in entrance test conducted by the Telangana State Government (EAMCET) or the College or on the basis of any other order of merit approved by the College, subject to reservations as prescribed by the government from time to time.

2.2 The medium of instructions for the entire under graduate programme in Engineering & Technology will be English only.

3.0 **B.Tech. Programme structure**

3.1 A student after securing admission shall complete the B.Tech. programme in a minimum period of four academic years (8 semesters), and a maximum period of eight academic years (16 semesters) starting from the date of commencement of first year first semester, failing which student shall forfeit seat in B.Tech course. Each student shall secure 160 credits (with CGPA ≥ 5) required for the completion of the under graduate programme and award of the B.Tech. degree.

3.2 UGC/ AICTE specified definitions/ descriptions are adopted appropriately for various terms and abbreviations used in these academic regulations/ norms, which are listed below.

3.2.1 **Semester scheme**

Each under graduate programme is of 4 academic years (8 semesters) with the academic year divided into two semesters of 22 weeks (≥ 90 instructional days) each, each semester having - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)' under Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) indicated by UGC, and curriculum/course structure as suggested by AICTE are followed.

3.2.2 **Credit courses**

All subjects/ courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject/ course in an L: T: P: C (lecture periods: tutorial periods: practical periods: credits) structure based on the following general pattern.

- One credit for one hour/ week/ semester for theory/ lecture (L) courses or Tutorials.
- One credit for two hours/ week/ semester for laboratory/ practical (P) courses.

Courses like Environmental Science, Constitution of India, Intellectual Property Rights, and Gender Sensitization lab are mandatory courses. These courses will not carry any credits.

3.2.3 Subject Course Classification

All subjects/ courses offered for the under graduate programme in E&T (B.Tech. degree programmes) are broadly classified as follows. The College has followed almost all the guidelines issued by AICTE/UGC.

S. No.	Broad Course Classification	Course Group/ Category	Course Description
1	Foundation Courses (FnC)	BS – Basic Sciences	Includes mathematics, physics and chemistry subjects
2		ES - Engineering Sciences	Includes fundamental engineering subjects
3		HS – Humanities and Social sciences	Includes subjects related to humanities, social sciences and management
4	Core Courses (CoC)	PC – Professional Core	Includes core subjects related to the parent discipline/ department/ branch of Engineering.
5	Elective Courses (EℓC)	PE – Professional Electives	Includes elective subjects related to the parent discipline/ department/ branch of Engineering.
6		OE – Open Electives	Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering.
7	Core Courses	Project Work	B.Tech. project or UG project or UG major project or Project Stage I & II
8		Industrial training/ Mini- project	Industrial training/ Summer Internship/ Industrial Oriented Mini-project/ Mini-project
9.		Seminar	Seminar/ Colloquium based on core contents related to parent discipline/ department/ branch of Engineering.
10	Minor courses	-	1 or 2 Credit courses (subset of HS)
11	Mandatory Courses (MC)	-	Mandatory courses (non-credit)

4.0 Course registration

4.1 A 'faculty advisor or counselor' shall be assigned to a group of 20 students, who will advise the students about the under graduate programme, its course structure and curriculum, choice/option for subjects/ courses, based on their competence, progress, pre-requisites and interest.

4.2 The academic section of the college invites 'registration forms' from students before the beginning of the semester through 'registration', ensuring 'date and time stamping'. The registration requests for any 'current semester' shall be **completed before the commencement of SEEs (Semester End Examinations) of the 'preceding semester'**.

4.3 A student can apply for registration, **only after** obtaining the '**written approval**' from faculty advisor/counselor, which should be submitted to the college academic section through the Head of the Department. A copy of it shall be retained with Head of the Department, faculty advisor/ counselor and the student.

4.4 A student may be permitted to register for all the subjects/ courses in a semester as specified in the course structure with maximum additional subject(s)/course(s) limited to 4 credits, based on **progress** and SGPA/ CGPA, and completion of the '**pre- requisites'** as indicated for various subjects/ courses, in the department course structure and syllabus contents.

4.5 Choice for '**additional subjects/ courses**' must be clearly indicated, which needs the specific approval and signature of the faculty advisor/ counselor.

4.6 If the student submits ambiguous choices or multiple options or erroneous entries during registration for the subject(s) / course(s) under a given/ specified course group/ category as listed in the course structure, only the first mentioned subject/ course in that category will be taken into consideration.

4.7 Subject/ course options exercised through registration are final and **cannot** be changed or inter-changed; further, alternate choices also will not be considered. However, if the subject/ course that has already been listed for registration by the Head of the Department in a semester could not be offered due to any unforeseen or unexpected reasons, then the student shall be allowed to have alternate choice either for a new subject (subject to offering of such a subject), or for another existing subject (subject to availability of seats). Such alternate arrangements will be made by the head of the department, with due notification and time-framed schedule, within the **first week** after the commencement of class-work for that semester.

4.8 Dropping of subjects/ courses may be permitted, only after obtaining prior approval from the faculty advisor/ counselor 'within a period of 15 days' from the beginning of the current semester.

4.9 **Open electives**: The students have to choose three open electives (OE-I, II & III) from the list of open electives given. However, the student cannot opt for an open elective subject offered by his own (parent) department, if it is already listed under any category of the subjects offered by parent department in any semester.

4.10 Professional electives: The students have to choose six professional electives (PE-I toVI) from the list of professional electives given.

5.0 Subjects/ courses to be offered

5.1 A typical section (or class) strength for each semester shall be 60.

5.2 A subject/ course may be offered to the students, **only if** a minimum of 20 students (1/3 of the section strength) opt for it. The maximum strength of a section is limited to 80 (60 + 1/3 of the section strength).

5.3 More than **one faculty member** may offer the **same subject** (lab/ practical may be included with the corresponding theory subject in the same semester) in any semester. However, selection of choice for students will be based on - '**first come first serve** basis and CGPA criterion' (i.e. the first focus shall be on early **on-line entry** from the student for registration in that semester, and the second focus, if needed, will be on CGPA of the student).

5.4 If more entries for registration of a subject come into picture, then the Head of the Department concerned shall decide, whether or not to offer such a subject/ course for **two (or multiple) sections**.

5.5 In case of options coming from students of other departments/ branches/ disciplines (not considering **open electives**), first **priority** shall be given to the student of the '**parent department**'.

6.0 Attendance requirements:

6.1 A student shall be eligible to appear for the semester end examinations, if the student acquires a minimum of 75% of attendance in aggregate of all the subjects/ courses (excluding attendance in mandatory courses like Environmental Science, Constitution of India, Intellectual Property Rights, and Gender Sensitization lab) for that semester. Two periods of attendance for each theory subject shall be considered, if the student appears for the mid-term examination of that subject. **This attendance should also be included in the fortnightly upload of attendance to the College.** The attendance of Mandatory Non-Credit courses should be uploaded separately to the College.

6.2 Shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each semester may be condoned by the college academic committee on genuine and valid grounds, based on the student's representation with supporting evidence.

6.3 A stipulated fee shall be payable for condoning of shortage of attendance.

6.4 Shortage of attendance below 65% in aggregate shall in **no** case be condoned.

6.5 Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examinations of that semester. They get detained and their registration for that semester shall stand cancelled. They will not be promoted to the next semester. They may seek re-registration for all those subjects registered in that semester in which the student is detained, by seeking re-admission into that semester as and when offered; if there are any professional electives and/ or open electives, the same may also be re-registered if offered. However, if those electives are not offered in later semesters, then alternate electives may be chosen from the **same** set of elective subjects offered under that category.

6.6 A student fulfilling the attendance requirement in the present semester shall not be eligible for readmission into the same class.

7.0 Academic requirements

The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in item no.6.

7.1 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course, if student secures not less than 35% (25 marks out of 70 marks) in the semester end examination, and a minimum of 40% (40 marks out of 100 marks) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of letter grades, this implies securing **'C'** grade or above in that subject/ course.

7.2 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Industrial Oriented Mini Project/Summer Internship and seminar, if the student secures not less than 40% marks (i.e. 40 out of 100 allotted marks) in each of them. The student is deemed to have failed, if he (i) does not submit a report on Industrial Oriented Mini Project/Summer Internship, or does not make a presentation of the same before the evaluation committee as per schedule, or (ii) does not present the seminar as required in the IV year I Semester, or (iii) secures less than 40% marks in Industrial Oriented Mini Project/Summer Internship and seminar evaluations.

A student may reappear once for each of the above evaluations, when they are scheduled again; if the student fails in such 'one reappearance' evaluation also, the student has to reappear for the same in the next subsequent semester, as and when it is scheduled.

7.3 Promotion Rules

S. No.	Promotion	Conditions to be fulfilled
1	First year first semester to first year second semester	Regular course of study of first year first semester.
2	First year second semester to second year first semester	i. Regular course of study of first year second semester. ii. Must have secured at least 18 credits out of 37 credits i.e., 50% credits up to first year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3.	Second year first semester to second year second semester	Regular course of study of second year first semester.
4	Second year second semester to third year first semester	i. Regular course of study of second year second semester. ii. Must have secured at least 47 credits out of 79 credits i.e., 60% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Third year first semester to third year second semester	Regular course of study of third year first semester.

6	**Third year second semester to fourth year first semester**	**(i) Regular course of study of third year second semester.** **(ii) Must have secured at least 73 credits out of 123 credits i.e., 60% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.**
7	**Fourth year first semester to fourth year second semester**	**Regular course of study of fourth year first semester.**

7.4 A student (i) shall register for all courses/subjects covering 160 credits as specified and listed in the course structure, (ii) fulfills all the attendance and academic requirements for 160 credits, (iii) earn all 160 credits by securing SGPA ≥ 5.0 (in each semester), and CGPA (at the end of each successive semester) ≥ 5.0, (iv) **passes all the mandatory courses,** to successfully complete the under graduate programme. The performance of the student in these 160 credits shall be taken into account for the calculation of 'the final CGPA **(at the end of under graduate programme),** and shall be indicated in the grade card of IV year II semester.

7.5 If a student registers for '**extra subjects'** (in the parent department or other departments/branches of Engg.) other than those listed subjects totaling to 160 credits as specified in the course structure of his department, the performances in those '**extra subjects**' (although evaluated and graded using the same procedure as that of the required 160 credits) will not be taken into account while calculating the SGPA and CGPA. For such '**extra subjects'** registered, percentage of marks and letter grade alone will be indicated in the grade card as a performance measure, subject to completion of the attendance and academic requirements as stated in regulations 6 and 7.1 – 7.4 above.

7.6 A student eligible to appear in the semester end examination for any subject/ course, but absent from it or failed (thereby failing to secure **'C'** grade or above) may reappear for that subject/ course in the supplementary examination as and when conducted. In such cases, internal marks (CIE) assessed earlier for that subject/ course will be carried over, and added to the marks to be obtained in the SEE supplementary examination for evaluating performance in that subject.

7.7 A student **detained in a semester due to shortage of attendance may be re-admitted in the same semester in the next academic year for fulfillment of academic requirements**. The academic regulations under which a student has been readmitted shall be applicable. However, no grade allotments or SGPA/ CGPA calculations will be done for the entire semester in which the student has been detained.

7.8 A student detained **due to lack of credits, shall be promoted to the next academic** year only after acquiring the required academic credits. The academic regulations under which the student has been readmitted shall be applicable to him.

8.0 Evaluation - Distribution and Weightage of marks

8.1 The performance of a student in each semester shall be evaluated subject– wise with a maximum of 100 marks for theory and 75 marks for practical subjects. In addition, an Industry oriented mini- project, Technical Seminar, Comprehensive viva-voce, and Main Project Work shall be evaluated for 50, 50, 100 and 200 marks respectively.

8.2 For theory subjects the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End-Examination, Two mid examinations will be conducted in each semester as per the academic calendar. Each mid examination is evaluated for 25 marks. First mid examination should be conducted for 1 – 2 ½ Units of syllabus and the second mid examination shall be conducted for 2 ½ - 5 Units of syllabus. The mid descriptive type exam paper consists of Section-A and Section-B.

Section-A [compulsory] consists of 5 short answer questions and each carries one mark.

Section-B consists of 6 questions out of which 4 are to be answered and each question carries 5 marks. The time duration of each mid examination is 90 minutes.

Two assignments are to be given to students covering the syllabus of first mid and second Mid examinations and these assignments and Attendance are evaluated for 5 marks each. The first assignment shall be submitted before first mid examinations and second Assignment should be submitted before second mid examination.

At the end of the semester Internal Marks Maximum of 30 for the respective subjects are allotted as follows:

a) 25 marks for the average of the two mid term examinations
b) 5 marks of the average of the two assignment marks & Attendance

- Award of final sessional marks : Subject-wise attendance, average marks of two assignments and mid-examination marks will be added and rounded of to the next Integer.

8.2.1 For practical subjects there shall be a continuous evaluation during the semester for 25 sectional marks and 50 marks for end examination. Out of the 25 marks for internal, day-to-day work in the laboratory shall be evaluated for 10 marks, and 10 marks for internal examination (two internal practical examinations will be conducted and the average of the two examinations will be taken into account) and 5 marks for laboratory record.

NOTE: A student who is absent for any assignment/Mid term examination for any reason what so ever shall be deemed to have secured 'zero' marks in the test/examination and no makeup test/examination shall be conducted.

8.2.2 For the subjects having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing, Production Drawing Practice, and Estimation etc., the distribution shall be 30 marks for internal evaluation (15 marks for day-to-day work and 15 marks for internal tests (the average of the two

examinations will be taken into account) and 70 marks for end examination. There shall be two internal tests in a semester. The Internal and End Examination pattern for the above subjects may be different from the other theory subjects.

8.2.3 There shall be an industry-oriented mini-Project, in collaboration with an industry of their specialization, to be taken up during the vacation after III year II Semester examination. The mini project shall be evaluated during the IV year II Semester. The industry oriented mini project shall be submitted in report form and should be presented before a committee, which shall be evaluated for 50 marks. The committee consists of Head of the Department, the supervisor of mini project and a senior faculty member of the department and External Examiner.

8.2.4 There shall be a seminar presentation in IV year II Semester. For the seminar, the student shall collect the information on a specialized topic other than the project topic and prepare a technical report, showing his understanding of the topic, and submit to the department, which shall be evaluated by a Departmental committee consists of the Head of the department, seminar supervisor and a senior faculty member. The seminar report shall be evaluated for 50 marks. There shall be no external examination for seminar.

8.2.5 There shall be a Comprehensive Viva-Voce in IV year I semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of the Head of the Department and three Senior Faculty members of the Department. The Comprehensive Viva-Voce is aimed to assess the student's understanding in various subjects studied during the B.Tech. course of study. The Comprehensive Viva-Voce is evaluated for 100 marks by the Committee. There will be no internal assessment for the Comprehensive viva-voce.

8.3 The Project work shall be started by the student in the beginning of the IV year II Semester. Out of a total of 200 marks for the project work, 50 marks shall be for Internal Evaluation and 150 marks for the Semester end Examination. The Semester end Examination (viva-voce) shall be conducted by a committee comprising of an external examiner, Head of the Department and the project supervisor. The evaluation of project work shall be conducted at the end of the IV year II Semester. The Internal Evaluation shall be on the basis of three seminars conducted during the IV year II semester for 20 marks by the committee consisting of Head of the Department, project supervisor and senior faculty member of the Department and for 30 marks by the supervisor of the project.

8.4 **Semester End Examination**

(a) **Theory Courses**

Each course is evaluated for 70 marks. Examination is of 3 hours duration.

Question paper contains two sections [Section-A and Section-B]

Section-A : This Section Carries 20 marks [Five short answer questions of four marks each and only one question to be set from any five units] which is compulsory.

Section-B: This Section carries 50 marks with 5 questions consisting of two parts each (a) and (b), out of which the student has to answer either (a) or (b), not both. Each question in Part B carries 10 marks.

(b) **Practical Courses**

Each lab course is evaluated for 50 marks. The examination shall be conducted by the laboratory teacher and another senior teacher concerned with the subject of the same/other department/Industry. The external examiner may be appointed by the Chief Superintendent in consultation with HOD as and when required.

(c) **Supplementary Examinations**

Supplementary examinations will be conducted along with regular semester end examinations. (during even semester regular examinations, supplementary examinations of odd semester and during odd semester regular examinations, supplementary examinations of even semester will be conducted).

8.5 The laboratory marks and the internal marks awarded by the college are subject to scrutiny and scaling by the College wherever necessary. In such cases, the internal and laboratory marks awarded by the college will be referred to a committee. The committee will arrive at a scaling factor and the marks will be scaled accordingly. The recommendations of the committee are final and binding. The laboratory records and internal test papers shall be preserved in the College as per the College rules and produced before the committees of the College as and when asked for.

8.6 For mandatory courses of Environmental Science, Constitution of India, Intellectual Property Rights, and Gender Sensitization lab, a student has to secure 40 marks out of 100 marks (i.e. 40% of the marks allotted) in the continuous internal evaluation for passing the subject/course. These marks should also be uploaded along with the internal marks of other subjects.

8.7 No marks or letter grades shall be allotted for mandatory/non-credit courses. Only Pass/Fail shall be indicated in Grade Card.

9.0 **Grading procedure**

9.1 Grades will be awarded to indicate the performance of students in each theory subject, laboratory / practicals, seminar, Industry Oriented Mini Project, and project Stage - I & II. Based on the percentage of marks obtained (Continuous Internal Evaluation plus Semester End Examination, both taken together) as specified in item 8 above, a corresponding letter grade shall be given.

9.2 As a measure of the performance of a student, a 10-point absolute grading system using the following letter grades (as per UGC/AICTE guidelines) and corresponding percentage of marks shall be followed:

% of Marks Secured in a Subject/Course (Class Intervals)	Letter Grade (UGC Guidelines)	Grade Points
Greater than or equal to 90%	O (Outstanding)	10
80 and less than 90%	A^+ (Excellent)	9
70 and less than 80%	A (Very Good)	8
60 and less than 70%	B^+ (Good)	7
50 and less than 60%	B (Average)	6
40 and less than 50%	C (Pass)	5
Below 40%	F (FAIL)	0
Absent	Ab	0

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

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

9.5 A letter grade does not indicate any specific percentage of marks secured by the student, but it indicates only the range of percentage of marks.

9.6 A student earns grade point (GP) in each subject/ course, on the basis of the letter grade secured in that subject/ course. The corresponding 'credit points' (CP) are computed by multiplying the grade point with credits for that particular subject/ course.

Credit points (CP) = grade point (GP) x credits …. For a course

9.7 A student passes the subject/ course only when **GP ≥ 5 ('C' grade or above)**

9.8 The Semester Grade Point Average (SGPA) is calculated by dividing the sum of credit points (∑CP) secured from all subjects/ courses registered in a semester, by the total number of credits registered during that semester. SGPA is rounded off to **two** decimal places. SGPA is thus computed as

$$\mathbf{SGPA} = \{ \sum_{i=1}^{N} C_i \, G_i \} / \{ \sum_{i=1}^{N} C_i \} \text{ …. For each semester,}$$

where 'i' is the subject indicator index (takes into account all subjects in a semester), 'N' is the no. of subjects 'registered' for the semester (as specifically required and listed under the course structure of the parent department), C_i is the no. of credits allotted to the i^{th} subject, and G_i represents the grade points (GP) corresponding to the letter grade awarded for that i^{th} subject.

9.9 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student in all semesters considered for registration. The CGPA is the ratio of the total credit points secured by a student in **all** registered courses in **all** semesters, and the total number of credits registered in **all** the semesters. CGPA is

rounded off to **two** decimal places. CGPA is thus computed from the I year II semester onwards at the end of each semester as per the formula

$$\text{CGPA} = \{ \sum_{j=1}^{M} C_j G_j \} / \{ \sum_{j=1}^{M} C_j \} \text{ ... for all semesters registered}$$

(i.e., up to and inclusive of semesters, S ≥ 2).

where 'M' is the total no. of subjects (as specifically required and listed under the course structure of the parent department) the student has 'registered' i.e., from the 1st semester onwards up to and inclusive of the 8th semester, 'j' is the subject indicator index (takes into account all subjects from 1 to 8 semesters), C_j is the no. of credits allotted to the j^{th} subject, and G_j represents the grade points (GP) corresponding to the letter grade awarded for that j^{th} subject. After registration and completion of I year I semester, the SGPA of that semester itself may be taken as the CGPA, as there are no cumulative effects.

Illustration of calculation of SGPA:

Course/Subject	Credits	Letter Grade	Grade Points	Credit Points
Course 1	4	A	8	4 x 8 = 32
Course 2	4	O	10	4 x 10 = 40
Course 3	4	C	5	4 x 5 = 20
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A+	9	3 x 9 = 27
Course 6	3	C	5	3 x 5 = 15
	21			152

SGPA = 152/21 = 7.24

Illustration of calculation of CGPA up to 3rd semester:

Semester	Course/Subject Title	Credits Allotted	Letter Grade Secured	Corresponding Grade Point (GP)	Credit Point (CP)
I	Course 1	3	A	8	24
I	Course 2	3	O	10	30
I	Course 3	3	B	6	18
I	Course 4	4	A	8	32
I	Course 5	3	A+	9	27
I	Course 6	4	C	5	20
II	Course 7	4	B	6	24
II	Course 8	4	A	8	32
II	Course 9	3	C	5	15
II	Course 10	3	O	10	30
II	Course 11	3	B+	7	21
II	Course 12	4	B	6	24
II	Course 13	4	A	8	32
II	Course 14	3	O	10	30

III	Course 15	2	A	8	16
III	Course 16	1	C	5	5
III	Course 17	4	O	10	40
III	Course 18	3	B+	7	21
III	Course 19	4	B	6	24
III	Course 20	4	A	8	32
III	Course 21	3	B+	7	21
	Total Credits	**69**		**Total Credit Points**	**518**

CGPA = 518/69 = 7.51

The above illustrated calculation process of CGPA will be followed for each subsequent semester until 8th semester. The CGPA obtained at the end of 8th semester will become the final CGPA secured for entire B.Tech. Programme.

9.10 For merit ranking or comparison purposes or any other listing, **only** the '**rounded off' values of the CGPAs will be used.**

9.11 SGPA and CGPA of a semester will be mentioned in the semester Memorandum of Grades if all subjects of that semester are passed in first attempt. Otherwise the SGPA and CGPA shall be mentioned only on the Memorandum of Grades in which sitting he passed his last exam in that semester. However, mandatory courses will not be taken into consideration.

10.0 Issue of Grade Card:

After the completion of each semester, a grade card or grade sheet shall be issued to all the registered students of that semester, indicating the letter grades and credits earned. It will show the details of the courses registered (course code, title, no. of credits, grade earned, etc.), credits earned.

11.0 Declaration of results

11.1 Computation of SGPA and CGPA are done using the procedure listed in 9.6 to 9.9.

11.2 For final percentage of marks equivalent to the computed final CGPA, the following formula may be used.

% of Marks = (final CGPA – 0.5) x 10

12.0 Award of degree

12.1 A student who registers for all the specified subjects/ courses as listed in the course structure and secures the required number of 160 credits (with CGPA ≥ 5.0), within 8 academic years from the date of commencement of the first academic year, shall be declared to have '**qualified'** for the award of B.Tech. degree in the chosen branch of Engineering selected at the time of admission.

12.2 A student who qualifies for the award of the degree as listed in item 12.1 shall be placed in the following classes.

12.3 A student with final CGPA (at the end of the under graduate programme) ≥ 8.00, and fulfilling the following conditions - shall be placed in '**first class with distinction'**.

However, he

(i) Should have passed all the subjects/courses in '**first appearance'** within the first 4 academic years (or 8 sequential semesters) from the date of commencement of first year first semester.

(ii) Should have secured a CGPA ≥ 8.00, at the end of each of the 8 sequential semesters, starting from I year I semester onwards.

(iii) Should not have been detained or prevented from writing the semester end examinations in any semester due to shortage of attendance or any other reason.

A student not fulfilling any of the above conditions with final CGPA ≥ 8 shall be placed in **'first class'.**

12.4 Students with final CGPA (at the end of the under graduate programme) ≥ 6.50 but < 8.00 shall be placed in **'first class'.**

12.5 Students with final CGPA (at the end of the under graduate programme) ≥ 5.50 but < 6.50, shall be placed in '**second class'**.

12.6 All other students who qualify for the award of the degree (as per item 12.1), with final CGPA (at the end of the under graduate programme) ≥ 5.00 but < 5.50, shall be placed in '**pass class**'.

12.7 A student with final CGPA (at the end of the under graduate programme) < 5.00 will not be eligible for the award of the degree.

12.8 Students fulfilling the conditions listed under item 12.3 alone will be eligible for award of **'Gold Medal' / College Toppers**.

13.0 Withholding of results

13.1 If the student has not paid the fees to the College at any stage, or has dues pending due to any reason whatsoever, or if any case of indiscipline is pending, the result of the student may be withheld, and the student will not be allowed to go into the next higher semester. The award or issue of the degree may also be withheld in such cases.

14.0 Student transfers

14.1 There shall be no branch transfers after the completion of admission process.

14.2 There shall be no transfers from one college/stream to another within the constituent colleges and units of Sri Indu College of Engineering & Technology.

14.3 The students seeking transfer to colleges affiliated to JNTUH with special directions of GAD / JNTUH from various other Universities/institutions have to pass the failed subjects which are equivalent to the subjects of JNTUH, and also pass the subjects of JNTUH which the students have not studied at the earlier institution. Further,

though the students have passed some of the subjects at the earlier institutions, if the same subjects are prescribed in different semesters of JNTUH, the students have to study those subjects in JNTUH in spite of the fact that those subjects are repeated.

14.4 The transferred students from other Universities/institutions to Sri Indu college who are on rolls are to be provided one chance to write the CBT (internal marks) in the **equivalent subject(s)** as per the clearance letter issued by the University.

14.5 The Sri Indu College of Engineering & Technology (Autonomous) will provide one chance to write the internal examinations in the **equivalent subject(s)** to the students transferred from other universities/institutions who are on rolls, as per the clearance (equivalence) letter issued by the University.

15.0 Scope

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

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

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

15.4 Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

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ACADEMIC REGULATIONS FOR B.TECH. (LATERAL ENTRY SCHEME) FROM THE AY 2019-20

1. **Eligibility for award of B. Tech. Degree (LES)**

   The LES students after securing admission shall pursue a course of study for not less than three academic years and not more than six academic years.

2. The student shall register for 123 credits and secure 123 credits with CGPA ≥ 5 from II year to IV year B.Tech. programme (LES) for the award of B.Tech. degree.

3. The students, who fail to fulfill the requirement for the award of the degree in six academic years from the year of admission, shall forfeit their seat in B.Tech.

4. The attendance requirements of B. Tech. (Regular) shall be applicable to B.Tech. (LES).

5. **Promotion rule**

S. No	Promotion	Conditions to be fulfilled
1	Second year first semester to second year second semester	Regular course of study of second year first semester.
2	Second year second semester to third year first semester	**(i)** Regular course of study of second year second semester. **(ii)** Must have secured at least 25 credits out of 42 credits i.e., 60% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3	Third year first semester to third year second semester	Regular course of study of third year first semester.
4	Third year second semester to fourth year first semester	(i) Regular course of study of third year second semester. (ii) Must have secured at least 51 credits out of 86 credits i.e., 60% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Fourth year first semester to fourth year second semester	Regular course of study of fourth year first semester.

6. All the other regulations as applicable to B. Tech. 4-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme).

MALPRACTICES RULES
DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

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

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

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

Frequently asked Questions and Answers about autonomy

1. **Who grants Autonomy? UGC, Govt., AICTE or University**

   In case of Colleges affiliated to a university and where statutes for grant of autonomy are ready, it is the respective University that finally grants autonomy.

2. **Shall SICET award its own Degrees?**

   No. Degree will be awarded by Jawaharlal Nehru Technological University, Hyderabad with a mention of the name SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY on the Degree Certificate.

3. **What is the difference between a Deemed University and an Autonomy College?**

   A Deemed University is fully autonomous to the extent of awarding its own Degree. A Deemed University is usually a Non-Affiliating version of a University and has similar responsibilities like any University. An Autonomous College enjoys Academic Autonomy alone. The University to which an autonomous college is affiliated will have checks on the performance of the autonomous college.

4. **How will the Foreign Universities or other stake – holders know that we are an Autonomous College?**

   Autonomous status, once declared, shall be accepted by all the stake holders. Foreign Universities and Indian Industries will know our status through our college website.

5. **What is the change of Status for Students and Teachers if we become Autonomous?**

   An autonomous college carries a prestigious image. Autonomy is actually earned out of continued past efforts on academic performances, capability of self-governance and the kind of quality education we offer.

6. **Who will check whether the academic standard is maintained / improved after Autonomy? How will it be checked?**

   There is a built in mechanism in the autonomous working for this purpose. An Internal Committee called Academic Programme Evaluation Committee is a Non – Statutory body, which will keep a watch on the academics and keep its reports and recommendations every year. In addition to Academic Council, the highest academic body also supervises the academic matters. At the end of three years, there is an external inspection by the University for this purpose. The standards of our question papers, the regularity of academic calendar, attendance of students, speed and transparency of result declaration and such other parameters are involved in this process.

7. **Will the students of SICET as an Autonomous College qualify for University Medals and Prizes for academic excellence?**

   No, SICET has instituted its own awards, medals, etc. for the academic performance of the students. However for all other events like sports, cultural and co-curricular organized by the University the students shall qualify.

8. Can SICET have its own Convocation?

No, since the University awards the Degree the Convocation will be that of the University.

9. Can SICET give a provisional degree certificate?

Since the examinations are conducted by SICET and the results are also declared by SICET, the college sends a list of successful candidates with their final percentage of marks to the University. Therefore with the prior permission of the University the college will be entitled to give the provisional certificate.

10. Will Academic Autonomy make a positive impact on the Placements or Employability?

Certainly. The number of students qualifying for placement interviews is expected to improve, due to rigorous and repetitive classroom teaching and continuous assessment, besides the autonomous status is more responsive to the needs of the industry. As a result, there will be a lot of scope for industry oriented skill development built-in into the system. The graduates from an autonomous college will therefore represent better employability.

11. What is the proportion of Internal and External Assessment as an Autonomous College?

Presently, it is 30% for internal assessment and 70% for external assessment. As the autonomy matures the internal assessment component shall be increased at the cost of external assessment.

12. Will there be any Revaluation or Re-Examination System?

No. There will not be any Revaluation system or Re-examination. But, there is a personal verification of the answer scripts.

13. How fast Syllabi can be and should be changed?

Autonomy allows us the freedom to change the syllabi as often as we need.

14. Will the Degree be awarded on the basis of only final year performance?

No. The percentage of marks will reflect the average performance of all the semesters put together.

15. Who takes Decisions on Academic matters?

The Academic Council of College is the top academic body and is responsible for all the academic decisions. Many decisions are also taken at the lower level like the BOS which are like Boards of Studies of the University.

16. What is the role of Examination committee?

The Exam Committee is responsible for the smooth conduct of inter and external examinations. All matters involving the conduct of examinations, spot valuations, tabulations, preparation of Memorandum of Marks etc fall within the duties of the Examination Committee.

17. Is there any mechanism for Grievance Redressal?

Yes, the college has grievance redressal committee, headed by a senior faculty member of the college.

18. How many attempts are permitted for obtaining a Degree?

All such matters are defined in Rules & Regulations.

19. Who declares the result?

The result declaration process is also defined. After tabulation work the entire result is reviewed by the Moderation Committee. Any unusual deviations or gross level discrepancies are deliberated and removed. The entire result is discussed in the College Academic Council for its approval. The result is then declared on the college notice boards as well put on the web site of the college. It is eventually sent to the University.

20. What is our relationship with the Jawaharlal Nehru Technological University, Hyderabad?

We remain an affiliated college of the Jawaharlal Nehru Technological University, Hyderabad. The University has the right to nominate its members on the academic bodies of the college.

21. Shall we require University approval if we want to start any New Courses?

Yes, It is expected that approvals or such other matters from an autonomous college will receive priority.

22. Shall we get autonomy for PG and Doctoral Programmes also?

Yes, presently our PG programmes are also enjoying autonomous status.

23. How many exams will be there as an autonomous college?

This is defined in the Rules & Regulations.

24 Is the College adapting Choice Based Credit System (CBCS) or Not ?
Yes, this College has adapted CBCS system with effect from the Academic Year 2016-17.

25. What is Choice Based Credit System (CBCS)?

Choice Based Credit System (CBCS): The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).

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SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous Institution under UGC, New Delhi)

Choice Based Credit System (CBCS)

REGULATIONS – BR-18

B. Tech. MECHANICAL ENGINEERING
(Common to ME & CIVIL)

I YEAR I SEMESTER **COURSE STRUCTURE**

S. No.	Course Code	Course Title	L	T	P	Credits
1	R18MTH1101	Mathematics – I (Linear Algebra and Calculus)	3	1	0	4
2	R18EPH1101	Engineering Physics	3	1	0	4
3	R18CSE1101	Programming for Problem Solving	3	1	0	4
4	R18MED1102	Engineering Graphics	1	0	4	3
5	R18EPH12L1	Engineering Physics Lab	0	0	3	1.5
6	R18CSE12L1	Programming for Problem Solving Lab	0	0	3	1.5
7	R18HAS1102	Environmental Science	3	0	0	0
8	R18IPG1101	Induction Programme for Three Weeks	0	0	0	0
		Total Credits	**13**	**3**	**10**	**18**

I YEAR II SEMESTER **COURSE STRUCTURE**

S. No.	Course Code	Course Title	L	T	P	Credits
1	R18MTH1201	Mathematics – II (Advanced Calculus)	3	1	0	4
2	R18ECH1101	Chemistry	3	1	0	4
3	R18MED1103	Engineering Mechanics	3	1	0	4
4	R18MED1101	Engineering Workshop	1	0	3	2.5
5	R18HAS1101	English	2	0	0	2
6	R18ECH12L1	Engineering Chemistry Lab	0	0	3	1.5
7	R18HAS12L1	English Language and Communication Skills Lab	0	0	2	1
8	R18COI1101	Constitution of India	3	0	0	0
9	R18ITK1101	Essence of Indian Traditional Knowledge	3	0	0	0
		Total Credits	**18**	**3**	**8**	**19**

SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY

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Choice Based Credit System (CBCS)

REGULATIONS – BR-18

B. Tech. MECHANICAL ENGINEERING

II YEAR I SEMESTER **COURSE STRUCTURE**

S. No.	Course Code	Course Title	L	T	P	Credits
1	R18MTH2101	Probability Distribution & Complex Variables	3	1	0	4
2	R18MED2101	Mechanics of Solids	3	1	0	4
3	R18MED2102	Material Science & Metallurgy	3	0	0	3
4	R18MED2103	Production Technology	3	0	0	3
5	R18MED2104	Thermodynamics	3	1	0	4
6	R18MED21L1	Production Technology Lab	0	0	2	1
7	R18MED21L2	Machine Drawing Practice	0	0	2	1
8	R18MED21L3	Material Science & Mechanics of Solids Lab	0	0	2	1
9	R18MAC2100	Gender Sensitization Lab	0	0	2	0
		Total Credits	**15**	**3**	**8**	**21**

II YEAR II SEMESTER **COURSE STRUCTURE**

S.No	Course Code	Course Title	L	T	P	Credits
1	R18EEE2205	Basics of Electrical & Electronics Engineering	3	0	0	3
2	R18MED2201	Kinematics of Machinery	3	1	0	4
3	R18MED2202	Thermal Engineering-I	3	1	0	4
4	R18MED2203	Fluid Mechanics & Hydraulic Machines	3	1	0	4
5	R18MED2204	Instrumentation & Control Systems	3	0	0	3
6	R18EEE22L4	Basics of Electrical & Electronics Lab	0	0	2	1
7	R18MED22L1	Fluid Mechanics & Hydraulic Machines Lab	0	0	2	1
8	R18MED22L2	Instrumentation & Control Systems Lab	0	0	2	1
10	R18MAC2200	Intellectual Property Rights	3	0	0	0
		Total Credits	**18**	**3**	**6**	**21**

SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY

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Choice Based Credit System (CBCS)

REGULATIONS – BR-18

B. Tech. MECHANICAL ENGINEERING

III YEAR I SEMESTER **COURSE STRUCTURE**

S. No.	Course Code	Course Title	L	T	P	Credits
1	R18MED3101	Dynamics of Machinery	3	1	0	4
2	R18MED3102	Design of Machine Members-I	3	0	0	3
3	R18MED3103	Metrology & Machine Tools	3	0	0	3
4	R18MBA2201	Business Economics & Financial Analysis	3	0	0	3
5	R18MED3104	Thermal Engineering-II	3	0	0	3
6	R18MTH3101	Operations Research	3	0	0	3
7	R18MED31L1	Thermal Engineering Lab	0	0	2	1
8	R18MED31L2	Metrology & Machine Tools Lab	0	0	2	1
9	R18MED31L3	Kinematics & Dynamics Lab	0	0	2	1
10	R18MAC3100	MOOCs-I	0	0	2	0
		Total Credits	**18**	**1**	**8**	**22**

III YEAR II SEMESTER **COURSE STRUCTURE**

S. No	Course Code	Course Title	L	T	P	Credits
1	R18MED3201	Design of Machine Members-II	3	0	0	3
2	R18MED3202	Heat Transfer	3	1	0	4
3	R18MED3203	CAD & CAM	3	0	0	3
Professional Elective – I						
4	R18MED3211	Unconventional Machining Processes	3	0	0	3
	R18MED3212	Machine Tool Design				
	R18MED3213	Production Planning & Control				
5		Open Elective – I	3	0	0	3
6	R18MED3204	Finite Element Methods	3	0	0	3
7	R18MED32L1	Heat Transfer Lab	0	0	2	1
8	R18MED32L2	CAD & CAM Lab	0	0	2	1
9	R18HAS31L1	Advanced Communication Skills lab	0	0	2	1
10	R18MAC3200	MOOCs-II	0	0	2	0
		Total Credits	**18**	**1**	**8**	**22**

SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous Institution under UGC, New Delhi)

Choice Based Credit System (CBCS)

REGULATIONS – BR-18

B. Tech. MECHANICAL ENGINEERING

IV YEAR I SEMESTER **COURSE STRUCTURE**

S. No.	Course Code	Course Title	L	T	P	Credits
1	R18MED4101	Refrigeration & Air Conditioning	3	0	0	3
Professional Elective – II						
2	R18MED4121	Additive Manufacturing	3	0	0	3
	R18MED4122	Automation in Manufacturing				
	R18MED4123	Micro Electro Mechanical Systems (MEMS)				
Professional Elective – III						
3	R18MED4131	Power Plant Engineering	3	0	0	3
	R18MED4132	Automobile Engineering				
	R18MED4133	Renewable Energy Sources				
Professional Elective – IV						
4	R18MED4141	Computational Fluid Dynamics	3	0	0	3
	R18MED4142	Turbo Machinery				
	R18MED4143	Fluid Power Systems				
5		Open Elective - II	3	0	0	3
6	R18MED41L1	Technical Seminar	0	0	2	1
7	R18MED41P2	Comprehensive Viva-voce	0	0	6	3
8	R18MED41P1	Industrial Oriented Mini Project/ Summer Internship	0	0	0	2*
		Total Credits	**15**	**0**	**8**	**21**

*** To be carried out during the summer vacation between 6th and 7th semesters.**

Note: Students should submit report of Industrial Oriented Mini Project/ Summer Internship for valuation.

IV YEAR II SEMESTER **COURSE STRUCTURE**

S. No.	Course Code	Course Title	L	T	P	Credits
Professional Elective – V						
1	R18MED4251	Industrial Robotics	3	0	0	3
	R18MED4252	Mechanical Vibrations				
	R18MED4253	Composite Materials				
Professional Elective – VI						
2	R18MED4261	Industrial Management	3	0	0	3
	R18MED4262	Production Operation and Management				
	R18MED4263	Tribology				
3		Open Elective - III	3	0	0	3
4	R18ECE42P1	Project Work	0	0	14	7
		Total Credits	**9**	**0**	**14**	**16**

***MC – Satisfied/Unsatisfied**

LIST OF OPEN ELECTIVES

Open Elective – I

S. No.	Course Code	Course Title	L	T	P	Credits
1	R18CIV3271	Disaster Management & Mitigation	3	0	0	3
2	R18CSE3272	Database Concepts				
3	R18ECE3273	Consumer Electronics				
4	R18EEE3274	Electrical Estimation & Costing				
5	R18INF3275	Information Technology Essentials				
6	R18MED3276	Introduction to Robotics				
7	R18HMS3277	Fundamentals of Entrepreneurship				
8	R18HMS3278	Day to Day Biology				

Open Elective –II

S. No.	Course Code	Course Title	L	T	P	Credits
1	R18CIV4181	Green Building Engineering	3	0	0	3
2	R18CSE4182	Cyber Security Fundamentals				
3	R18ECE4183	Principles of Modern Communication Systems				
4	R18EEE4184	Illumination Engineering				
5	R18INF4185	E-Commerce				
6	R18MED4186	Industrial Design & Ergonomics				
7	R18HMS4187	Creative Writing				
8	R18HMS4188	Design Thinking				

Open Elective –III

S. No.	Course Code	Course Title	L	T	P	Credits
1	R18CIV4291	Remote Sensing Concepts	3	0	0	3
2	R18CSE4292	Fundamentals of Soft Computing				
3	R18ECE4293	Audio & Video Engineering				
4	R18EEE4294	Non Conventional Energy Resources				
5	R18INF4295	Information Security Fundamentals				
6	R18MED4296	Total Engineering Quality Management				
7	R18HMS4297	Human Values & Professional Ethics for Engineers				
8	R18HMS4298	Science Fiction				

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B.Tech. - II Year – I Semester

L	T	P	C
3	1	0	4

(R18MTH2101) Probability Distribution & Complex Variables

Objectives: To learn

- The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
- The basic ideas of statistics including measures of central tendency, correlation and regression.
- The statistical methods of studying data samples.
- Differentiation and integration of complex valued functions.
- Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem. I Expansion of complex functions using Taylor's and Laurent's series.

UNIT-I: Basic Probability

Probability spaces conditional probability, independent events, and 'Bayes' theorem.
Random variables: Discrete and continuous random variables, Expectation of Random Variables, Moments, Variance of random variables

UNIT-II: Probability distributions

Binomial, Poisson, evaluation of Statistical parameters for these distributions, Poisson approximation to the Binomial distribution
Continuous random variables and their properties, distribution functions and density functions, Normal and exponential, evaluation of statistical parameters for these distributions

UNIT-III: Testing of Hypothesis

Test of significance: Basic of testing of Hypothesis. Null and alternate Hypothesis, types of errors, level of significance, critical region.
Large sample test for single proportion, difference of proportions, single mean, difference of means; small sample tests: Test for single mean, difference of means and test for ratio of variances

UNIT-IV: Complex Variables (Differentiation)

Limit, Continuity and Differentiation of Complex functions, Analyticity, Cauchy-Riemann equations (without proof), finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT-V: Complex Variables (Integration)

Line integral, Cauchy's theorem, Cauchy's integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series; Residues, Cauchy Residue theorem, Conformal mappings, Mobius transformations and their properties

Course outcomes:

After learning the contents ofthis paper the student must be able to

- Formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.
- Analyse the complex function with reference to their analyticity, integration using Cauchy's integral and residue theorems
- Taylor's and Laurent's series expansions of complex function

Text Books

1. BS. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, 9‘h Edition, Pearson Publications.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.

References

1. Fundamentals of Mathematical Statistics, Khanna Publications, S C Guptha and V.K. Kapoor.
2. Miller and Freund’s, Probability and Statistics for Engineers, 8‘h “Edition, Pearson Educations
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

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L	T	P	C
3	1	0	4

(R18MED2101) Mechanics of Solids

Objectives:

1. To gain a fundamental understanding of the concepts of stress and strain. Hooks law, Poissons ratio, Factor of safety
2. To study engineering properties of materials, stress-strain relationship, modulii and their relationship
3. To learn fundamental principles of equilibrium, compatibility, strain energy, resilience
4. To analyze determinate and indeterminate , shear forces, and bending moments and point of Contra flexture.
5. Theory of bending, assumptions and Bending moment equation.
6. shear stress distribution and analysis, Principal stresses and strains and types theories of failures,
   torsion of shops.
7. Theory of thin and thick cylinders. And flexture

UNIT – I

Simple Stresses & Strains : 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 – Elastic modulii & the relationship between them – Bars of varying section – compositebars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT – II

Shear Force and Bending Moment : 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, u.d.l., uniformly varying loads and combination of these loads – Point of contra
flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT – III

Flexural Stresses : Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y
= E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections
(Solid and Hollow), I,T,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

Principal Stresses and Strains: Introduction – Stresses on an inclined section of a bar under axial loading
– compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses –

Principal stresses and strains – Analytical and graphical solutions.
Theories of Failure: Introduction – Various theories of failure - Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory (Von Mises Theory).

UNIT – V
Torsion of Circular Shafts : Theory of pure torsion – Derivation of Torsion equations : $T/J = q/r = N\theta/L$ – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.
Thin Cylinders : 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– Thin spherical shells. Introduction to thick cylinders and its theory.

TEXT BOOKS :
6. Strength of materials – R.S. Kurmi and Gupta.
7. Solid Mechanics, by Popov
8. Strength of Materials – Ryder. G.H.; Macmillan Long Man Pub.
9. Strength of Materials – W.A. Nash, TMH

REFERENCES :
1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani.
3. Mechanics of Structures Vol –I by H.J.Shah and S.B.Junnarkar, Charotar Publishing House Pvt. Ltd.
4. Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.
5. Strength of Materials by S.S.Rattan, Tata McGraw Hill Education Pvt. Ltd.
6. Fundamentals of Solid Mechancis by M.L.Gambhir, PHI Learning Pvt. Ltd
7. Strength of Materials by R.K Rajput, S.Chand & Company Ltd.

Course Outcomes:
At the end of this course, the student will be able to:
1) Solve the problems related to the theory of elasticity, concepts of stress and strain, strength and stiffness, deformations and displacements, strain energy, and load carrying capacity.
2) List different materials and structural elements to the analysis of simple structures;
3) Identify and formulate the structural problem and solve using a range of analytical methods.
4) Predict the behaviour of the solid and hollow shafts subjected to various torsion loading.
5) Theories of failure applied for various materials fully understood by student.
6) The theory of thin and thick cylinders is exposed.

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L	T	P	C
3	0	0	3

(R18MED2102) Material Science & Metallurgy

Objectives :

1. To Understand basics of structure of metals
2. To understand the phase diagrams of metals and steels
3. To understand the property of steels, cast irons, ceramics, composites, TTT diagram

UNIT – I

Structure of Metals: Crystallography, Miller's indices, Packing Efficiency, Density calculations. Grains and Grain Boundaries. Effect of grain size on the properties. Determination of grain size by different methods. All mechanical properties of metals Tensile, Compression, Torsion, Yield, Ductility, Toughness, impact. Hardness : Rockwell, Brinell & Vickers and their relations including creep, fatigue and fracture.

Constitution of Alloys: Necessity of alloying, Types of solid solutions, Hume – Rothery rules, Intermediate alloy phases, Pig Iron making process by blast furnace Steel making process by Bessemer converter, LD converter and Electric Arc furnace.

UNIT –II

Phase Diagrams: Construction and interpretation of phase diagrams, Phase rule. Lever rule. Binary phase Diagrams, Isomorphous, Eutectic and Eutectoid, Peritectic & Peritectoid transformations with examples.

UNIT –III

Engineering Materials –I STEELS:

Iron-Carbon Phase Diagram and Heat Treatment: Study of Fe-Fe3C phase diagram. Construction of TTT diagrams. Annealing, Normalizing, Hardening Spheroidising and Tempering of steels, Hardenability. Alloy steels. Case Hardening Carburising, Nitriding, Cyaniding , Carbo Nitriding, Induction, Plasma & Vacuum Hardening,

UNIT –IV

Engineering Materials –II: CAST IRONS: Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron. Ledeburite, Austenite, Ferrite and Cementite

Engineering Materials-III: Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Al-Cu phase diagram, Titanium and its alloys, Superalloys.

UNIT – V

Engineering Materials –IV:

Ceramics, Polymers and Composites: Crystalline ceramics, glasses, cermets: structure, properties and applications. Classification, properties and applications of composites. Classification, Properties and applications of Polymers.

TEXT BOOKS:

1. Material Science and Metallurgy/ Kodgire
2. Essentials of Materials Science and engineering / Donald R.Askeland / Thomson.

REFERENCES:

1. Introduction to Physical Metallurgy / Sidney H. Avner.
2. Materials Science and engineering / William and callister.
3. Elements of Material science / V. Rahghavan
4. Engineering Material and Metallurgy – Er Amandeep Singh Wadhva
5. Materials Science for Engineering Students- Traugott Fischer 2009 Edition.
6. W.D. Callister – Material Science and Engineering

Course Outcomes:

At the end of this course, the student will be able to:

1. Summarize significance Develop concept of crystal structure and its defects.
2. Metallurgy and material science and its role in manufacturing will be understood by student.
3. Able to know about steel making processes such as Bessemer convertor, LD Convertor and electric process.
4. Classify different engineering material (metals, alloys, Steels, cast irons, non- ferrous metals and alloys, tool materials, ceramics, polymers, Semi-conductor and Composites).
5. Describe phase diagram, iron – carbon diagram and heat treatment processes and TTT diagram.
6. Develop concept of diffusion, mechanical properties and high temperature material problems.
7. Select a material for a specific use based on consideration of cost and performance.

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L	T	P	C
3	0	0	3

(R18MED2103) Production Technology

Course Objectives:

- To equip with knowledge of the fundamental techniques to manufacture an engineering component.
- To equip the graduates with the knowledge to manufacture engineering components through
- foundry, metal forming, welding, non-conventional machining and powder metallurgy techniques.
- To prepare graduates with a solid foundation to investigate and develop a methodology and establish a manufacturing sequence to fabricate engineering components.
- To prepare the graduates to find the probable routes to manufacture a particular engineering component.
- To prepare the graduates to selected the most economical route to fabricate the required engineering component.

UNIT - I

Casting: Steps involved in making a casting – its applications – Patterns and Types of patterns – Pattern allowances and their construction. Types of casting processes – Solidification of casting, and their all types of sand tests.

UNIT – II

Welding: Welding Types – Oxy-fuel gas cutting – standard time and cost calculations. Arc welding, forge welding – Resistance welding, Thermit welding.

UNIT – III

Inert Gas Welding, TIG Welding, MIG welding, Friction Welding, Introduction welding, explosive Welding, Laser Welding Soldering and Brazing, Heat affected zone in welding. Welding defects – causes and remedies – destructive and non-destructive testing of welds, DPT, MPT.

UNIT – IV

Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth, Comparison of properties of Cold and Hot worked parts, Rolling fundamentals – theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements.

UNIT – V

Extrusion of Metals: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion – Forward extrusion and backward extrusion – impact extrusion – Extruding requirement – Tube extrusion and pipe making Hydrostatic extrusion. Forces in extrusion

Forging Processes: Forging operations and principles – tools – Forging methods – smith forging. Drop Forging – Roll forging. **Forging hammers:** Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

TEXT BOOKS:

1. Manufacturing Technology (Vol. 1) / P.N. Rao/ TMH/ 2nd Edition
2. Workshop Technology (Vol. 1)/Hajra Chowdary/Asia Publishing House/2nd Edition

REFERENCE BOOKS:

1. Production Technology / Sarma P.C. / S. Chand
2. Production Technology / R.K. Jain / Khanna Publications
3. Metal Casting / T.V. Ramana Rao / New Age
4. Principles of Metal Castings / Rosenthal/TMH
5. A Course in Workshop Technology / B.S. Raghuwamshi / Dhanpat rai & Sons
6. Manufacturing Engineering and Technology / Kalpakjin S / Pearson Edu.

Course Outcomes :

After taking this course the students should be able to:

1. List fundamental techniques to manufacture an engineering component.
2. Explain manufacture engineering components through foundry, cold and hot working, metal forming, All welding techniques, extrusion, forging.
3. Predict and develop a methodology and establish a manufacturing sequence to fabricate engineering components.
4. Judge probable routes to manufacture a particular engineering component.
5. Propose the most economical route to fabricate the required engineering component.
6. Identify and distinguish different types of advanced manufacturing technologies.

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L	T	P	C
3	1	0	4

(R18MED2104) Thermodynamics

Course Objectives:

- Be able to have the basic concepts of thermal sciences and their application to in formulating the thermal engineering problems.
- Have a good understanding of first and second laws of thermodynamics and will be in a position to fully understand the analysis to be taught at the higher levels.
- Be in a position to check the feasibility of proposed processes and cycles using the ideas of second law of thermodynamics and entropy.
- Have the understanding of basic principles of heat transfer and related simple problems.

UNIT – I

Introduction: Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas ScaleJoule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation, Electrical, Magnetic, Gravitational Spring and Shaftwork.

UNIT II

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's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics

UNIT – III

Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non -flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes. Deviations from perfect Gas Model – Vader Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables- Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

UNIT IV

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction , Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour, Atmospheric air - Psychrometric 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 – Psychrometric chart.

UNIT - V

Thermodynamic Cycles : Power cycles: Otto, Diesel, Dual Combustion cycles, Stirling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.
Refrigeration Cycles: Bell-Coleman cycle- Vapour compression cycle-performance Evaluation.

TEXT BOOKS :

1. Engineering Thermodynamics / PK Nag /TMH, 5th Edition
2. Engineering Thermodynamics/E Rathakrishnan/PHI/Second Edition/2013

REFERENCE BOOKS:

1. Engineering Thermodynamics/DP Mishra/ Cengage Learning/Second impression 2012
2. Thermodynamics – An Engineering Approach – Yunus Cengel & Boles /TMH
3. Thermodynamics – J.P.Holman / McGrawHill
4. Engineering Thermodynamics – Jones & Dugan
5. Engineering Thermodynamics/P.Chattopadhyay/Oxford Higher Education/Revised First Edition
6. Thermodynamics & Heat Engines – Yadav – Central Book Depot, Allahabad.

Course outcomes: After taking this course the students shall be able to:

1. Define the basic concepts of units and dimensions, systems(open and closed systems and control volumes) and its boundaries, properties, state, process, cycle, quasi-static process etc.- required as foundation for development of principles and laws of thermodynamics
2. Develop Intuitive problem solving technique
3. Use & Practice two property rule and hence thermodynamic tables, thermodynamic diagrams and concept of equation of state, also their simple application.
4. Explain heat, work and first law of thermodynamics. Application of energy balance
5. Discuss Second law of thermodynamics and its corollaries viz. absolute (thermodynamic) temperature scale, reversibility, entropy, feasibility of a process based on first law and second law, isentropic efficiency of adiabatic machines.
6. All power cycles such as Otto, Diesel, Dual Combustion, Sterling, Atkinson, Ericsson , Lenoir Cycle will be thoroughly known to the students by going through their P–V and T-S diagrams.
7. Review introductory concept of power and refrigeration cycles.

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L	T	P	C
0	0	2	1

(R18MED21L1) Production Technology Lab

I. METAL CASTING LAB:

1. Pattern design and making – for one casting drawing
2. Sand properties testing – Exercise – for strengths, and permeability – 1
3. Moulding Melting and Casting – 1 Exercise

II. WELDING LAB:

1. ARC Welding Lap & Butt Joint – 2 Exercises
2. Spot Welding – 1 Exercise
3. TIG Welding – 1 Exercise
4. Plasma Welding and Brazing – 2 Exercises (Water Plasma Device)

III MECHANICAL PRESS WORKING

1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations

IV. PROCESSING OF PLASTICS

1. Injection Moulding
2. Blow Moulding

REFERENCE BOOK

1) Dictionary of Mechanical Engineering – G.H.F. Nayler, Jaico Publishing House

Course Outcomes

1. Apply some of the manufacturing process directly in the preparation of complicated jobs.
2. Make different types patterns for casting & drawing.
3. Use welding machine for various welding processes.
4. Development of plastic bottles in moulding machines.
5. Study of simple, compound and progressive press tool in manufacturing process.
6. Impart hands on practical exposure on manufacturing processes and equipment.

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L	T	P	C
0	0	2	1

(R18MED21L2) Machine Drawing Practice

Course Objectives:

1. To develop the technical skills necessary to generate an engineering drawing and an engineering
2. To introduce the elements of engineering communications; including graphical representation of Machines and its elements.
3. To model simple assembly drawings and prepare detailed part drawings with geometric dimensioning .

PART – A Machine Drawing Convention:

Need for drawing conventions – introduction to IS conventions – Conventional representation of materials, common machine elements such as screws, nuts, bolts, keys, gears, webs, ribs. Methods of dimensioning, general rules for sizes and placement of dimension for holes, centers, curved and tapered features. Title boxes, their size, location and details – common abbreviations & their liberal usage. Types of Drawings – working drawings for machine parts.

Drawing of Machine Element

Simple Parts - Selection of Views, additional views for the following machine elements and parts with every drawing proportion. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws. Keys, cottered joints and knuckle joint. Rivetted joints for plates. Shaft coupling, spigot and socket pipe joint. Journal, pivot and collar and foot step bearings.

PART – B ASSEMBLY DRAWINGS:

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. Engine parts – stuffing boxes, cross heads, Eccentrics - connecting rod, piston assembly. Machine tool parts: Tail stock, Tool Post, Machine Vices – Screws Jacks – Plummer Block.

VALVES: Spring loaded safety valve, feed check valve and air cock.

Note: First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

TEXT BOOK:

1. Machine Drawing – K.L. Narayana / New Age International Publishers.
2. Textbook of Machine Drawing/K.C. John / PHI/ Eastern Economy Edition

REFERENCE BOOKS:

1. Machine Drawing – P.S.Gill.
2. Machine Drawing / Junnarkar N.D. / Pearson Edu.
3. Machine Drawing / Bhattacharya/Oxford University Press.
4. Machine Drawing / N.D. Bhat / Charotar
5. A Textbook of Machine Drawing / R.K. Dhawan / S. Chand.

Course Outcomes:

At the end of this course, the student will be able to:

1. Describe the theory of projections and IS Conventions of drawing
2. Apply various concepts engineering graphics like dimensioning, conventions and standards related to machine drawings in order to become professionally efficient.
3. Read and interpret assembly drawings with moderate complexity.
4. Explain the conventions and the methods of assembly drawings.
5. Develop visualization skills so that they can apply these skills in developing new products.
6. To understand the concepts of different types valves.

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L	T	P	C
0	0	2	1

(R18MED21L3) Material Science & Mechanics of Solids Lab

(A) METALLURGY LAB :

1. Preparation and study of the Micro Structure of pure metals like Iron, Cu and Al.
2. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – C steels.
3. Study of the Micro Structures of Cast Irons.
4. Study of the Micro Structures of Non-Ferrous alloys.
5. Study of the Micro structures of Heat treated steels.
6. Hardenability of steels by Jominy End Quench Test.
7. To find out the hardness of various treated and untreated steels.

(B) MECHANICS OF SOLIDS LAB :

1. Direct tension test
2. Torsion test
3. Hardness test
   a) Brinells hardness test b) Rockwell hardness test
4. Test on springs
5. Compression test on cube
6. Impact test
7. Punch shear test

Course Outcomes

1. Prepare the samples and identify the microstructures of Cu, Al, Iron.
2. Identify the differences between the microstructures of ferrous and non-ferrous alloys.
3. Conduct standard tension tests of steel & other metals.
4. Conduct compression and shear tests on Cement Brick & Mild steel.
5. Evaluate hardness and impact strength of the sample specimens.
6. Interpret & determine the standard mechanical properties from plots of stress versus strain.

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L	T	P	C
0	0	2	0

(R18MAC2100) Gender Sensitization Lab

Course Objectives:

- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- To introduce students to information about some key biological aspects of genders.
- To expose the students to debates on the politics and economics of work.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women.

Course Outcomes:

- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students will acquire insight into the gendered division of labour and its relation to politics and economics.
- Men and women students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life.
- Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

UNIT – I UNDERSTANDING GENDER:

Gender: Why Should We Study It? (Towards a World of Equals: Unit -1) Socialization: Making Women, Making Men (Towards a World of Equals: Unit -2) Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

UNIT – II GENDER AND BIOLOGY Missing Women:

Sex Selection and Its Consequences (Towards a World of Equals: Unit-4) Declining Sex Ratio. Demographic Consequences. Gender Spectrum: Beyond the Binary (Towards a World of Equals: Unit -10) Two or Many? Struggles with Discrimination.

UNIT – III GENDER AND LABOUR Housework:

The Invisible Labour (Towards a World of Equals: Unit -3) "My Mother doesn't Work." "Share the Load." Women's Work: Its Politics and Economics (Towards a World of Equals: Unit -7) Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

UNIT – IV ISSUES OF VIOLENCE Sexual Harassment:
Say No! (Towards a World of Equals: Unit -6) Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "Chupulu". Domestic Violence: Speaking Out (Towards a World of Equals: Unit -8) Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading: New Forums for Justice. Thinking about Sexual Violence (Towards a World of Equals: Unit -11) Blaming the Victim-"I Fought for my Life…." – Additional Reading: The Caste Face of Violence.

UNIT – V GENDER : CO – EXISTENCE Just Relationships:
Being Together as Equals (Towards a World of Equals: Unit -12) Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Additional Reading: Rosa Parks-The Brave Heart.

Prescribed Textbook : All the five Units in the Textbook, "Towards a World of Equals: A Bilingual Textbook on Gender" written by A.Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu and published by Telugu Akademi, Hyderabad,Telangana State in the year 2015.

Note: Since it is an Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

REFERENCE BOOKS:

- Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
- Abdulali Sohaila. "I Fought For My Life…and Won."Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY
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B.Tech. - II Year – II Semester

L	T	P	C
3	0	0	3

(R18EEE2205) Basics of Electrical & Electronics Engineering

Objective:
This course introduces the concepts of electrical DC and AC circuits, basic law's of electricity, instruments to measure the electrical quantities, different methods to solve the electrical networks, construction operational features of energy conversion devices i.e. DC and AC machines, transformers. It also emphasis on basics of electronics, semiconductor devices and their characteristics and operational features.

UNIT-I:
Electrical Circuits: Basic definitions, Types of elements, Ohm's Law, Resistive networks, Kirchhoff's Laws, Inductive networks, capacitive networks, Series, Parallel circuits and Star-delta and delta-star transformations. **Instruments:** Basic Principle of indicating instruments – permanent magnet moving coil and moving iron instruments.

UNIT-II:
DC Machines: Principle of operation of DC Generator – EMF equation - types – DC motor types – torque equation – applications – three point starter.

UNIT-III:
Transformers: Principle of operation of single phase transformers –EMF equation – losses – efficiency and regulation.
AC Machines: Principle of operation of alternators – regulation by synchronous impedance method – Principle of operation of induction motor – slip – torque characteristics – applications.

UNIT–IV:
Diodes: P-n junction diode, symbol, V-I Characteristics, Diode Applications, and Rectifiers – Half wave, Full wave and Bridge rectifiers (simple Problems).
Transistors: PNP and NPN Junction transistor, Transistor as an amplifier, SCR characteristics and applications.

UNIT-V:
Cathode Ray Oscillos Scope: Principles of CRT (Cathode Ray Tube), Deflection, Sensitivity, Electrostatic and Magnetic deflection, Applications of CRO - Voltage, Current and frequency measurements.

EEE: TEXT BOOKS:
1. Basic concepts of Electrical Engineering, PS Subramanyam, BS Publications.
2. Basic Electrical Engineering, S.N. Singh, PHI.

EEE: REFERENCE BOOKS:
1. Basic Electrical Engineering, Abhijit Chakrabarthi, Sudipta nath, Chandrakumar Chanda, Tata-McGrawHill.
2. Principles of Electrical Engineering, V.K Mehta, Rohit Mehta, S.Chand Publications.

3. Basic Electrical Engineering, T.K.Nagasarkar and M.S. Sukhija, Oxford University Press.
4. Fundamentals of Electrical Engineering, RajendraPrasad, PHI.
5. Basic Electrical Engineering by D.P.Kothari , I.J. Nagrath, McGraw-Hill.

ECE: TEXT BOOKS:

1. Electronic Devices and Circuits, S.Salivahanan, N.Suresh Kumar, A.Vallavaraj,Tata McGraw-Hill companies..
2. Electronic Devices and Circuits, K. Lal Kishore,BS Publications.

ECE: REFERENCE BOOKS:

1. Millman's Electronic Devices and Circuits,J. Millman, C.C.Halkias, and Satyabrata Jit, Tata McGraw- Hill companies.
2. Electronic Devices and Circuits, R.L. Boylestad and Louis Nashelsky,PEI/PHI.
3. Introduction to Electronic Devices and Circuits, Rober T. Paynter,PE.
4. Integrated Electronics, J. Millman and Christos C. Halkias, Tata McGraw-Hill companies.
5. Electronic Devices and Circuits, Anil K. Maini, Varsha Agarwal,Wiley India Pvt. Ltd.

Course Outcomes:

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

1. Explain the basic electrical DC and AC circuits.
2. Construction operation characteristics of DC and AC machines and also the constructional features and operation of measuring instruments like voltmeter, ammeter, wattmeter etc & different semiconductor devices.
3. Describe the operation of the transformers in the energy conversion process.
4. Summarize the operation of diodes, transistors, realization of various electronic circuits with the various semiconductor devices.
5. Explain the principles cathode ray oscilloscope and its applications.
6. Apply the above conceptual things to real world electrical and electronics problems and applications.

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B.Tech. - II Year – II Semester

L	T	P	C
3	1	0	4

(R18MED2201) Kinematics of Machinery

Course Objectives:

1. The study of kinematics machines is an applied field of mechanical engineering that is concerned with understanding the relationship between mechanism and structure, the parts of a machine and the forces that produce this motion.
2. The overall objective of this course is to learn how to analyze the all links, pairs motions of mechanisms, design mechanisms to have given motions, and analyze forces in machines.
3. This includes relative motion analysis and design of all types of gears, gear trains, cams, and linkages, simultaneous graphical and analytical analysis of position, velocity, and acceleration, considering static and inertial forces.

UNIT – I

Mechanisms : Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematics pairs – Types of constrained motion – kinematic chain – Mechanism-machine-structure – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains, Mechanical Advantage – Grubler's Criterion

UNIT – II

Kinematics: Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method.

Plane Motion of Body: Instantaneous center of rotation – centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method.

UNIT - III

Straight-Line Motion Mechanisms : Exact and approximate copied and generated types – Peaucellier – Hart – Scott Russel – Grasshopper – Watt's – Tchebicheff's and Robert Mechanism – Pantographs

Steering Gears: Conditions for correct steering - Davis Steering gear, Ackerman's steering gear

Hooke's Joint: Single and double Hooke's joint – velocity ratio – application – problems.

UNIT – IV

CAMS: Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion – uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases

Analysis of Motion Of followers: Tangent cam with Roller follower – Circular arc cam with straight, concave and convex flanks

UNIT – V

Higher Pair : Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding.

Forms of teeth, cycloidal and involutes profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference – expressions for arc of

contact and path of contact of Pinion & Gear and Pinion & Rack arrangements – Introduction to Helical – Bevel and worm gearing.

Gear Trains: Introduction – Types – Simple – Compound and reverted gear trains – Epicyclic gear train. Methods of finding train value or velocity ratio of Epicyclic gear trains. Selection of gear box – differential gear for an automobile.

TEXT BOOKS:

1. Theory of Machines and Mechanisms / JOSEPH E. SHIGLEY/ Oxford / 3rd Edition / International Edition
2. Theory of Machines / Thomas Bevan / Pearson/ 3rd Edition

REFERENCE BOOKS:

1. Theory of Mechanism and Machines / Jagdish Lal / Metropolitan Book Company
2. Theory of Machines / S.S. Rattan / Tata McGraw Hill Publishers
3. Kinematics & Dynamics of machinery / Norton/TMH
4. Theory of machines / Sadhu Singh / Pearson
5. Mechanism and Machine Theory / JS Rao and RV Duggipati / New Age.
6. Theory of Machines by / R.K. Bansal (Lakshmi Publications).

Course Outcomes:

At the end of this course, the student will be able to:

1. Understand the fundamentals of the theory of kinematics of machines.
2. Understand techniques for studying motion of machines and their components.
3. Distinguish kinematic and kinetic motion, change link machine structure and mechanism
4. Identify the basic relations between distance, time, velocity, and acceleration.
5. Apply vector mechanics as a tool for solving kinematic problems.
6. Create a velocity and acceleration drawing of cam and a real-world mechanism.
7. Use graphical and analytic methods to study the motion of a planar mechanism.
8. Design of basic gear trains.
9. Design of basic cam systems, all types straight line mechanisms, steering mechanisms.
10. Design of higher pairs and hooks joints.
11. An ability to identify, formulate, and solve mechanical engineering problems.

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B.Tech. - II Year – II Semester

L	T	P	C
3	1	0	4

(R18MED2202) Thermal Engineering-I

Course Objectives:

1. To give an overview of Internal Combustion Engines, their classification, applications, operation and processes.
2. To carry out thermodynamic analysis of various cycles of operation.
3. To give complete knowledge of type of fuels used in IC engines and the fuel supply systems
4. To describe combustion phenomena in IC engines
5. To describe rotary, axial, reciprocating compressors and types of refrigeration systems and their cop calculation

UNIT – I

I.C. Engines:

Four & Two stroke engine – SI & CI engines – Valve and Port Timing Diagrams – Fuel Injection Systems for SI engines – Fuel injection systems for CI engines – ignition – Cooling and Lubrication system – Fuel properties and Combustion Stoichiometry.

UNIT – II

Combustion in SI and CI Engines: Normal Combustion and abnormal combustion in SI engines – importance of flame speed and effect of engine variables – Abnormal combustion - pre-ignition and knocking in SI Engines-Fuel requirements and fuel rating – anti knock additives – combustion chamber – requirements – types of SI engines. Four stages of combustion in CI engines – Delay period and its importance – Effect of engine variables – Diesel Knock – Need for air movement, suction, Compression and combustion induced turbulence in Diesel engine – Open and divided combustion chambers and fuel injection – Diesel fuel requirements and fuel rating.

UNIT – III

Testing and Performance of Engines and Compressors: Measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition Brake power – Performance test – Heat balance sheet and chart Classification of compressors – Fans, blowers and compressors – positive displacement and dynamic types – reciprocating and rotary types – Introduction to the Windtunnel and Turbomachines.

UNIT – IV

Rotary, Dynamic and Axial Flow (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, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – powers, Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor – isentropic efficiency – pressure rise calculations – Polytropic efficiency.

UNIT – V

Refrigeration: Mechanical Refrigeration and types – units of refrigeration – Air Refrigeration system, details and principle of operation – applications of air refrigeration, Vapour compression refrigeration systems – calculation of COP – effect of superheating and sub cooling, desired properties of refrigerants and common refrigerants – Vapour absorption system – mechanical details – working principle, use of p-h charts for calculations.

TEXT BOOKS :

1. I.C. Engines / V. Ganesan / TMH
2. Thermal Engineering / R.K. Rajput / Lakshmi Publications / Reprints 2011.

REFERENCE BOOKS :

1. Thermal Engineering / P.K. Nag / 3rd Edition
2. IC Engines – Mathur & Sharma – Dhanpath Rai & Sons
3. Engineering fundamentals of IC Engines – Pulkrabek / Pearson / PHI
4. Thermal Engineering / Rudramoorthy / TMH
5. Thermodynamics / Heat Engiens / B. Yadav / Central Book Depot., Allahabad
6. I.C. Engines / Heywood / McGrawHill.

Course Outcomes:

At the end of this course, the student will be able to:

1. Classify various types of I.C. Engines and Cycles of operation.
2. Express the effect of various operating variables on engine performance
3. Discuss fuel metering and fuel supply systems for different types of engines
4. Distinguish normal and abnormal combustion phenomena in SI and CI engines
5. Justify the suitability of conventional fuels for IC engines.
6. Rotary, axial, reciprocating air compressors , their working principles, capabilities performance are known after completion of course and types of refrigeration systems and their cop calculation

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B.Tech. - II Year – II Semester

L	T	P	C
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(R18MED2203) Fluid Mechanics & Hydraulic Machines

Course Objectives:

1. To develop a concept of fluid and an understanding of Continuum model of fluid motion
2. Development of basic concepts of continuum mechanics like localized force distributions, Eulerian and Lagrangian frames of reference and mathematical derivatives.
3. Development of principles of fluid statics and their applications.
4. To provide knowledge of kinematic aspects of fluid motion and basic methods of flow visualization.
5. Development of tools for analysis of fluid motions using Finite Control Volume approach.
6. To provide basic knowledge of incompressible flow in circular pipes and exposure to design problems involving piping systems.
7. To develop basic concepts of compressible flow and development of Quasi-1D isentropic flow theory for variable area flow passages.
8. Analysis of Normal Shock waves.

UNIT – I

Fluid statics: Dimensions and units: physical properties of fluids. Specific gravity, viscosity, surface tensionvapour
pressure and their Influence on fluid motion – atmospheric, gauge and vacuum pressures- measurement of pressure – Piezometer, U-tube and differential manometers.

UNIT – II

Fluid kinematics: Stream line, path line and streak lines and stream tube, classification of flows – steady & unsteady, uniform & non uniform, laminar & turbulent, rotational & irrotational flows – equation of continuity for one dimensional flow and three dimensional flows.
Fluid dynamics: Surface and body forces – Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.

UNIT – III

Boundary Layer Concepts: Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.
Closed conduit flow: Reynold's experiment – Darcy Weisbach equation – Minor losses in pipes – pipes in series and pipes in parallel – total energy line hydraulic gradient line. Measurement of flow: pitot tube, venturimeter, and orifice meter, Flow nozzle

UNIT – IV

Basics of turbo machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip. Velocity diagrams, work done and efficiency, flow over radial vanes.
Hydraulic Turbines: Classification of turbines. Heads and efficiencies impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine – working proportions, work done, efficiencies, hydraulic design draft tube theory – functions and efficiency.

Performance of Hydraulic Turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT – V

Centrifugal Pumps: Classification, working, work done – barometric head losses and efficiencies specific speed – performance characteristic curves, NPSH.

Reciprocating pumps: Working, Discharge, slip, indicator diagrams.

TEXT BOOKS:

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by Rajput.

REFERENCE BOOKS:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.

Course Outcomes:

At the end of this course, the student will be able to:

1. Generate mathematical models of fluid motion including steady and unsteady flow.
2. Recite fluid properties and fluid statics.
3. State and visualize fluid kinematics.
4. Predict and design a fluid dynamical system based on inviscid theory.
5. Model compressible flow systems.
6. Design of hydraulic Impulse, Francis, Kaplan turbines and design of centrifugal and reciprocating pumps and their specifications , working principles and their characteristics
7. To understand boundary layer concepts, types of losses in pipes and measurement of flow.
8. Able to understand basics of turbo machines, pelton wheel, francis turbine and Kaplan turbine.
9. Centrifugal and Reciprocating pumps.

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B.Tech. - II Year – II Semester

L	T	P	C
3	0	0	3

(R18MED2204) Instrumentation & Control Systems

Course Objectives:

- To gain the knowledge of different process instruments,
- To understand dynamic modeling of a physical process using first principles,
- To convert the model to a form amenable to solution and analysis,
- To design various control schemes,
- To apply the control system in various processes.

UNIT – I

Definition – 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.

UNIT – II

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 Temperature: Classification – Ranges – Various Principles of measurement – Expansion, Electrical Resistance – Thermistor – Thermocouple – Pyrometers – Temperature Indicators..

Measurement of Pressure: Units – classification – different principles used. Manometers, Piston, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

UNIT – III

Measurement of Level: Direct method – Indirect methods – capacitive, ultrasonic, magnetic, cryogenic fuel level indicators – Bubbler level indicators.

Flow Measurement: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA) .

Measurement of Speed: Mechanical Tachometers – Electrical tachometers – Stroboscope, Noncontact type of tachometer.

Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle.

UNIT – IV

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 Humidity: Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter.

Measurement Of Force, Torque And Power: Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT – V

Elements of Control Systems: Introduction, Importance – Classification – Open and loop systems Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems.

TEXT BOOKS:

1. Measurement Systems: Applications & Design / D.S Kumar/Anuradha Agencies.
2. Instrumentation, measurement & analysis /B.C.Nakra & K.K.Choudhary/ TMH.

REFERENCE BOOKS:

1. Principles of Industrial Instrumentation and Control Systems/ Chennakesava R Alavala/ Cengage Learning.
2. Instrumentation and Control systems/ S.Bhaskar/ Anuradha Agencies.
3. Experimental Methods for Engineers / Holman/McGraw Hill.
4. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
5. Mechanical Measurements / Sirohi and Radhakrishna / New Age.
6. Instrumentation & Mech. Measurements /A.K. Tayal /Galgotia Publications.

Course Outcomes:

At the end of this course, the student will be able to:

1.Interpret the knowledge of field instrumentations.
2.Describe dynamic modeling and system behavior .
3.Design of controllers.
4.Application of control systems in processes.
5.Study of measurement of displacement, temperature, pressure, flow measurements, level measurements, speed, acceleration, vibration, stress and strain, humidity, force, torque and power.
6.Explain the types of transducers and their working principles.

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B.Tech. - II Year – II Semester

L	T	P	C
0	0	2	1

(R18EEE22L4) Basics of Electrical & Electronics Engineering Lab

SECTION A: ELECTRICAL ENGINEERING:

1. Verification of KCL and KVL.
2. Magnetization characteristics of D.C. Shunt generator.
3. Speed control of DC motor.
4. Swinburne's Test on DC shunt machine.
5. Brake test on DC shunt motor.
6. OC and SC tests on Single-phase transformer.
7. Brake test on 3-phase Induction motor.
8. Regulation by an alternator by synchronous impedance method.

SECTION B: ELECTRONICS ENGINEERING:

1. PN Junction Diode Characteristics (Forward bias, Reverse bias)
2. Transistor CE Characteristics (Input and Output)
3. Study of CRO.
4. Class A Power Amplifier
5. Zener Diode Characteristics
6. Transistor CE Characteristics
7. Rectifier without Filters (Full wave & Half wave)
8. Rectifier with Filters (Full wave & half wave).

Course Outcomes

1. Explain the basic electrical DC and AC circuits.
2. Construction operation characteristics of DC and AC machines and also the constructional features and operation of measuring instruments like voltmeter, ammeter, wattmeter etc & different semiconductor devices.
3. Describe the operation of the transformers in the energy conversion process.
4. Summarize the operation of diodes, transistors, realization of various electronic circuits with the various semiconductor devices.
5. Explain the principles cathode ray oscilloscope and its applications.
6. Apply the above conceptual things to real world electrical and electronics problems and applications.

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B.Tech. - II Year – II Semester

L	T	P	C
0	0	2	1

(R18MED22L1) Fluid Mechanics & Hydraulic Machines Lab

1. Impact of jet on vanes
2. Performance test on Pelton wheel
3. Performance test on Francis turbine.
4. Performance test on Kaplan turbine.
5. Performance test on single stage centrifugal pump.
6. Performance test on multi-stage centrifugal pump.
7. Performance test on reciprocating pump.
8. Calibration of Venturimeter
9. Calibration of Orifice meter
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline
12. Verification of Bernoulli's equation.

Course Outcomes

1. Conduct performance tests on impact of jet apparatus and determine the impact factor.
2. Analyze the performance curves of different turbines.
3. Perform the tests on pumps and calculate the efficiency of pumps.
4. Calibrate the coefficient of discharge of different flow meters.
5. Conduct the test on Bernoulli’s apparatus and K5-Evaluate the Bernoulli’s theorem.
6. Determine the friction factor for a given pipe.

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B.Tech. - II Year – II Semester

L	T	P	C
0	0	2	1

(R18MED22L2) Instrumentation & Control Systems Lab

Instrumentation & Control Systems Experiments

1. Calibration of Pressure Gauges
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge for temperature measurement.
5. Calibration of thermocouple for temperature measurement.
6. Calibration of capacitive transducer for angular displacement.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of resistance temperature detector for temperature measurement.
9. Study and calibration of a rotameter for flow measurement.
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.
12. Time response of Second order system
13. Characteristics of Synchros
14. Effect of P, PD, PI, PID Controller on a second order systems
15. Lag and lead compensation— Magnitude and phase plot
16. Temperature controller using PID

Course Outcomes

1. Calibrate the pressure gauge, LVDT and capacitive transducer.
2. Calibrate the thermocouple, RTD for temperature measurement.
3. Calibrate the photo and magnetic speed pickups for measurement of speed.
4. Calibration of Rotameter for flow measurement.
5. Operate seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
6. Calibration of Mcleod gauge for low pressure

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B.Tech. - II Year – II Semester

L	T	P	C
3	1	0	0

(R18MAC2200) Intellectual Property Rights

UNIT – I: Introduction to Intellectual property:
Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

UNIT – II: Trade Marks:
Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

UNIT – III: Law of copy rights :
Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

UNIT – IV: Trade Secrets:
Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation. Unfair competition: Misappropriation right of publicity, false advertising.

UNIT – V: New development of intellectual property:
New developments in trade mark law; copy right law, patent law, intellectual property audits. International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT BOOKS & REFERENCES:

- Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
- Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tate McGraw Hill Publishing company ltd.,

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B.Tech. - III Year – I Semester

L	T	P	C
3	1	0	4

(R18MED3101) Dynamics of Machinery

Objectives :

- Develop an ability to apply knowledge of mathematics, science, and engineering
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To develop an ability to identify, formulate, and solve engineering problems.
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

UNIT - I:

Angular Motion: Gyroscopes - effect of precession - motion on the stability of moving vehicles such as motorcycle - motorcar - aero planes and ships. Static and Dynamic Force Analysis of planar mechanisms.

UNIT - II:

Friction: Inclined plane - Friction of screw and nuts - Pivots and collars - uniform pressure, uniform wear - friction circle and friction axis: lubricated surfaces - boundary friction - film lubrication, Clutches, Single plate, multi plate, cone clutch, centrifugal clutches.

Brakes And Dynamometers: Simple block brake - Internal expanding brake band brake of vehicle. Dynamometers - absorption and transmission types, General description and methods of operation.

UNIT - III:

Turning Moment Diagram and Flywheels: Turning moment- Interia torque- connecting rod angular velocity and acceleration-crank effort and torque diagrams-fluctuation of energy - flywheels and their design.

Governors: Watt, Porter and Proell governors- Spring loaded governors - Hartnell and Hartung with auxiliary springs- Sensitiveness, isochronisms and hunting- effort and power of the governors.

UNIT - IV:

Balancing: Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples. Examination of "V" and multi cylinder inline and radial engines for primary and secondary balancing- locomotive balancing - Hammer blow - Swaying couple - variation of tractive effort.

UNIT - V:

Vibrations: Free Vibration of mass attached to vertical spring - oscillation of pendulums- Transverse loads - vibrations of beams with concentrated and distributed loads. Dunkerly's method - Raleigh's method. Whirling of shafts - critical speed - torsional vibrations - one, two and three rotor systems.

TEXT BOOKS:

1. Theory of Machines / S. S. Rattan / Mc Graw Hill.
2. Theory of Mechanism and Machines / Jagdish Lal / Metropolitan Book Company.

REFERENCES BOOKS:

1. Theory of Machines / Shigley / Mc Graw Hill Publishers.
2. Theory of Machines / Thomas Bevan / Pearson.
3. Theory of Machines / R. K. Bansal / Lakshmi Publications / 5th Edition
4. Mechanism and Machine Theory / JS Rao and RV Duggipati / New Age.
5. Theory of Machines / Sadhu Singh / Pearson / 3rd Edition.
6. Mechanism and Machine Theory / Ashok G. Ambekar / PHI / Eastern Economy Edition.

Outcomes :

At the end of this course, the student will be able to:

1. Use of mathematical methods to analyze the forces and motion of complex systems of linkages.
2. Design linkage, cam and gear mechanisms for a given motion or a given input/output motion or force relationship and friction circle and friction axis.
3. K4-Analyze the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams.
4. K4-Analyze all types of brakes, Governors, balancing of masses, Hammer blow, swaying couple, traction effort.
5. Study of transverse and forced vibrations, whirling of shafts and torsional vibrations.
6. Explain the friction occurs in various types of clutches.

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B.Tech. - III Year – I Semester

L	T	P	C
3	0	0	3

(R18MED3102) Design of Machine Members - I

Objectives : This course is intended to introduce the mechanical engineering student to the basic components of machinery, and how to select and size these components to achieve design goals in the construction of mechanical systems.

1. Understanding of the uncertainties and remedial approach pertaining to material properties and engineering analysis as a real-world engineering application.
2. Ability to select the material and configuration of different machine elements under a variety of environmental and service conditions. These includes
   a. Joints (Cotter, Knuckle)
   b. Shafts (Solid & Hollow)
   c. Keys
   d. Couplings
3. Understanding of the concepts of factor of safety
4. Ability to conduct a failure analysis for the design of machine element

NOTE : Design Data books are not permitted in the Examinations. The design must not only satisfy strength criteria but also rigidity criteria.

UNIT – I

Introduction: General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design. Tolerances and fits –BIS codes of steels. Theories of failure – Factor of safety – Design for strength and rigidity – preferred numbers.

Fatigue loading: 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.

UNIT – II

Design of Fasteners: Riveted joints-methods of failure of riveted joints-strength equations-efficiency of riveted joints- eccentrically loaded riveted joints.

Welded joints: Design of fillet welds- axial loads-circular fillet welds-bending and torsion.

Design of bolts with pre-stresses- design of joints under eccentric loading-bolts of uniform strength.

UNIT – III

Keys, Cotters and Knuckle Joints: Design of Keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter, Gib and cotter joints-Knuckle joints.

UNIT – IV

Design of Shafts: Design of solid and hollow shafts for strength and rigidity

– Design of shafts for complex loads– Shaft sizes – BIS code- Design of shafts for gear and belt drives.

Shaft couplings : Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – PIN-Bush coupling.

UNIT – V

Mechanical Springs: Stresses and deflections of helical springs-extension-compression springs-springs for static and fatigue loading-natural frequency of helical springs-energy storage capacity-helical torsion springs-co-axial springs.

TEXT BOOKS:

1) Machine design/Pandya & Shah/ Charotar Publishing House Pvt. Ltd.
2) Machine Design/ PV Soundararajan Murthy and N. Shanmugam/ Anuradha Publishers.

REFERENCE BOOKS:

1) Design of Machine Elements/V.M. Faires.
2) Machine design/ Schaum Series.
3) Mechanical Engineering Design/JE Shigley.
4) Machine Design/S Md. Jalaluddine/Anuradha Publishers.
5) Machine Design/UC Jindal/Pearson.
6) Design of Machine Elements (Vol.1)/T. Krishna Rao/IK International Publishing House/2nd Edition.

Outcomes :

At the end of this course, the student will be able to:

1. Students will be able to identify the elements of the design process.
2. Students will be able to define strict liability, negligence and express and implied warrantee.
3. Students will be able to list the fundamental canons of engineering ethics.
4. Students will be able to identify or define the yield stress and the ultimate stress of a material.
5. Students will be able to calculate the endurance limit of a material with appropriate corrections.
6. Students will be able to identify the stresses acting on a surface and find principal stresses.
7. Students will be able to evaluate loading and stress results using principal shear stress criterion.
8. Students will be able to evaluate loading and stress results using maximum distortion energy criterion.
9. Students will be able to create a Soderberg endurance failure line.
10. Understanding all types of welded joints, keys, cotter, knuckle joints, shafps, couplings and mechanical springs.

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B.Tech. - III Year – I Semester

L	T	P	C
3	0	0	3

(R18MED3103) Metrology & Machine Tools

Objectives:
Where students acquire the ability to

a) Formulate problems in metal cutting and evaluate the cutting parameters when vendor gives machine requirement or cutting condition requirement
b) determine a complete solution to metal cutting problems using mathematical or graphical techniques, and
c) determine physical and design interpretations of metal cutting parameters in design and sale of machine tools.
d) Thorough evaluation of newly developed products, to ensure that components designed are within the process and measuring instrument capabilities available in the plant.
e) To determine the process capabilities and ensure that these are better than the relevant component tolerances.
f) To determine the measuring instrument capabilities and ensure that these are adequate for their respective measurements.
g) To minimise the cost of inspection by effective and efficient use of available facilities, and to reduce the cost of rejects and rework through application of Statistical Quality Control Techniques.
h) Standardisation of measuring methods. This is achieved by laying down inspection methods for any product right at the time when production technology is prepared.
i) Preparation of designs for all gauges and special inspection fixtures.

UNIT - I:

Elementary treatment of metal cutting theory - Element of cutting process - Geometry of single point tool and 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, coolants, machinability - Tool materials.

UNIT - II:

Engine lathe - Principle of working, specification of lathe - types of lathe - work and tool holding devices, Taper turning, Thread turning - Lathe attachments. Turret and capstan lathe - Principle features of automatic lathes - classification: Single spindle and multi-spindle automatic lathes - tool layouts.

Shaping, slotting and planning machines - Principles of working - principal parts - specification, classification, operations performed. Kinematic scheme of shaping, slotting and planning machines, machining time calculations.

Drilling and 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. Kinematics scheme of the drilling and boring machines

UNIT - III:

Milling machine - Principles of working - specifications - classifications of milling machines - Principal features of horizontal, vertical and universal milling machines - machining operations Geometry of milling cutters - methods of indexing - Accessories to milling machines, kinematic scheme of milling machines

Finishing Processes: Grinding - fundamentals - theory of grinding - classification of grinding machines - cylindrical and surface grinding machine - Tool and cutter grinding machine - special types of grinding machines, Different types of abrasives - bonds specification of a grinding wheel and selection of a grinding wheel, Kinematic. Scheme of grinding machines, Honing Machines, Lapping Machines there working principles. Types of Jigs and Fixtures, 3-2-1 Principle, Types of Clamping and Work Holding devices.

UNIT - IV:

Systems of Limits and Fits: Introduction, normal size, tolerance limits, deviations, allowance, fits and their types - unilateral and bilateral tolerance system, hole and shaft basis systems – inter changeability and selective assembly. Indian standard Institution system - International Standard system for plane and screwed work.

Linear Measurement: Length standard: line and end standard, slip gauges - calibration of slip gauges, Dial indicator, micrometers.

Measurement of Angles and Tapers: Different methods - Bevel protractor - angle slip gauges - spirit levels - sine bar - Sine plate used to determine the tapers.

Limit Gauges: Taylor's principle - Design of GO and NO GO gauge, plug, ring, snap, taper, profile and position gauges.

UNIT - V:

Optical Measuring Instruments: Tool maker's microscope and its uses - collimators, optical projector - optical flats and their uses, interferometer.

Flat Surface Measurement: Measurement of flat surfaces - instruments used; straight edges, surface plates, optical flat and auto collimator.

Surface Roughness Measurement: Difference between surface roughness and surface waviness - Numerical assessment of surface finish: CLA, R.M.S Values, R_a Values, Rz value - Methods of measurement of surface finish: profilograph, Talysurf - ISI symbol for indication of surface finish.

TEXT BOOKS:

1. Principles of Machine Tools / Bhattacharya A and Sen. G. C / New Central Book Agency.
2. Workshop Technology - Vol. - II / B. S. Raghuvamsi.
3. Elements of Work Shop Technology - Vol. II / Hajra Choudary / Media Promoters.
4. Fundamentals of Metal Machining and Machine Tools / Geofrey Boothroyd / Mc Graw Hill.
5. Manufacturing Processes / JP Kaushish / Prentice Hall / 2nd Edition.
6. Production Technology / HMT / Tata Mc Graw Hill.
7. Production Technology / R. K. Jain and S. C. Gupta / Khanna Pulishers.
8. Engineering Metrology / R. K. Jain / Khanna Publishers
9. Engineering Metrology / I C Gupta / Dhanpath Rai

REFERENCE BOOKS:

1. Machine Tools / C Elanchezhian & M. Vijayan / Anuradha Publications.
2. Dimensional Metrology / Connie Dotson / Thamson 4th Edition.
1. BIS Standards on Limits & Fits, Surface Finish, Machine Tool Alignment etc.
2. Fundamentals of Dimensional Metrology / Connie Dotson / Thamson / 4th Edition.
3. Engineering Metrology / Kenneth John Hume / Mc Donald.
4. Engineering Metrology / D. M Anthony / Pergamon Press.
5. Principles of Engineering Metrology / Rega Rajendra / Jaico Publications.

Course Outcomes :

At the end of this course, the student will be able to:

1. Able to understand metal cutting principles by using all types of the cutting tools with without the coolants. All types of the chip formations.
2. Apply analytical tools from a variety of their technical specifications
3. Perform cutting force analysis of metal cutting machines
4. Perform chip formation analysis of metal cutting machines
5. Analysis various machining processes and calculate relevant quantities such as velocities, forces, powers etc.
6. Identify all types of lathe machines, there operations, drilling machines, milling machines, boring machines, shaper, slotter and planner and their cutting operations and kinematic schemes.
7. Have a basic knowledge of safe workshop practice and the environmental implications of machining process decisions
8. Understand the limitations of various machining processes with regard to shape formation and surface quality and the impact this has on design
9. Explain the relationship between manufacturing technology and systems, the impact of manufacturing on the economy and the relationship between materials selection, design and manufacture
10. Study of classification of grinding machine, types of abrasives and super finishing operations.
11. Able to understand linear measurement and angular measurements, limit gages plug gages as well as optical measurements.
12. Make accurate and precise dimensional and physical measurements.
13. Calculate Test Uncertainty Ratios (TURs) – defined as the Uncertainty of the Unit Under Test to that of the Standard/Calibrator.
14. Apply critical and analytical thinking skills in problem solving situations
15. To understand concepts of surface roughness measurement, thread measurement, machine tool alignment tests on lathe milling and drilling machine.

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B.Tech. - III Year – I Semester

L	T	P	C
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(R18MBA2201) Business Economics & Financial Analysis

Objectives:

To enable the student to understand and appreciate, with a particular insight, the importance of certain basic issues governing the business operations namely; demand and supply, production function, cost analysis, markets, forms of business organizations, capital budgeting and financial accounting and financial analysis.

Unit I

Introduction & Demand Analysis: Definition, Nature and Scope of Managerial Economics. Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting.

Unit II

Production & Cost Analysis: Production Function - Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale. Cost Analysis: Cost concepts. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems) - Managerial Significance.

Unit III

Markets & New Economic Environment: Types of competition and Markets, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly. Pricing: Objectives and Policies of Pricing. Methods of Pricing. Business: Features and evaluation of different forms of Business Organisation: Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises and their types, New Economic Environment: Changing Business Environment in Post-liberalization scenario.

Unit IV

Capital Budgeting: Capital and its significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising capital - Trading Forecast, Capital Budget, Cash Budget. Capital Budgeting: features of capital budgeting proposals, Methods of Capital Budgeting: Payback Method, Accounting Rate of return (ARR) and Net Present Value Method (simple problems).

Unit V

Introduction to Financial Accounting & Financial Analysis: Accounting concepts and Conventions - Introduction IFRS - Double - Entry Book Keeping, Journal, Ledger, Trial Balance - Final Accounts (Trasing Account, Profit and Loss Account and Balance Sheet with simple adjustments). Financial Analysis: Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability ratios. Du Pont Chart.

TEXT BOOKS:

1. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2009.
2. S.A. Siddiqui & A.S. Siddiqui, Managerial Economics and Financial Analysis, New Age international Publishers, Hyderabad 2013.
3. M. Kasi Reddy & Saraswathi, Managerial Economics and Financial Analysis, PHI New Delhi, 2012.

REFERENCES:

1. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi, 2012.
2. H. Craig Peterson & W. Cris Lewis, Managerial Economics, Pearson, 2012.
3. Lipsey & Chrystel, Economics, Oxford University Press, 2012.
4. Domnick Salvatore: Managerial Economics In a Global Economy, Thomson, 2012.
5. Narayanaswamy: Financial Accounting - A Managerial Perspective, Pearson, 2012.
6. S.N. Maheswari & S.K. Maheswari, Financial Accounting, Vikas, 2012.
7. Truet and Truet: Managerial Economics: Analysis, Problems and Cases, Wiley, 2012.
8. Dwivedi: Managerial Economics, Vikas, 2012.
9. Shailaja & Usha: MEFA, University Press, 2012.
10. Aryasri: Managerial Economics and Financial Analysis, TMH, 2012.
11. Vijay Kumar & Appa Rao, Managerial Economics & Financial Analysis, Cengage 2011.
12. J.V. Prabhakar Rao & P.V. Rao, Managerial Economics & Financial Analysis, Maruthi Publishers, 2011.

Outcomes:

At the end of this course, the student will be able to:

1. Discuss the market dynamics namely, demand and supply, demand forecasting, elasticity of demand and supply, pricing methods and pricing in different market structures.
2. Justify the gain an insight into how production function is carried out to achieve least cost combination of inputs and cost analysis.
3. Analyze how capital budgeting decisions are carried out.
4. Explain the framework for both manual and computerized accounting process.
5. Analyze and interpret the financial statements through ratio analysis.
6. Explain the various methods of capital budgeting.

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B.Tech. - III Year – I Semester

L	T	P	C
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(R18MED3104) Thermal Engineering-II

Course Objectives:

At the beginning of this course the student will

a. Be able to have the basic concepts of thermal sciences and their application to in formulating the thermal engineering problems.
b. Have a good understanding of Gas and Steam Turbines of thermal Engineering .
c. A position to fully understand the analysis to be taught at the higher levels.
d. Understanding of the Boilers and its principles.

UNIT - I:

Basic Concepts: Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance - Regeneration & reheating.

Combustion: Fuels and combustion- concept of heat of reaction-adiabatic flame temperature-stoichiometry-flue gas analysis.

UNIT - II:

Boilers: Classification - Working principles with sketches including H.P. Boilers - Mountings and Accessories - Working principle.

Steam Nozzles: Function of nozzle - Applications and Types- Flow through nozzles- Thermodynamic analysis. Wilson line, Degree of Super saturation & Degree of under cooling.

UNIT - III:

Steam Turbines: Classification - Impulse turbine; Mechanical details - Velocity diagram - Effect of friction - Power developed, Axial thrust, Blade or diagram efficiency - Condition for maximum efficiency.

Reaction Turbine: Mechanical details - Principle of operation, Thermodynamic analysis of a stage, Degree of reaction - Velocity diagram - Parson's reaction turbine - Condition for maximum efficiency.

Steam Condensers: Requirements of steam condensing plant - Classification of condensers - Working principle of different types. Vacuum efficiency and condenser efficiency

UNIT - IV:

Gas Turbines: Simple gas turbine plant - Ideal cycle, essential components - Parameters of performance - Actual cycle - Regeneration, Inter cooling and Reheating - Closed and Semi - closed cycles - merits and Demerits - Brief Concepts about compressors- Combustion chambers and turbines of Gas Turbine plant.

UNIT - V:

Jet Propulsion: Principle of Operation - Classification of jet propulsive engines - Working Principles with schematic diagrams and representation on T-S diagram- Thrust, Thrust Power and Propulsion Efficiency - Turbo jet engines - Needs and Demands met by Turbo jet - Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation - Methods.

Rockets: Application - Working Principle - Classification - Propellant Type - Thrust, Propulsive Efficiency - Specific Impulse - Solid and Liquid propellant Rocket Engines.

TEXT BOOKS:

1. Thermal Engineering / Rajput / Lakshmi Publications.
2. Gas Turbines / V. Ganesan / TMH.

REFERENCES BOOKS:

1. Gas Turbines and Propulsive Systems / P. Khajuria & S.P. Dubey / Dhanapatrai Pub.
2. Thermal Engineering / Ballaney / Khanna Pub.
3. Gas Turbines / Cohen, Rogers and Saravana Muttoo / Addison Wesley - Longman.
4. Thermal Engineering / R.S. Khurmi & J.S. Gupta / S. Chand Pub.
5. Thermodynamics and Heat Engines / R. Yadav / Central Book Depot.
6. Thermal Engineering / Ajoy Kumar / Narosa.

Course outcomes:

At the end of this course, the student will be able to:

1. Conduct experiments on the Boilers, Turbines.
2. Explain the principles of Jet Propulsion and rockets.
3. State the principles of steam turbines, Gas turbines, steam condensers.
4. Describe the applications and analysis of steam nozzles.
5. Discuss the types of compressors and their principles.
6. Explain the basic concepts of combustion analysis.

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B.Tech. - III Year – I Semester

L	T	P	C
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(R18MTH3101) Operations Research

Objectives :
Students will be exposed to allocation problem, Linear Programming, Assignment, Theory of games, Inventory, Waiting Lines and Dynamic Programming.

UNIT – I
Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.
Allocation: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method.

UNIT – II
Transportation Problem – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.
Assignment problem – Formulation – Optimal solution - Variants of Assignment Problem- Traveling Salesman problem.

UNIT – III
Sequencing – Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines
Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

UNIT – IV
Theory of Games: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.
Inventory: Introduction – Single item, Deterministic models – Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand may be discrete variable or continuous variable – Single Period model and no setup cost.

UNIT – V
Waiting Lines: Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.
Dynamic Programming:
Introduction – Terminology- Bellman's Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem.
Simulation: Introduction, Definition, types of simulation models, Steps involved in the simulation process- Advantages and disadvantages-applications of simulation to queuing and inventory.

TEXT BOOKS :

1. Operations Research /J.K.Sharma 4e. /MacMilan.
2. Introduction to O.R/Hillier & Libermann/TMH.

REFERENCE BOOKS :

1. Introduction to O.R /Taha/PHI.
2. Operations Research/ NVS Raju/ SMS Education/3rd Revised Edition.
3. Operations Research /A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
4. Operations Research / Wagner/ PHI Publications.
5. Operations Research/M.V. Durga Prasad, K, Vijaya Kumar Reddy, J. Suresh Kumar/ Cengage Learning.

Course Outcomes:

After taking this course the students should be able to

1 Identify necessity and development of mathematical models for various industries.
2 Describe basic optimization and simulation techniques applied to various industries.
3 Recall investment analysis and game theory.
4 Propose a queuing model based upon given data.
5 Define the different types of simulation models.
6 Explain the types of inventory models.

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B.Tech. - III Year – I Semester

L	T	P	C
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(R18MED31L1) Thermal Engineering Lab

PERFORM ANY 10 OUT OF THE 12 EXERCISES

1. I.C. Engines Valve / Port Timing Diagrams
2. I.C. Engines Performance Test for 4 Stroke SI engines
3. I.C. Engines Performance Test for 2 Stroke SI engines
4. I.C. Engines Morse, Retardation, Motoring Tests
5. I.C. Engine Heat Balance - CI/SI Engines
6. I.C. Engines Economical speed Test on a SI engine
7. I.C. Engines effect of A/F Ratio in a SI engine
8. Performance Test on Variable Compression Ratio Engine
9. IC engine Performance Test on a 4S CI Engine at constant speed
10. Volumetric efficiency of Air - Compressor Unit
11. Dis-assembly / Assembly of Engines
12. Study of Boilers
13. Wind tunnel testing.
14. Axial Flow Fan
15. Performance Test on blower

Course Outcomes

1. Conduct performance tests on 2 strokes and 4 strokes S.I and C.I engines.
2. Perform heat balance sheet, Morse test and motoring test on given engine.
3. Perform the assembly and disassembly of IC engine.
4. K5-Evaluate volumetric efficiency of air compressor practically.
5. Draw valve timing diagrams for 4 stroke engines respectively.
6. Summarize the working principle of boilers.

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B.Tech. - III Year – I Semester

L	T	P	C
0	0	2	1

(R18MED31L2) Metrology & Machine Tools Lab

Section - A:

1. Use of gear teeth vernier calipers for checking the chordal addendum and chordal height of the spur gear.
2. Machine tool alignment of test on the lathe.
3. Tool makers microscope and its application
4. Angle and taper measurements by bevel protractor and sine bars.
5. Use of spirit level and optical flats in finding the flatness of surface plate.
6. Thread measurement by 2-wire and 3-wire methods.

Section - B:

1. Introduction of general purpose machine - Lathe, Drilling machine, Milling machine, Shaper.
2. Planning machine, slotting machine, Cylindrical Grinder, surface grinder and tool and cutter grinder.
3. Step turning and taper turning on lathe machine.
4. Thread cutting and knurling on -lathe machine.
5. Drilling and Tapping
6. Shaping and Planning
7. Slotting
8. Milling
9. Cylindrical Surface Grinding
10. Grinding of Tool angles.

Course Outcomes

1. Explain the work on machines and usage of tools.
2. Produce the required job as per given dimensions in different types of machines.
3. Explain the Quick return mechanism in shaper.
4. Describe the various types of measuring devices and its measuring methods.
5. Operate the Lathe machine and conduct tool alignment test.
6. Experiment on tool makers microscope and discuss its applications.

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B.Tech. - III Year – I Semester

L	T	P	C
0	0	2	1

(R18MED31L3) Kinematics & Dynamics Lab

Pre-requisites:

Prerequisites for the graduate-level course are Kinematics, Dynamics, differential equations, motion simulation, displacement, velocity, acceleration, force, torque, power, Newton's motion laws, vibration, Gyroscopic Effect, Cams, Bearings.

Course Objectives:

The objective of the lab is to understand the kinematics and dynamics of mechanical elements such as linkages, gears, cams and learn to design such elements to accomplish desired motions or tasks.

Course Outcomes: Upon successful completion of this lab, students should be able to: Understand types of motion

1. Analyze forces and torques of components in linkages
2. Understand static and dynamic balance
3. Understand forward and inverse kinematics of open-loop mechanisms
4. To understand the critical speed of a given shaft for different n-conditions
5. To understand the effect of gyroscope for different motions
6. To understand time period, amplitude and frequency of un-damped free longitudinal vibration of single degree spring mass systems.

Experiments: (A Minimum of 10 experiments are to be conducted)

1. To determine the state of balance of machines for primary and secondary forces
2. To determine the frequency of torsional vibration of a given rod
3. Determine the effect of varying mass on the centre of sleeve in porter and proell governor
4. Find the motion of the follower if the given profile of the cam
5. The balance masses statically and dynamically for single rotating mass systems
6. Determine the critical speed of a given shaft for different n-conditions
7. For a simple pendulum determine time period and its natural frequency
8. For a compound pendulum determine time period and its natural frequency
9. Determine the effect of gyroscope for different motions
10. Determine time period, amplitude and frequency of un-damped free longitudinal vibration of single degree spring mass systems.
11. Determine the pressure distribution of lubricating oil at various load and speed of a Journal bearing.
12. Determine time period, amplitude and frequency of damped free longitudinal vibration of single degree spring mass systems

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(R18MAC3100) MOOCs - I

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B.Tech. - III Year – II Semester

L	T	P	C
3	0	0	3

(R18MED3201) Design of Machine Members - II

Objectives:

Design Data Book Permitted. Design of all components should include design for strength and rigidity apart from engineering performance requirements.

1. Understanding of the uncertainties and remedial approach pertaining to material properties and engineering analysis as a real-world engineering application.
2. The Design includes
   a. bearings
   b. IC Engine Parts
   c. Pulleys, Gears (Spur and Helical)
   d. Design of Screws

UNIT – I

Bearings : Types of Journal bearings –basic modes of Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design. Ball and roller bearings

– Static load – dynamic load – equivalent radial load – design and selection of ball & roller bearings.

UNIT – II

Design of IC Engine Parts :

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.

UNIT – III

Power Transmission Systems and Pulleys: Transmission of power by Belt and Rope ways, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives-materials-chain drives.

UNIT – IV

Gears : Spur gears– Load concentration factor – Dynamic load factor. – analysis of spur gears –check for plastic deformation-check for dynamic and wear consideration.

Helical and bevel gear drives: Helical and bevel gears- Load concentration factor- Dynamic load factor-analysis of helical and bevel gears- check for plastic deformation-check for dynamic and wear consideration

Design of worm gears: Properties of worm gears- selection of materials-strength and wear rating of worm gears- force analysis-friction in worm gears.

UNIT – V

Design of Power Screws: Design of Screw – design of nut – compound screw – differential screw – ball screw-possible failures.

Note : Design Data Books will be provided for Exams

TEXT BOOKS:

1. Machine Design/Pandya & Shah/ Charotar Publishing House Pvt. Ltd.
2. Machine Design/ PV Soundararajan Murthy and N. Shanmugam/ Anuradha Publishers.

REFERENCE BOOKS:

1. Design of Machine Elements/V.M. Faires.
2. Machine design/ Schaum Series.
3. Mechanical Engineering Design/JE Shigley.
4. Machine Design/S Md. Jalaluddine/Anuradha Publishers.
5. Machine Design/UC Jindal/Pearson.
6. Design of Machine Elements (Vol.1)/T. Krishna Rao/IK International Publishing House/2nd Edition.

Course Outcome

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

1. designs bearings, Pulleys, IC Engine Parts such as connecting rod, piston. Design of the belts and ropes their materials.
2. Study of different types of gears.
3. Study of the power screw and compound screw and differential screw

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B.Tech. - III Year – II Semester

L	T	P	C
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(R18MED3202) Heat Transfer

Course Objectives:
To equip graduates with the heat and mass transfer process that continuously takes place in buildings and human bodies and in various equipments employed in automobiles, electrical and electronic devices, chemical and process industries, power plants and refrigeration systems like condensers, evaporators, boilers, intercoolers, regenerators, etc. and to formulate simple problems and estimate rates of heat and mass transfer, temperature variation and efficiency of such equipments.

UNIT – I
Introduction**,** Basic Modes of heat transfer – Fundamental laws of heat transfer – Simple General discussion about applications of heat transfer.
Conduction Heat Transfer: Fourier Heat transfer equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady and periodic heat transfer – Initial and boundary conditions.

UNIT – II
One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation-Variable Thermal conductivity – systems with heat sources or Heat generation-Extended surface and fins.
One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – Chart solutions of transient conduction systems.

UNIT – III
Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham Theorem and method, application for developing semi – empirical non-dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – use of empirical correlation for convective heat transfer.
Forced convection: External Flows: Flat plates and Horizontal pipes.

Free Convection: Vertical plates and pipes-concepts about Hydrodynamic and thermal boundary layer along a vertical plate.

UNIT – IV
Heat Transfer With Phase Change:
Boiling: – Pool boiling– Calculations on Nucleate boiling, Critical Heat flux and Film boiling.
Condensation: Film wise and drop wise condensation –Film Condensation on a vertical and horizontal cylinders using empirical correlations.
Radiation Heat Transfer : Emission characteristics and laws of black-body
radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

UNIT V

Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

TEXT BOOKS :

1. Heat& Man Transfer-D.S.Kumar/S.K.Kataria& sons.
2. Heat Transfer-P.K.Nag /Mc Graw Hill/Third Edition.

REFERENCE BOOKS:

1. Heat Transfer: A Practical Approach /Yunus Cengel, Boles / TMH.
2. Heat Transfer: A Conceptual Approach/PK Sharma, K. Rana Krishna/ New age International Publishers.
3. Heat Transfer / HOLMAN/TMH.
4. Heat and Mass Transfer/ R. Yadav /CPH.
5. Essential Heat Transfer/ Christopher A Long / Pearson Education.
6. Fundamentals of Engineering, Heat & Man Transfer/R.C.Sachdeva/ NewAge.

Course Outcome

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

1. Formulate and predict heat conduction problems with and without heat generation in composite walls and extended surfaces subjected to convective boundaries also K4-Analyze 1D unsteady and 2D steady conduction problems.
2. Develop concept of boundary layer formation over heated surfaces during forced and free convection, formulation of momentum and energy equations of the solution by approximate method..
3. Study of heat transfer with phase change.
4. Study of the heat exchangers.
5. Explain the radiation heat transfer concepts and state the laws related to radiation.
6. Calculate Nucleate boiling, critical heat flux and film boiling also categorize types of condensation.

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(R18MED3203) CAD & CAM

Objectives :

The course examines the area that is commonly referred to as CAD/CAM. The general objectives of the course are to enable the students to:

- Model the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings,
- Understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program,
- Improve visualization ability of machine components and assemblies before their actual fabrication through modeling, animation, shading, rendering, lighting and coloring,
- Model complex shapes including freeform curves and surfaces,
- Understand the possible applications of the CAD/CAM systems in motion analysis, structure analysis, optimization, rapid prototyping, reverse engineering and virtual engineering,
- Implement CNC programs for milling and turning machining operations,
- Create a computer aided manufacturing (CAM) model and generate the machining codes automatically using the CAM system,
- Integrate the CAD system and the CAM system by using the CAD system for modeling design information and converting the CAD model into a CAM model for modeling the manufacturing information,
- Use full-scale CAD/CAM software systems designed for geometric modeling of machine components and automatic generation of manufacturing information.

Topics:

- Drawing, editing and modifying sketches
- Adding Relations and dimensions to sketches Creating reference geometries
- Creating, editing and modifying features
- Advanced part modeling (with complex geometries)
- Assembly modeling
- Introduction to geometric modeling (parametric curves, surfaces and solids)
- Coordinate transformations (translation, rotation, scaling, reflection)
- Working with drawings, views, dimensions and tolerances.
- Sheet metal design
- Mold Design
- Surface Modeling
- Simulation using Finite Element Method (stress and deformation analysis)
- Motion and mechanism simulation
- Introduction to numerical control machines and part programming
- Creation of tool path and automatic generation of part programming using CAM system
- Several advanced CAD/CAM applications will be covered as time permits

UNIT – I

Fundamentals of CAD/CAM, Automation , design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD ,Design workstation, Graphic terminal, CAD software- definition of system software and application software ,CAD database and structure.

Geometric Modeling: 3-D wire frame modeling, wire frame entities and their definitions, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

UNIT-II

Surface modeling: Algebraic and geometric form, Parametric space of surface, Blending functions,parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT – III

NC Control Production Systems : Numerical control, Elements of NC system, NC part programming : Methods of NC part programming, Manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

UNIT – IV

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning.

UNIT – V

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Computer Integrated Manufacturing: CIM system, Benefits of CIM, Benefits of CIM

TEXT BOOKS:

1. CAD/CAM /Groover M.P./ Pearson education.
2. CAD/CAM Concepts and Applications/ Alavala/ PHI.

REFERENCE BOOKS :

1. CAD/CAM Principles and Applications/P.N.Rao/ TMH.
2. CAD / CAM Theory and Practice/ Ibrahim Zeid/TMH.
3. CAD / CAM / CIM/Radhakrishnan and Subramanian/ New Age.
4. Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson.
5. Computer Numerical Control Concepts and programming/Warren S Seames/ Thomson.

Outcomes:

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

1. To describe the fundamental theory and concepts of the CAD/CAM.
2. Develop the concepts and underlying theory of modeling and the usage of models in different engineering applications.
3. Develop the Presentation skills
4. Compare the different types of modeling techniques and explain the central role solid models play in the successful completion of CAD/CAM-based product development.
5. Develop transformations for 2D geometric modeling.
6. Explain the basic concepts of CNC programming and machining.
7. Describe the principles of Computer Aided Designing systems and the concepts of Geometric modeling, solid modeling, and feature-based design modeling.
8. Create and design mechanical parts and elements in 2D transformations.
9. Distinguish the different CAD/CAM neutral files. Understand the import and export procedure of CAD/CAM electronic neutral files (IGES, STEP,.).
10. Compare and distinguish the difference between the operation and programming of a CNC machine tool using manual programming and the operation and programming of CNC machine tool using CAM systems.
11. Apply both practices (manually and CAM) to develop the G,M, S,T & F code program.
12. To develop APT (automatic program tool) programming.
13. To understand GT, CAPP, MRP, FMS, CAQC & CIM.

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Professional Elective - I

(R18MED3211) Unconventional Machining Processes

Objectives:

1. To understand the need and importance of non-traditional machining methods.
2. To know the basic principle, equipment, process variables and mechanics of metal removal in abrasive jet machining and water jet machining.
3. To study the fundamentals of tool design, surface finishing and metal removal rate of electro chemical grinding , electro chemical machining and electro chemical honing.
4. To understand principles of operation, types of electrodes and process parameters and machine tool selection in EDM and Electric discharge grinding and wire cut process.
5. To know the basics of Electron Beam Machining and comparison of thermal and non thermal processes.
6. To study the various process parameters and applications of Plasma in manufacturing industries.

UNIT I

Introduction to NTMM, history of Non Traditional Machining methods, classification of NTM methods, need of NTMM development, process selection of NTMM, physical parameters of Non Traditional processes, shapes to be cut by NTMM, process capability, process economy, the present scenario of NTMM, difference between conventional and non non-traditional machining methods, applications of non traditional machining methods, advantages and disadvantages of NTMM,

UNIT II

Introduction to Ultra Sonic Machining: History of USM, principle and working of USM, mechanism of USM, mechanical system and various components of USM, basic components for cutting action of USM, process parameters and their effects on MRR, advantages, disadvantages and applications of USM. Material removal models in USM, future scope and recent developments of Ultrasonic machining. Introduction and history of RUSM, problems on USM. Abrasive Jet Machining(AJM) Introduction to AJM, schematic diagram, working process, process capability, process parameters of AJM, effect of process parameters on MRR, advantages and disadvantages of AJM, material removal models in AJM, problems in AJM.

Water Jet Machining(WJT): Introduction to WJT, principle, history and schematic diagram of WJT, Construction of WJM, classification of water jets, abrasive water jet system process parameters, advantages, disadvantages and applications of WJM, machining of different work piece materials by WJM, recent developments in Abrasive water jets.

UNIT III

Chemical Machining (CHM): Introduction to chemical machining, history, maskant types, advantages, limitations, applications of CHM. Photo chemical machining (PCHM), process, applications, economy, advantages and disadvantages of PCHM. Electrical Chemical Machining(ECM) Introduction to ECM, history of ECM , principle and equipment of ECM Process, working of ECM.

Elements of ECM, process parameters ECM, design techniques of ECM Tooling, operation, advantages, disadvantages, applications of ECM, Similarities between EDM and ECM.

Electrochemical grinding ECG applications, advantages, disadvantages of ECG. Electro Chemical Deburring, Electro chemical turning, Electro chemical sawing, ECM tooling and its characteristics, future scope of ECM

UNIT IV

introduction to electrical discharge machine (EDM): History, process, equipment, electrode material, dielectric fluid reservoir, power supply of EDM, Analysis of RC Relaxation Generator of EDM, Power generators of EDM, Process parameters and their effect on MRR of EDM, characteristics of EDM, methods of improving MRR by electrode design in EDM, capabilities, advantages and disadvantages, Applications of EDM, different types of EDM.

Wire EDM : Development of wire EDM, influence of process parameters of WEDM process, process parameters, advantages and disadvantages of WEDM, Scope of EDM, advanced EDMs, Powder mixed electrical discharge machining (PMEDM), History of PMEDM, Applications of PMEDM, Future scope of PMEDM, Cryogenic electrical discharge machining, Experimental methodology, cryogenic treatment, future scope of cryogenic EDM.

UNIT V

Laser Beam Machining: Introduction of Laser beam machining(LBM), History, Principle, Lasing action, Laser Medium, Population Inversion of Laser, Process of LBM, Mechanism of material removal in Laser cutting, Classification of Lasers Based on material, Classification of Laser beam based on pulse, properties of lasers, LASER process characteristics, Methods of cutting of materials by lasers, Types of laser cutting machines, requirement of laser, various process parameters of LBM, LBM Applications, Advanced LBM methods, History of pulsed LBM, Laser Ablation, LBM Applications, Advantages and disadvantages of LBM.

Electron Beam Machining (EBM): Introduction to Electron beam machining, working process of EBM, history, parts, process characteristics, specifications, process parameters, process capability, Advantages ,disadvantages and applications of EBM.

Plasma Arc Machining (PAM): Introduction to PAM, History, gases used in PAM, system components of PAM, types of arcs of PAM, key process variables of PAM, development of PAM.

Advanced Unconventional machining methods: Introduction to Advanced Unconventional machining methods, Magnetic Abrasive finishing (MAF), processing principle, magnetic field sources, motion facilitating equipment, working principle of magnetic abrasive finishing, the effect of process parameters of MAF.

Shaped Tube Electrolytic Machining (STEM), Electro Stream Drilling (ESD), Types of ESD, performance of ESD.

Abrasive Flow Machining, Abrasive flow machining parameters, AFM applications, Benefits and Future Scope.

TEXT BOOK:

1. Advanced machining processes - VK Jain, Allied publishers.

REFERENCES :

1. Modern Machining Process - Pandey P.C. and Shah H.S., TMH.
2. New Technology - Bhattacharya A, The Institution of Engineers, India 1984.
3. Unconventional Machining Processes - C. Elanchezhian,, B. Vijaya Ramnath and M Vijayan, Anuradha Publications, 2005.
4. Unconventional Manufacturing Processes – M.K. Singh, New Age International Publishers.
5. Dr. P. Mallesham, “A Book on Recent Trends in Unconventional Machining Methods”, Research India Publication, 2018

Outcomes:

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

1. Understand the basic techniques of unconventional machining processes
2. Understand the economical aspects of unconventional machining
3. Understand the need and type of material to machined by unconventional methods.
4. Ability to extend the knowledge of unconventional machining methods to various industries such as aerospace, nuclear and defense industries.
5. Various unconventional machining methods are categorized based on their energies such as Mechanical, Electro Chemical, Electro Thermal and chemical energies.
6. Prediction of the processes for thermal EDM, LBM, PAM, WEDM and EBM.
7. Selection of the tool material and machining process parameters
8. Understanding of micro finishing process such as Magnetic Abrasive finishing, Shaped tube electro stream machining, Magnetic Abrasive Flow Finishing

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Professional Elective - I

(R18MED3212) Machine Tool Design

Course Objectives: As a result of this course, students will be able to:

- Implement the tool design process when designing tooling for the manufacturing of a product.
- Apply Geometric Tolerancing principles in the designs of tooling.
- Evaluate and select appropriate materials for tooling applications.
- Design, develop, and evaluate cutting tools and work holders for a manufactured product.
- Design, develop, and evaluate appropriate gaging /gaging systems to define limits and specifications of a work piece during the manufacturing process.
- Design, develop, and evaluate tooling for various joining processes.
- Apply ANSI standards to tool design drawings and layouts.
- Use CAD and conventional techniques in creating tooling drawings.

Course Outcomes:

At the end of the course, the student will be able to, Understand basic motions involved in a machine tool. Design machine tool structures. Design and analyze systems for specified speeds and feeds. Select subsystems for achieving high accuracy in machining. Understand control strategies for machine tool operations. Apply appropriate quality tests for quality assurance.

Unit – I:

Introduction to Machine Tool Drives and Mechanisms: Introduction to the course, Working and Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission.

Unit – II :

Regulation of Speeds and Feeds: Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design.

Unit – III:

Design of Machine Tool Structures: Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriages.

Unit – IV :

Design of Guideways, Power Screws and Spindles: Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slideways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws.

Design of Spindles and Spindle Supports: Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings.

Unit – V:

Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness Acceptance Tests

Text books:

- Machine Tool Design and Numerical Control/ N.K. Mehta / Mc Graw Hill
- Principles of Machine Tools/ G.C. Sen and A. Bhattacharyya / , New Central Book Agency

Reference books:

- Design of Machine Tools / D. K Pal, S. K. Basu / Oxford
- Machine Tool Design, Vol. I, II, III and IV / N. S. Acherkhan / MIR

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Professional Elective - I
(R18MED3213) Production Planning & Control

Objectives:

1. To plan production facilities in the best possible manner along with the proper systematic planning of production activities.
2. Providing men, machines, materials etc. of right quality, quantity and also providing them at the right time forms a very important factor and Japanese concepts of the inventory control.
3. To inform, about the difficulties or the various awkward positions expected to crop up later, to the management beforehand.
4. Involves order preparation, process planning or routing concerns, fixation of method of manufacture, scheduling, dispatching, progressing, expediting etc.
5. Involves cost estimation, work measurement, subcontracting, capacity planning and demand forecasting etc.

UNIT-I

Introduction: Definitions – objectives of production planning and control-functions of production planning and control-elements of production control-types of production- organization of production planning and control – internal organizations department

UNIT-II

Forecasting – Importance of forecasting – types of forecasting, their uses-general principles of forecasting techniques- Qualitative methods and quantitative methods.

UNIT-III

Inventory management – Functions inventory- Relevant inventory cost- ABC analysis- VED Analysis-EOQ model – Inventory control systems – P- Systems and Q – Systems

Introduction to MRP And ERP, LOB(Line of balance), JIT inventory, Japanese concepts.

UNIT- IV

Routing – Definition – routing procedure- Route sheets – Bill of material-factors affecting routing procedure. Schedule – definition – difference with loading.

Scheduling polices – techniques, standard scheduling methods- job shop, flow shop,.

Line balancing, aggregate planning- methods for aggregate planning- Chase planning, expediting, control aspects.

UNIT-V

Dispatching – Activities of dispatcher- Dispatching procedure - follow up – definition – reasons for existence of functions – types of follow up, applications of computer in production planning and control

TEXT BOOKS:

1. Production Planning and Control/ M.Mahajan/ Dhanpati rai & Co.
2. Production Planning and Control/ Jain & Jain/ Khanna publications

REFRENCE BOOKS :

1) Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2) Production and operations Management/ R.Panneer Selvam/PHI.
3) Operations Management/Chase/PHI.
4) Operations management/ Heizer/Pearson.
5) Production and Operations Management(Theory and Practice) / Dipak Kumar Bhattacharyya / University Press.
6) Operations Management/S.N. Chary/TMH.

Course Outcomes

At the end of this course, the student will be able to:

1 Design of production/operating system.
2 Develop forecasts using forecasting techniques and choose a location.
3 Choose a facility layout and perform work measurement.
4 Explain capacity planning, materials management and inventory management.
5 Explain the master production schedule, shop floor planning and control and material management.
6 Explain advanced softwares related production planning & control

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(R18MED3204) Finite Element Methods

Objective

1) To provide the fundamental concepts of the theory of the finite element method:
2) To develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results)
3) To realistic engineering problems through the use of a major commercial general-purpose finite element code.
4) Student will be exposed to the Heat-transfer analysis, dynamic analysis by using Ansys.

UNIT - I

Introduction to Finite Element Method for solving field problems. Stress and Equilibrium. Boundary conditions. Strain – Displacement relations. Stress – strain relations for 2-D and 3-D Elastic problems.

One Dimensional Problems: Finite element modeling coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT – II:

Analysis of Trusses: Stiffness Matrix for Plane Truss Elements, Stress Calculations and problems.

Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node beam element and simple problems.

UNIT – III:

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of Load Vector, Stresses.

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.

Two dimensional four noded Isoparametric elements and problems.

UNIT – IV:

Steady State Heat Transfer Analysis: one dimensional analysis of Slab, fin and two dimensional analysis of thin plate. Analysis of a uniform shaft subjected to torsion.

UNIT – V:

Dynamic Analysis: Formulation of finite element model, element - Mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar, truss.

Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation, techniques such as semi automatic and fully Automatic use of softwares such as ANSYS, NISA, NASTRAN, etc.

TEXT BOOKS:

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.
2. Finite Element Methods: Basic Concepts and applications/ Alavala/ PHI.

REFERENCE BOOKS :

1. Introduction to Finite Elements in Engineering/Chandrupatla, Ashok and Belegundu/ Prentice – Hall.
2. Finite Element Method /Zincowitz / Mc Graw Hill.
3. Introduction to Finite element analysis/ S.Md.Jalaludeen/Anuradha Publications, print-2012.
4. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition.
5. Finite Element Method/Krishna Murthy / TMH.
6. Finite Element Analysis /Bathe / PHI.

Outcomes :

After taking this course the students should be able to

- to obtain an understanding of the fundamental theory of the FEA method;
- to develop the ability to generate the governing FE equations for systems governed by partial differential equations;
- to understand the use of the basic finite elements for structural applications using truss, beam, frame, and plane elements; and
- to understand the application and use of the FE method for heat transfer problems.
- to demonstrate the ability to create models for trusses, frames, plate structures, machine parts, and components using ANSYS general-purpose software;
- to model multi-dimensional heat transfer problems using ANSYS;
- to demonstrate the ability to evaluate and interpret FEA analysis results for design and evaluation purposes;
- to develop a basic understanding of the limitations of the FE method and understand the possible error sources in its use.
- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

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(R18MED32L1) Heat Transfer Lab

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere (Insulating Powder)
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction (Unsteady State Heat Conduction)
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzman Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Film and Drop wise condensation apparatus

Course Outcomes

1. Perform experiment and calculate the thermal conductivity through metal, insulating powder and lagged pipe.
2. Determine the heat transfer coefficient and heat transfer rate in natural convection, forced convection in parallel and counter flow heat exchanger.
3. Determine the emissivity, Stefan Boltzmann constant to estimate heat transfer through radiation by conducting experiment.
4. Solve the heat transfer in conduction process and to determine critical temperature of heat element.
5. Learn the heat pipe principle and two phase flow principle.
6. Study of heat transfer in pin-fin apparatus.

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(R18MED32L2) CAD & CAM Lab

1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances.
2. Part Modeling: Generation of various 3D Models through Protrusion, revolve, sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling and Assembly Modeling. Study of various standard Translators. Design of simple components.
3. Determination of deflection and stresses in 2D and 3D trusses and beams.
4. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain and Axi-symmetric components.
5. Determination of stresses in 3D and shell structures (at least one example in each case)
6. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
7. Study state heat transfer analysis of plane and axi-symmetric components.
8. Development of process sheets for various components based on Tooling and Machines.
9. Development of manufacturing defects and tool management systems.
10. Study of various post processors used in NC Machines.
11. Development of NC code for free form and sculptured surfaces using CAM software.
12. Machining of simple components on NC lathe and Mill by transferring NC Code / from CAM software.
13. Quality Control and inspection.

Course Outcomes

1 To Create 2-D & 3-D drawings using AutoCAD.
2 Draw assembly drawings using PRO-E.
3 Determine deflections and stresses in various beams and structures by using ANSYS.
4 Predict natural frequencies of 2D beams and perform study state heat transfer analysis of plane and axi-symmetric components.
5 Develop NC code for Turning operations using CAM software and machine simple components on NC lathe by transferring NC code from CAM software.
6 Develop NC code for free form using CAM software and machine simple components on NC Mill by transferring NC code from CAM software.

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(R18HAS31L1) Advanced Communication Skills lab

Introduction

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

The proposed course should be a laboratory course to enable students to use 'good' English and perform the following:

- Gathering ideas and information to organise ideas relevantly and coherently.
- Engaging in debates.
- Participating in group discussions.
- Facing interviews.
- Writing project/research reports/technical reports.
- Making oral presentations.
- Writing formal letters.
- Transferring information from non-verbal to verbal texts and vice-versa.
- Taking part in social and professional communication.

Objectives:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve the students' fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts.
- Further, they would be required to communicate their ideas relevantly and coherently in writing.
- To prepare all the students for their placements.

Syllabus:

The following course content to conduct the activities is prescribed for the Advanced Communication Skills (ACS) Lab:

1. **Activities on Fundamentals of Inter-personal Communication and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language – Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.
2. **Activities on Reading Comprehension** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading & effective googling.
3. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/ Technical report writing/ Portfolio writing* – planning for writing – improving one's writing.

4. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/ e-mails/assignments etc.
5. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-conference and Mock Interviews.

Minimum Requirement:
The Advanced Communication Skills (ACS) Laboratory shall have the following infra-structural facilities to accommodate at least 35 students in the lab:

- **Spacious room with appropriate acoustics.**
- **Round Tables with movable chairs**
- **Audio-visual aids**
- **LCD Projector**
- **Public Address system**
- **P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ**
- **T. V, a digital stereo & Camcorder**
- **Headphones of High quality**

Prescribed Lab Manual: A book titled ***A Course Book of Advanced Communication Skills (ACS) Lab*** published by Universities Press, Hyderabad.

Suggested Software:
The software consisting of the prescribed topics elaborated above should be procured and used.

- **Oxford Advanced Learner's Compass**, 7th Edition
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
- **Lingua TOEFL CBT Insider**, by Dreamtech
- **TOEFL & GRE**(KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- **The following software from 'train2success.com'**
  - **Preparing for being Interviewed**
  - **Positive Thinking**
  - **Interviewing Skills**
  - **Telephone Skills**
  - **Time Management**

Books Recommended:

1) Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.
2) Advanced Communication Skills Laboratory Manual by Sudha Rani, D, Pearson Education 2011.
3) Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
4) Business and Professional Communication: Keys for Workplace Excellence. Kelly M. Quintanilla & Shawn T. Wahl. Sage South Asia Edition. Sage Publications. 2011.
5) The Basics of Communication: A Relational Perspective. Steve Duck & David T. McMahan. Sage South Asia Edition. Sage Publications. 2012.
6) English Vocabulary in Use series, Cambridge University Press 2008.

7) Management Shapers Series by Universities Press(India)Pvt Ltd., Himayatnagar, Hyderabad 2008.
8) Handbook for Technical Communication by David A. McMurrey & Joanne Buckley. 2012. Cengage Learning.
9) Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
10) Handbook for Technical Writing by David A McMurrey & Joanne Buckely CENGAGE Learning 2008.
11) Job Hunting by Colm Downes, Cambridge University Press 2008.
12) Master Public Speaking by Anne Nicholls, JAICO Publishing House, 2006.
13) English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw-Hil 2009.
14) Books on TOEFL/GRE/GMAT/CAT/ IELTS by Barron's/DELTA/ Cambridge University Press.
15) International English for Call Centres by Barry Tomalin and Suhashini Thomas, Macmillan Publishers, 2009.

DISTRIBUTION AND WEIGHTAGE OF MARKS:

Advanced Communication Skills Lab Practicals*:*

1. The practical examinations for the ACS Laboratory practice shall be conducted as per the University norms prescribed for the core engineering practical sessions.
2. For the English Language lab sessions, there shall be continuous evaluation during the year for 25 sessional marks and 50 End Examination marks. Of the 25 marks, 15 marks shall be awarded for day-to-day work and 10 marks to be awarded by conducting Internal Lab Test(s). The End Examination shall be conducted by the teacher concerned, by inviting the External Examiner from outside. In case of the non-availability of the External Examiner, other teacher of the same department can act as the External Examiner.

Mini Project: As a part of Internal Evaluation

1. Seminar/ Professional Presentation

2. A Report on the same has to be prepared and presented.

**** Teachers may use their discretion to choose topics relevant and suitable to the needs of students.***

**** Not more than two students to work on each mini project.***

**** Students may be assessed by their performance both in oral presentation and written report.***

Outcomes

- Accomplishment of sound vocabulary and its proper use contextually.
- Develop Flair in Writing and felicity in written expression.
- Generate Enhanced job prospects.
- Develop the Effective Speaking Abilities.
- Develop the activities on group discussion activities.
- Create the interview skills

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B.Tech. - III Year – II Semester	L	T	P	C
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(R18MAC3200) MOOCs-II

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B.Tech. - IV Year – I Semester

L	T	P	C
3	0	0	3

(R18MED4101) Refrigeration & Air Conditioning

Course Objectives:

1. The purpose of this course is to impart adequate knowledge in both practice and theory.
2. The course structures covers various types of Refrigeration Systems to familiarize the students with the fundamentals of Refrigeration and Air Conditioning Systems.
3. After the completion of this course the students will be acquainted with the operation and maintenance/repair of different components of Refrigeration Systems.

UNIT – I

Introduction to Refrigeration: -Basic concepts - Unit of refrigeration and C.O.P-refrigerators-heat pump- carnot refrigerator-applications of refrigerator – Vapour compression refrigeration- Ideal cycle – effect of sub cooling of liquid- super heating of vapour-deviations of practical (actual cycle) from ideal cycle- construction and use of P-H chart- problems.

UNIT – II

Components :

Compressors –classification – Working – Advantages and Disadvantages.
Condensers – classification – Working Principles
Evaporators – classification – Working Principles
Expansion devices – Types – Working Principles

UNIT III:

Vapor Absorption refrigeration – Description and working of ammonia – water, Li Br – water system – Calculation of HCOP, Principle and operation of three fluid vapour absorption refrigeration system.
Air refrigeration- Bell Coleman cycle – open and dente air system - ideal and actual refrigeration – applications – steam jet refrigeration system – working principle – basic operation

UNIT – IV:

Introduction to Air Conditioning:

Psychometric Properties & Processes – Sensible and latent heat loads – Characterization – Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF, ASHF, ESHF and ADP.
Concept of human comfort and effective temperature –Comfort Air conditioning – Industrial air conditioning and Requirements – Air conditioning Load Calculations.

UNIT – V:

Air Conditioning systems: Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, deodorants, fans and blowers.
Heat Pump – Heat sources – different heat pump circuits – Applications.

TEXT BOOKS:

1. Refrigeration and Air Conditioning / CP Arora / TMH.
2. A Course in Refrigeration and Air Conditioning / SC Arora & Domkundwar / Dhanpatrai.

REFERENCE BOOKS:

1. Principles of Refrigeration /Dossat / Pearson Education.
2. Basic Refrigeration and Air-Conditioning/ Ananthanarayanan / TMH.
3. Refrigeration and Air Conditioning/ Manohar Prasad/ New Age.
4. Refrigeration and Air Conditioning/Ahmadul Ameen/PHI.

Course Outcomes:

At the end of this course, the student will be able to:

1. Explain different types of Basic Refrigeration cycles and its applications in multi compressor and multi evaporator systems.
2. Describe the methods for low temperature refrigeration.
3. Propose the selection and design of different components of Refrigeration systems.
4. Describe functioning of different kind of heat energy operated vapour absorption systems.
5. Recommend the selection and application of suitable/eco-friendly refrigerants.
6. Classify Air conditioning systems and study of heat pump.

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Professional Elective – II
(R18MED4121) Additive Manufacturing

Course Objectives:

- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effect of the additive manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in additive manufacturing.
- Realize the potential implications of AM technologies on product development and identify needs for new technologies to accelerate the advancement and impact of AM.

UNIT I

Introduction to Rapid prototyping, RP Technology Historical Development, Need of Rapid Prototyping, The Basic Design process of Rapid prototyping, Rapid prototyping technology cycle, Principle of rapid prototyping, fundamentals of rapid prototyping systems, challenges associated with rapid prototyping technologies, factors to be considered during development of rapid prototyping.

Advantages of rapid prototyping, limitations of rapid prototyping, materials used in rapid prototyping technology, terms used in rapid prototyping, classification of rapid prototyping systems(RPS),liquid based RPS, solid based RPS, Powered based RPS, Automation of Rapid prototyping, process chain of RP, Rapid tooling, classification, constrains, advantages, Rapid prototyping tooling Vs conventional tooling

Reverse Engineering using RP, process of reverse engineering, future developments of RE, future developments of RP Technology, Difference between Conventional machining and rapid prototyping.

UNIT II

Liquid Based And Solid Based Rapid Prototyping Systems

Introduction of liquid based and solid based rapid prototyping systems, stereolithography, history of stereolithography, capabilities of SLA, principle of SLA, working process of SLA, specifications of SLA, advantages, disadvantages and applications of SLA. Photopolymers, photo polymerization, advantages of photopolymers, layered manufacturing, issues of layered.

Laser scanning, laser scanning applications, advantages of laser scanning. Introduction to solid ground curing(SGC), working of SGC, principle of SGC, advantages, disadvantages SGC. Introduction to Laminated Object manufacturing(LOM), capabilities of LOM, working process of LOM, advantages, disadvantages of LOM. Introduction Fused deposition modeling, history of FDM, capabilities of FDM, materials of FDM, problem formulation FDM, process parameters, challenges, benefits, disadvantages of FDM, Future of FDM.

UNIT III

Powder Based Rapid Prototyping Systems and Rapid Tooling

Introduction to powder based RPS, History of SLS, physical phenomena of selective laser sintering (SLS), working of SLS, capabilities of SLS, materials and applications, advantages, disadvantages of SLS.Introduction to 3D Printing, working of 3D printing,

UNIT IV

Rapid Prototyping Data Formats

Introduction to STL file format, History of STL file, STL file uses in other fields, file formats of STL, different types of STL file formats , advantages, disadvantages of STL file, STL file problems, missing facets, degenerate faces, overlapping facet. Non manifold conditions, consequences of building a valid and invalid tessellated model STL file repair, generic solution, other translators, newly proposed formats, magic software, mimics, solid view, view expert, 3D view, 3D doctor.

UNIT V

Rapid Prototyping Applications

Introduction to Rapid Prototyping Applications, RP applications in Design, Heterogeneous object design, RP applications in Automotive Industry, 3D opportunity in the automotive industry, automotive case studies, RP applications in Aerospace industry, features of RP in Aircraft industries, Aerospace Case studies, RP Applications in jewelry and coin industry, RP Applications in GIS, Architectural interior design , art, medical industry. Challenges of rapid prototyping technologies in medicine. Recent and future trends in medical applications, Medical devices, RPA in forensic science, anthropology and visualization of bio molecules.

Testing of 3D printing samples, Introduction, Impact test, tension, compression, hardness test and conclusion, errors in 3D printed parts.

Text Books & References:

1. Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010
2. Chua Chee Kai, Leong Kah Fai, “Rapid Prototyping: Principles & Applications”, World Scientific, 2003.
3. Ali K. Kamrani, Emand Abouel Nasr, “Rapid Prototyping: Theory & Practice”, Springer, 2006.
4. D.T. Pham, S.S. Dimov, Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer 2001
5. Andreas Gebhardt, Understanding Additive Manufacture: Rapid Prototyping, Rapid Tooling and Rapid Manufacture, Hanser Publishers, 2013.
6. Dr. P. Mallesham, “A Book on Rapid Prototyping”, Research India Publication, 2018

Course Outcomes: Student will be able to:

1. Students can able to complete different methods to discuss the effects of the additive manufacturing technologies
2. Analyse the characteristics of the different materials in additive manufacturing.
3. Select a suitable material for Additive Manufacturing.
4. Analyze different Methods for post-processing of additive manufacturing parts.
5. Understand the applications of Additive Manufacturing
6. Able to know the Testing of 3D printing samples.

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Professional Elective – II
(R18MED4122) Automation in Manufacturing

UNIT – I

Introduction: Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and too changing and machine tool control transfer the automaton.

UNIT – II

Automated flow lines : Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

Analysis of Automated flow lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT – III

Assembly system and line balancing : Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT –I V

Automated material handling : Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems.

Automated storage systems, Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT – V

Fundamentals of Industrial controls: Review of control theory, logic controls, sensors and actuators, Data communication and LAN in Manufacturing

Business process Re-engineering: Introduction to BPE logistics, ERP, Software configuration of BPE.

TEXT BOOK:

1. Automation, Production Systems and Computer Integrated Manufacturing : M.P. Groover 3e./PE/PHI, 2009.

REFERENCES:

1. Computer Aided Manufacturing, Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang, Pearson, 2009.
2. Automation by W. Buekinsham.

Course Outcomes

1. Understand the concept and types of automation
2. Assessment of degree and level of automation, Automated flow lines
3. To know the automation, Assembly system and line balancing
4. Knowledge about various components of automation like sensors, actuators
5. Understanding transfer lines and advanced industrial automation
6. To know Automated material handling and Automated storage systems , Fundamentals of Industrial control

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B.Tech. - IV Year – I Semester

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Professional Elective – II
(R18MED4123) MICRO ELECTRO MECHANICAL SYSTEMS (MEMS)

Course Objectives:
1. To learn basics of Micro Electro Mechanical Systems (MEMS).
2. To learn about various sensors and actuators used in MEMS.
3. To learn the principle and various devices of MOEMS, Fluidic, bio and chemical systems.

Unit -I

Introduction: Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA. MECHANICAL SENSORS AND ACTUATORS: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

Unit -II

Thermal Sensors And Actuators: Thermal energy basics and heat transfer processes, thermisters, thermo devices, thermo couple, micro machined thermo couple probe, peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

Unit -III

Micro-Opto-Electro Mechanical Systems: Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

Unit -IV

Magnetic Sensors and Actuators: Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive Mechanical Engineering 148 sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.

Unit – V

Micro Fluidic Systems: Applications, considerations on micro scale fluid, fluid actuation methods, dielectro phoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, opto electro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS: RF - based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

Chemical and Bio Medical Micro Systems: Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (Enose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.

Text Book:

1. MEMS, Nitaigour Premchand Mahalik, TMH Publishing co.

Reference Books:

1. Foundation of MEMS, Chang Liu, Prentice Hall Ltd.
2. MEMS and NEMS, Sergey Edwrd Lyshevski, CRC Press, Indian Edition.
3. MEMS and Micro Systems: Design and Manufacture, Tai-Ran Hsu, TMH Publishers.
4. Introductory MEMS, Thomas M Adams, Richard A Layton, Springer International Publishers.

Course outcomes:

After taking this course the students should be able to

1. Students able to understand concepts applicable to MEMS, their fabrication.
2. To understand the basic concepts the design, analysis and testing of MEMS.
3. Apply the MEMS for different applications.
4. To understand the basic concepts and applications of Thermal Sensors and Actuators.
5. To understand the basic concepts and applications of Micro-Opto-Electro Mechanical Systems
6. To understand the basic concepts and applications Magnetic Sensors and Actuators,
7. To understand the basic concepts and applications Micro Fluidic Systems ,Chemical and Bio Medical Micro Systems

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Professional Elective – III

(R18MED4131) Power Plant Engineering

Course Objectives:

1. Basic knowledge of Different types of Power Plants, site selection criteria of each one of them.
2. Understanding of Thermal Power Plant Operation, turbine governing, different types of high pressure boilers including supercritical and supercharged boilers, Fluidized bed combustion systems.
3. Design of chimney in thermal power plants, knowledge of cooling tower operation, numerical on surface condenser design.
4. Basic knowledge of Different types of Nuclear power plants including Pressurized water reactor, Boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor.
5. Understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc.
6. Discussing environmental and safety aspects of power plant operation.

UNIT – I

Introduction to the Sources of Energy – Resources and Development of Power in India. **Steam Power Plant :** Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

Combustion Process: Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

UNIT – II

Internal Combustion Engine Plant:

DIESEL POWER PLANT: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging. **Gas Turbine Plant:** Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison. **Direct Energy Conversion:** Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.

UNIT – III

Hydro Electric Power Plant: Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways. **Hydro Projects And Plant:** Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants. **Power From Non-Conventional Sources:** Utilization of Solar- Collectors- Principle of Working, Wind Energy – types – HAWT, VAWT -Tidal Energy.

UNIT – IV

Nuclear Power Station: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation. **Types of Reactors:** Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

UNIT – V

Power Plant Economics And Environmental Considerations: Capital cost,
investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment
– pollutants and pollution standards – Methods of Pollution control.

TEXT BOOKS :

1) Power Plant Engineering/ P.C.Sharma / S.K.Kataria Pub.
2) A Course in Power Plant Engineering: / Arora and S. Domkundwar.

REFERENCES :

1. A Text Book of Power Plant Engineering / Rajput / Laxmi Publications.
2. Power Plant Engineering: P.K.Nag/ II Edition /TMH.
3. An Introduction to Power Plant Technology / G.D. Rai/Khanna Publishers.
4. Power plant Engg / Elanchezhian/ I.K. International Pub.
5. Power plant Engineering/ Ramalingam/ Scietech Publishers.

Course Outcomes:

After taking this course the students should be able to

1. Basic knowledge of Different types of Power Plants, site selection criteria of each one of them.
2. Understanding of Thermal Power Plant Operation, turbine governing, different types of high pressure boilers including supercritical and supercharged boilers, Fluidized bed combustion systems.
3. Design of chimney in thermal power plants, knowledge of cooling tower operation, numerical on surface condenser design.
4. Basic knowledge of Different types of Nuclear power plants including Pressurized water reactor, Boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor.
5. Understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc.
6. Discussing environmental and safety aspects of power plant operation.

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Professional Elective – III
(R18MED4132) Automobile Engineering

Course Objectives:
The purpose of this course is to impart adequate knowledge in both practically and theoretically, covering the various types of power-driven vehicles and to familiarize the students with the fundamentals of Automotive Engine System, Chassis and suspension system, braking and transmission system, and cooling system. The students are acquainted with the operation, maintenance and repairs of all components of the various transportation vehicles.

UNIT – I

Introduction : Layout of automobile – introduction chassis and body components . types of Automobile engines. – power unit – Introduction to engine lubrication – engine servicing.

Fuel System :S.I. Engine : Fuel supply systems, Mechanical and electrical fuel pump – filters – carburettor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

C.I. Engines : Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction CRDI and TDI Systems.

UNIT – II

Cooling System : Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling – pressure sealed cooling – antifreeze solutions.

Ignition System : Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

Electrical System : Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

UNIT – III

Transmission System : Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, constant mesh, synchro mesh gear boxes, epicyclic gear box , over drive, torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

Suspension System : Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

UNIT – IV

Braking System : Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder, tandem master cylinder, Requirement of brake fluid, Pneumatic and vacuum brakes.

Steering System : Steering geometry – camber, caster, king pin inclination, combined angle, toe-in, toe-out, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT – V

Emissions from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection, Energy alternatives – Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels and gaseous fuels, Hydrogen as a fuel for IC Engines. - their merits and demerits. Standard Vehicle maintenance practice.

TEXT BOOKS :

1. Automobile Engineering / William H Crouse/McGraw Hill-2012.
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi & Yosuf Ali, Frontline Publications.

REFERENCES :

1. A Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner.
3. Automotive Engineering / Newton Steeds & Garrett.
4. Automotive Engines / Srinivasan.
5. A Text Book of Automobile Engineering By Khalil U Siddiqui New Age International.
6. Automobile Engineering by Dr. Kripal Singh- Vol. 1 and 2.

Course Outcomes:

At the end of this course, the student will be able to:

1. List different types of Engine and their classifications.
2. Judge firing order for multi-cylinder engines for igniting of fuels.
3. Develop concept and define working of Automobile Engine cooling and lubrication system.
4. To understand the cooling system, ignition system of the IC engines
5. Transmission of the power transmission system of automobiles, suspension system of the automobiles including the rigid axle of the automobiles.
6. Mechanical braking system of the automobiles
7. Types of the steering mechanisms such as ackerman and davis.
8. Emission from automobiles.

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Professional Elective – III

(R18MED4133) Renewable Energy Sources

Course Objectives

The course should enable the students to :

1. Understand the various forms of conventional energy resources.
2. Learn the present energy scenario and the need for energy conservation
3. Explain the concept of various forms of renewable energy
4. Outline division aspects and utilization of renewable energy sources for both domestics and industrial application
5. Analyze the environmental aspects of renewable energy resources.

UNIT – I Principles of Solar Radiation: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power - Physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, Solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT – II Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.
Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications - solar heating/ cooling techniques, solar distillation and drying, Photovoltaic energy conversion.

UNIT – III Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics.
Bio-Mass: Principles of Bio-Conversion, Anaerobic /aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation, and economic aspects.

UNIT – IV Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.
OTEC : Principles, utilization, setting of OTEC plants, thermodynamic cycles.
Tidal and Wave Energy: Potential and conversion techniques, mini-hydel power plants, their economics.

UNIT –V Direct Energy Conversion: Need for DEC, Carnot cycle, limitations, Principles of DEC. Thermo-electric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principle, faraday's laws, thermodynamic aspects, selection of fuels and operating conditions.

Text Books:

1) Renewable Energy Sources / Twidell & Weir / Taylor and Francis / 2nd Special Indian Edition.
2) Non- conventional Energy Sources / G.D. Rai / Dhanpat Rai and Sons.

Reference Books:

2) Energy Resources Utilization and Technologies / Anjaneyulu & Francis / BS Publications/2012.
3) Principles of Solar Energy / Frank Krieth & John F Kreider / Hemisphere Publications.
4) Non-Conventional Energy / Ashok V Desai / Wiley Eastern.
5) Non-Conventional Energy Systems / K Mittal / Wheeler.
6) Renewable Energy Technologies / Ramesh & Kumar / Narosa.
7) Renewable Energy Resources / Tiwari and Ghosal / Narosa.

Outcomes of the course:

At the end of this course, the student will be able to:

1 Explain the working principle of solar energy& radiation.
2 Describe the working principle of wind energy and their classification.
3 Classify different types of Geo thermal energy sources and their principles.
4 Categorize the principles of biomass conversion and its applications.
5 Explain the principles and utilization of OTEC plants.
6 Analysis of Direct energy conversion and their effects.

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Professional Elective – IV

(R18MED4141) Computational Fluid Dynamics

Objective of the course:

1. Understanding the basic equations of fluid mechanics (Navier-Stokes equations)
2. Understanding the implementation of the equations in a CFD code
3. Choosing different models for flow simulations (turbulence models, etc.)
4. Critical evaluation of CFD-solutions
5. Applying CFD for the purposes of research and development

UNIT-I

Elementary details in numerical techniques: Number system and errors, representation of integers, fractions, floating point arithmetic, loss of significance and error propagation, condition for instability, computational methods for error estimation, convergence of sequences.

Applied Numerical Methods: Solution of a system of simultaneous Linear Algebraic Equations, iterative schemes of Matrix Inversion, Direct Methods for Matrix inversion, Direct Methods for banded matrices.

UNIT - II

Finite Difference Applications in Heat conduction and Convection – Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

Finite Differences, discretization, consistency, stability, and Fundamentals of fluid flow modeling: Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

UNIT - III

Introduction to first order wave equation; Stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme.

UNIT - IV

Review of Equations Governing Fluid Flow and Heat Transfer: Introduction, conservation of mass, Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier-stokes equations.

UNIT-V

Finite volume method: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, upwind interpolation, linear interpolation and quadratic interpolation.

TEXT BOOKS:

1) Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hema shava Publishers corporation & Mc Graw Hill.
2) Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications.

REFERENCES:

1) Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
2) Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
   Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis/Oxford University Press/2nd Edition.

Course Outcomes

1. To understand the basic concepts of Elementary details in numerical techniques, Applied Numerical Methods
2. To understand the basic concepts of Finite Difference Method and its Applications in Heat conduction and Convection
3. To know the Introduction to first order wave equation.
4. To know the basic Equations Governing Fluid Flow and Heat Transfer
5. To know the basic Equations in the Finite volume method
6. To understand the applications of CFD.

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B.Tech. - IV Year – I Semester

L	T	P	C
3	0	0	3

Professional Elective – IV
(R18MED4142) Turbo Machinery

Objectives:

1. To learn classification of turbomachines
2. To calculate energy transfer through a turbomachine
3. To understand energy transfer and losses in centrifugal compressors, axial fans and steam turbines

UNIT-I

Introduction to Turbomachines. Classification of Turbomachines. Second Law of Thermo dynamics - turbine/compressor work, Nozzle/diffuser work. Fluid equations - continuity, Euler's, Bernoulli's equation and its applications. Expansion and compression processes, Reheat Factor, Preheat Factor.

UNIT-II

Euler's Equation of Energy Transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje's slip factor. Suction pressure and net positive suction head. Phenomena of cavitation in pumps. Concept of specific speed, Shape number. Axial, Radial and Mixed Flow Machines. Similarity laws.

UNIT–III

Flow through Axial flow fans. Principles of Axial fan and propeller. Application of fans for air circulation and ventilation. Stage pressure rise and work done. Slip stream and Blade Element theory for propellers. Performance and characteristics of Axial fans.

UNIT-IV

Flow through Centrifugal compressors. Stage velocity triangles, specific work. forward, radial and backward swept vanes. Enthalpy entropy diagram, degree of reaction, slip factor, efficiency. Vane less and vaned diffuser systems, volute as spiral casing. Surge and stall in compressors

UNIT-V

Axial turbine stages, stage velocity triangles, work, efficiency, blade loading, flow coefficient. Single stage impulse and reaction turbines, degree of reaction, 50% reaction turbine stage, Radial equilibrium and Actuator disc approach for design of turbine blades. Partial admission problems in turbines. Losses in turbo machines.

REFERENC BOOKS

1. S.M. Yahya, Turbines, Compreessors and Fans, Tata Mcgraw Hill.
2. Gopalakrishnan G, Prithvi Raj D, "A treatise on Turbomachines", Scitec Publications, Chennai, 2002.
3. Sheppard, Principles of Turbomachinery.
4. R.K.Turton, Principles of Turbomachinery, E & F N Spon Publishers, London & New York.
5. Balajee, Designing of Turbomachines.

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B.Tech. - IV Year – I Semester

L	T	P	C
3	0	0	3

Professional Elective – IV
(R18MED4143) Fluid Power Systems

OBJECTIVES

To familiarize the students with
1. The fundamentals of fluid power
2. Principles and characteristics of the fluid power components
3. Circuit building and interpretation
4. Logic controls and trouble shooting

UNIT I : HYDRAULIC COMPONENTS

Introduction to fluid power system-Pascal's Law-Hydraulic fluids-Hydraulic pumps-Gear, Vane and Piston pumps-Pump Performance-Characteristics and Selection-actuators-valves-pressure control-flow control and direction control valves-Hydraulic accessories-Hydraulic Accumulator.

UNIT II : PNEUMATIC COMPONENTS

Introduction to Pneumatics-Compressors-types-Air treatment-FRL unit-Air dryer-Control valves-Logic valves-Time delay valve and quick exhaust valve-Pneumatic Sensors–types-characteristics and applications.

UNIT III : FLUID POWER CIRCUITS

Circuit Design Methodology-Sequencing circuits-Overlapping signals-Cascade method-KV Map method-Industrial Hydraulic circuits-Double pump circuits-Speed control Circuits-Regenerative circuits-Safety circuits-Synchronizing circuits-Accumulator circuits.

UNIT IV : ELECTRO - PNUEMATICS AND HYDRAULICS

Relay, Switches-Solenoid-Solenoid operated valves-Timer-Counter-Servo and proportional control-Microcontroller and PLC based control-Design of electro-pneumatic and hydraulic circuits.

UNIT V : APPLICATION, MAINTENANCE AND TROUBLE SHOOTING

Development of hydraulic / pneumatic circuits applied to machine tools-Presses-Material handling systems-Automotive systems-Packaging industries-Manufacturing automation-Maintenance and trouble shooting of Fluid Power circuits-Safety aspects involved.

TEXT BOOKS

1. Anthony "Esposito, Fluid Power with applications", Prentice Hall international–1997.
2. Majumdar.S.R, "Oil Hydraulics", Tata McGraw Hill, 2002.
3. Majumdar S.R, "Pneumatic systems-principles and maintenance", Tata McGraw Hill 1995.
4. Werner Deppert, "Kurt Stoll, Pneumatic Application", Vogel verlag–1986.

REFERENCES

1. John Pippenger, Tyler "Hicks, Industrial Hydraulics", McGraw Hill International Edition, 1980.
2. Andrew Parr, "Hydraulics and pneumatics", Jaico Publishing House, 2003.
3. FESTO, "Fundamentals of Pneumatics", Vol I, II, III.

Course Outcomes

1. To understand the basic concepts of Introduction to fluid power system- Hydraulic Components
2. To know the basic working principles of Pneumatic Components
3. To know the basic working principles of Fluid power systems.
4. To understand the basic concepts of Electro - Pnuematics and Hydraulics
5. To understand the basic concepts of Application, Maintenance And Trouble Shooting
6. An ability to identify, formulate, and solve engineering problems

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B.Tech. - IV Year – I Semester		L	T	P	C
		0	0	2	1
(R18MED41L1) Technical Seminar					

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B.Tech. - IV Year – I Semester		L	T	P	C
		0	0	6	3
(R18MED41P2) Comprehensive Viva-voce					

SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY					
(An Autonomous Institution under UGC, New Delhi)					
B.Tech. - IV Year – I Semester		L	T	P	C
		0	0	0	2
(R18MED41P1) Industrial Oriented Mini Project/ Summer Internship					

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B.Tech. - IV Year – II Semester

L	T	P	C
3	0	0	3

Professional Elective – V
(R18MED4251) Industrial Robotics

Objectives:
1) To acquire the knowledge on advanced algebraic tools for the description of motion.
2) To develop the ability to analyze and design the motion for articulated systems.
3) To develop an ability to use software tools for analysis and design of robotic systems.

UNIT – I
Introduction**,** Automation and Robotics – An over view of Robotics – classification by coordinate system and control systems
Components of the Industrial Robotics: Degrees of freedom – End effectors: Mechanical gripper – Magnetic – Vacuum cup and other types of grippers – General consideration on gripper selection and design, Robot actuator and sensors.

UNIT – II
Motion Analysis: Basic rotation matrices – Composite rotation matrices – Euler Angles – Equivalent Angle and Axis – Homogeneous transformation – Problems.
Manipulator Kinematics: D-H notations - Joint coordinates and world coordinates - Forward and inverse kinematics – problems.

UNIT – III
Differential Kinematics: Differential Kinematics of planar and spherical manipulators - Jacobians – problems.
Robot Dynamics: Lagrange – Euler formulations – Newton-Euler formulations – Problems on planar two link manipulators.

UNIT IV
Trajectory Planning: Joint space scheme – cubic polynomial fit – Avoidance of obstacles –
Types of motion: Slew motion - joint interpolated motion – straight line motion – problems.
Robot actuators and Feed back components: Actuators: Pneumatic.

UNIT V
Robot Application in Manufacturing: Material handling - Assembly and Inspection – Work cell design, work volume, Robot screan.

TEXT BOOKS :
1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control / JJ Craig/ Pearson/ 3rd edition.

REFERENCES :
1. Robotics / Fu K S/ McGraw Hill.
2. Robotic Engineering / Richard D. Klaftez/ Prentice Hall.
3. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
4. Robot Dynamics & Control/Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pvt. Ltd.
5. Robotics and Control / Mittal R K & Nagrath I J / TMH.

Outcomes:
At the end of this course, the student will be able to:

1) Use matrix algebra for computing the kinematics of robots.
2) Calculate the forward kinematics and inverse kinematics of serial and parallel robots.
3) Calculate the Jacobian for serial and parallel robot.
4) Demonstrate the path planning for a robotic system.
5) Study of different numerical methods.
6) Describe the robot Application in manufacturing.

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B.Tech. - IV Year – II Semester

L	T	P	C
3	0	0	3

Professional Elective – V
(R18MED4252) Mechanical Vibrations

Course Objectives:

1. Fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions,
2. Be able to obtain linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF),
3. Be able to write the differential equation of motion of vibratory systems,
4. Be able to make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi degree of freedom linear systems.

UNIT- I:

Single Degree of Freedom Systems : Undamped and damped free vibrations; forced vibrations coulomb damping; Response to excitation; rotating unbalance and support excitation; vibration isolation and transmissibility- Response to Non Periodic Excitations: unit impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

UNIT- II:

Two Degree Freedom Systems: Principal modes- undamped and damped free and forced vibrations; undamped vibration absorbers;

UNIT-III:

Multi Degree Freedom Systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi- rotor systems and geared systems; Discrete-Time systems.

Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

UNIT- IV:

Frequency Domain Vibration Analysis: Over view, machine-train monitoring parameters-Data base development-vibration data acquisition-trending analysis-failure- node analysis-signature analysis-root cause analysis.

UNIT V:

Numerical Methods: Raleigh's stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

TEXT BOOKS:

1. Mechanical Vibrations/Groover/Nem Chand and Bros.
2. Elements of Vibration Analysis / Meirovitch/ TMH, 2001.

REFERENCE BOOKS:

1. Mechanical Vibrations/VP Singh/Danapathi Rai & Sons.
2. Mechanical Vibrations/ SS Rao/ Pearson, 2009/4th Edition.
3. Mechanical Vibrations/Debabrata Nag/Wiley.
4. Vibration problems in Engineering / S.P. Timoshenko.
5. Mechanical Vibrations and sound engineering/ A.G.Ambekar/ PHI.
6. Theory and Practice of Mechanical Vibrations/JS Rao & K. Gupta/ New Age Intl. Publishers/Revised 2nd Edition

Course Outcomes:

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

1. Understand the causes and effects of vibration in mechanical systems and Single ,Two and Multi degrees of freedom
2. Develop schematic models for physical systems and formulate governing equations of motion.
3. Understand the role of damping, stiffness and inertia in mechanical systems
4. Analyze rotating and reciprocating systems and compute critical speeds.
5. Analyze and design machine supporting structures, Frequency domain vibration analysis
6. To understand the basic numerical methods

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B.Tech. - IV Year – II Semester

L	T	P	C
3	0	0	3

Professional Elective – V
(R18MED4253) Composite Materials

Course Objectives :
1. Ability to solve mechanics of composite materials problems using classical methods
2. Ability to do research and present on an advanced material topic

UNIT-I

Introduction to Composite Materials: Introduction ,Classification Polymer Matrix Composites, Metal Matrix Composites, Ceramic Matrix Composites, Carbon–Carbon Composites, Fiber-Reinforced Composites and nature-made composites, and applications .

UNIT-II

Reinforcements: Fibers- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibers. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT-III

Macro Mechanical Analysis of a Lamina: Introduction, Definitions Stress, Strain, Elastic Moduli, Strain Energy. Hooke's Law for Different Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

UNIT-IV

Macro Mechanical Analysis of Laminates: Introduction , Laminate Code , Stress–Strain Relations for a Laminate, In-Plane and Flexural Modulus.

UNIT-V

Failure Analysis of Laminates: Introduction, Special Cases of Laminates, Applications, Failure Criterion for a Laminate.

TEXT BOOKS:

1. Mechanics of Composite Materials/ R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials/Isaac and M Daniel/ Oxford University Press, 1994.

REFERENCES:

1. Analysis and performance of fibre Composites/ B. D. Agarwal and L. J. Broutman/ Wiley- Inter science, New York, 1980.
2. Mechanics of Composite Materials/ Second Edition (Mechanical Engineering)/ Autar K. Kaw/Publisher: CRC.

3. Analysis of Laminated Composite Structures/ L. R. Calcote/ Van Nostrand Rainfold, New York, 1969.
4. Advanced Mechanics of Composite Materials/ Vasiliev &Morozov/ Elsevier/Second Edition

Course Outcomes

1. Some understanding of types, manufacturing processes, and applications of composite materials
2. Ability to analyze problems on macromechanical behavior of lamina
3. Ability to analyze problems on micromechanical behavior of lamina
4. Ability to analyze problems on macromechanical behavior of laminate
5. Ability to analyze problems on bending, buckling, and vibration of laminated plates and beams
6. Ability to understand the failure behavior of laminates

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B.Tech. - IV Year – II Semester

L	T	P	C
3	0	0	3

Professional Elective – VI

(R18MED4261) Industrial Management

Objectives:
This course is intended to familiarise the students with the framework for the managers and leaders available for understanding and making decisions relating to issues related organisational structure, production operations, marketing, Human resource Management, product management and strategy.

UNIT I:
Introduction to Management: Entrepreneurship and organization - Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

UNIT II:
Designing Organizational Structures: Departmentation and Decentralization, Types of Organization structures - Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT III:
Operations Management: Objectives- product design process- Process selection-Types of production system(Job, batch and Mass Production),-Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts-Design of product layout- Line balancing(RPW method)
Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

UNIT IV:
Work Study: Introduction – definition – objectives – steps in work study – Method study –definition – objectives – steps of method study. Work Measurement – purpose – types of study – stop watch methods – steps – key rating – allowances – standard time calculations – work sampling.
Statistical Quality Control: variables-attributes, Shewart control charts for variables- $\bar{x}$ chart, R chart, - Attributes-Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

UNIT V:
Job Evaluation : methods of job evaluation – simple routing objective systems – classification method – factor comparison method – point method – benefits of job evaluation and limitations.
Project Management (PERT/CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

TEXT BOOKS:

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.
2. Industrial Engineering and Management Science/T.R. Banga and S.C.Sarma/Khanna Publishers.

REFERENCE BOOKS:

1. Motion and Time Study by Ralph M Barnes/ John Willey & SonsWork Study by ILO.
2. Human factors in Engineering & Design/Ernest J McCormick / TMH.
3. Production & Operation Management /Paneer Selvam /PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Hand Book /Maynard.
6. Industrial Engineering Management / RaviShankar/ Galgotia.

Course Outcome

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

1. List, justify and interpret productivity models in manufacturing and service organization.
2. Judge product development and industrial process design.
3. Predict facility location and network models.
4. Interpret and solve data from aggregate output planning models. Knowledge of human factors in engineering and various jobs designs.
5. Select and analyze an inventory control model based upon given data. Understanding of manufacturing resource and just-in-time planning.
6. Predict and control the quality of an end product.
7. Design and model industrial systems using linear and non-linear programming approaches.
8. To understand the methods of job evaluation, project management by using CPM and PERT.

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B.Tech. - IV Year – II Semester

L	T	P	C
3	0	0	3

Professional Elective – VI
(R18MED4262) Production Operation and Management

Course Objective:
To understand the concepts of production and operations management in an organization and analytical methods.

UNIT -I
Introduction: Overview & Definition of production and operations management. Nature and Scope of Production and Operations Management Historical Evolution –Role & responsibilities of the production manager. Types of manufacturing processes and Product Design.

UNIT -II
Production Planning and Control: Stages in PPC – Gantt – PPC in Mass, Batch, and Job Order Manufacturing- Aggregate planning and Master Scheduling, MRP, CRP. Maintenance management & Industrial Safety. Plant Location & Layout Planning- Factors influencing location - types of layouts. Capacity Planning – Optimal Production Strategies: Scheduling and Sequencing of Operations. Work Design: Method Study and Work Measurement - Work Sampling.

UNIT -III
Managing of Work Environment –Automation —Technology Management - Waste Management. Quality Assurance and Quality Circles – Statistical Quality Control –Control Charts for Variables- Average, Range and Control charts for Attributes. Acceptance Sampling Plans. Purchase functions and Procedure - Inventory control – Types of Inventory– Safety stock – Inventory Control Systems –JIT, VMI.

UNIT –IV
Basic concepts of quality, dimensions of quality, Juran's quality trilogy, Deming's 14 principles, Quality improvement and cost reduction, ISO 9000- 2000 clauses & coverage. Six Sigma, Productivity –factors affecting productivity, measurement & improvements in productivity - new product development and design - stages & techniques. Total Productive Maintenance (TPM).

UNIT -V
Stores Management: Objectives of Stores Management – Requirements for efficient. Management of Stores – safety stock Inventory Control - Different Systems of Inventory Control, Costs & Types of Inventory. – ABC, VED and FNSD analyses. Value Analysis– importance in cost reduction – concepts and procedures. Relevant cases have to be discussed in each unit and in examination case is compulsory from any unit.

REFERENCES
1. Panner Selvem: "Production and Operation Management", Prentice Hall of India, NewDelhi, 2012.
2. K.Aswathappa, K. Shridhara: "Production & Operation Management", Himalaya Publishing House, New Delhi, 2012

3. Ajay K Garg: “Production and Operation Management”, TMH, New Delhi,2012
4. Deepak Kumar Battacharya: “Production & Operation Management”, University Press, New Delhi, 2012
5. AlanMuhlemann, JohnOakland,jasti Katyayani: “Production and Operation Management”, Pearson, New Delhi,2013
7. Gagan Deep & Mandeep : “Production and operations Management”, Kalyani publishers, New Delhi, 2010
8. Upendra Kachru: “Production and Operations Management”, Excel Books, New Delhi, 2013.
9. L.C. Jhamb: “Production and Operations Management”, Everest Publishing House, New Delhi, 2013.
10. Kaushal: “Case Studies solutions in Production and Operations Management”, MacMillan, New Delhi, 2012.
11. P.Ram Murthy: “Production and Operations Management”, New Age International Publishers, New Delhi, 2009.

Course Outcome:

Students will be able to understand

1. Concepts of production Operation and management,
2. Production planning and Control
3. Managing of Work Environment –Automation —Technology Management - Waste Management
4. Product & process design, analysis,
5. Basic concepts of quality, dimensions of quality
6. Scheduling and materials management

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L	T	P	C
3	0	0	3

Professional Elective – VI
(R18MED4263) Tribology

(Course Objective: To get knowledge on lubrication system, frictional aspects and other tribological matters pertaining to industrial applications)

- To get knowledge on lubrication system, frictional aspects and other tribological matters pertaining to industrial applications.
- To study the fundamental concepts of viscosity and different viscometers
- To study and learn about hydrostatic lubrication system
- To understand and learn the concepts of hydrodynamic theory of lubrication
- To understand the mechanism and causes of friction and power losses in journal bearings
- To study and learn about importance of air lubricated bearings
- To study and learn about the various types of bearing materials and bearing oil

UNIT – I

(Learning Objective: To study the fundamental concepts of viscosity and different viscometers) **Study of various parameters**: Viscosity, flow of fluids, viscosity and its variation -absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers used.

UNIT – II

(Learning Objective: To study and learn about hydrostatic lubrication system) **Hydrostatic lubrication:** Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

UNIT – III

(Learning Objective: To understand and learn the concepts of hydrodynamic theory of lubrication) Hydrodynamic theory of lubrication: Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions -Effects of side leakage – Reynolds equation in three dimensions, Friction in sliding bearing, hydro dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti -friction bearing.

UNIT – IV

(Learning Objective: To understand the mechanism and causes of friction and power losses in journal bearings)

Friction and Power Losses in Journal Bearings and its Applications: Calibration of friction loss friction in concentric bearings, bearing moduIus, Sommerfield number, heat balance, practical consideration of journal bearing considerations. Study of current concepts of boundary friction and dry friction.

UNIT – V

(Learning Objective: To study and learn about importance of air lubricated bearings) **Air lubricated bearing:** Advantages and disadvantages application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect.

(Learning Objective: To study and learn about the various types of bearing materials and bearing oil pads)

Types of bearing materials and bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings. General requirements of bearing materials, types of bearing materials.

TEXT BOOK

- Fundamentals of Tribology, Basu, SenGupta and Ahuja/PHI
- Tribology in Industry: Sushil Kumar Srivatsava, S. Chand &Co.

REFERENCE

- Tribology – B.C. Majumdar

Course Outcomes

1. Describe the viscosity and laws of fluid flow with reference to lubrication
2. Analyze mathematical approach of hydrodynamic and hydrostatic lubrication
3. Describe the concept of idealized journal bearing and slider bearing under different load carrying conditions
4. Describe the oil flow through bearings lubricated under pressure and thermal equilibrium
5. Explain different bearing materials with their properties and list the advantages and disadvantages
6. Illustrate the behavior of tribological components subjected to different working conditions and describe different tribological measures

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B.Tech. - IV Year – II Semester		L	T	P	C
		0	0	14	7
(R18ECE42P1) Project Work					

LIST OF OPEN ELECTIVES

Open Elective – I

S. No.	Course Code	Course Title	L	T	P	Credits
1	R18CIV3271	Disaster Management & Mitigation	3	0	0	3
2	R18CSE3272	Database Concepts				
3	R18ECE3273	Consumer Electronics				
4	R18EEE3274	Electrical Estimation & Costing				
5	R18INF3275	Information Technology Essentials				
6	R18MED3276	Introduction to Robotics				
7	R18HMS3277	Fundamentals of Entrepreneurship				
8	R18HMS3278	Day to Day Biology				

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B.Tech. - III Year – II Semester	OPEN ELECTIVE- I	L	T	P	C
		3	0	0	3

(R18CIV3271) Disaster Management & Mitigation

The objective of this course is to provide an understanding of basic concepts of various disasters and its management. In addition, the course is expected to develop scientific temperament and mitigation techniques to manage disaster.

1. To understand basic concepts of disaster and hazards if India.
2. To study the various natural disasters.
3. To study the various manmade disasters.
4. To understand the disaster management principles.
5. To study the modern techniques used in disaster mitigation and management.

UNIT I - Introduction To Disaster - Meaning, Nature, Importance of Hazard, Risk, Vulnerability and DisasterDimensions & Scope of Disaster Management - India's Key Hazards – Vulnerabilities - National disaster management framework - Disaster Management Cycle.

UNIT II - Natural Disaster - Natural Disasters- Meaning and nature of natural disaster; their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.

UNIT III - Anthropogenic Disaster - Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation and industrial waste water pollution.

UNIT IV - Approaches in Disaster Management - Pre- disaster stage (preparedness) - Preparing hazard zonation maps, Predictability/ forecasting & warning - Preparing disaster preparedness plan Land use zoning - Preparedness through Information, education. Emergency Stage - Rescue training for search & operation - Immediate relief - Assessment surveys. Post Disaster stage – Rehabilitation - Social Aspect - Economic Aspect and Environmental Aspect.

UNIT V - Disaster Mitigation - Meteorological observatory - Seismological observatory - Hydrology Laboratory and Industrial Safety inspectorate.Technology in Disaster Management Emergency Management Systems (EMS) in the Disaster Management Cycle Remote Sensing and Geographic Information Systems(GIS) in Disaster Management.

TEXT BOOK

1. Sharma.S.R, "Disaster management", A P H Publishers, 2011.

REFERENCES

6. VenuGopalRao.K, "Geoinformatics for Disaster Management", Manglam Publishers and Distributors, 2010.
7. Singh.R.B, "Natural Hazards and Disaster Management: Vulnerability and Mitigation", Rawat Publications, 2006.
8. Gupta.H.K, "Disaster Management", University Press, India, 2003.
9. Gupta.M.C, "Manuals on Natural Disaster management in India", National Centre for Disaster Management,IIPA, New Delhi, 2001.

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B.Tech. - III Year – II Semester	OPEN ELECTIVE- I	L	T	P	C
		3	0	0	3

(R18CSE3272) Database Concepts

To study the concepts of Relational Database design and query languages

1. To provide a general introduction to relational model
2. To learn about ER diagrams
3. To learn about Query processing and Transaction Processing

UNIT I: **Introduction to Database Management** - Introduction to Database Management systems – History - Characteristics – Users- three-level architecture- Entity-- relationship data model.

UNIT II: The Relational Data Model and Relational Algebra - Data structures – Mapping E-R Model to Relational model – data manipulation – integrity – advantages – rules for fully relational systems – relational algebra – relational algebra queries.

UNIT III: Structured Query Language and Normalization - SQL – Data definition – manipulation – views SQL in procedural programming – data integrity and constraints – triggers – data control – database security.Normalization – Undesirable properties – single-valued normalization – desirable properties of decompositions – multivalued dependencies

UNIT IV: Storage Indexing and Transactions Management - Different types of memories – secondary storage – buffer management – file structures – heap files – sorted files – index and types – indexed sequential file – B-tree – B+ tree.Transaction management – concepts – examples – schedules – serializability – concurrency control – deadlocks – lock and multiple granularity – nonlocking techniques.

UNIT V: Database Backup, Recovery and Security - Database system failure – backup – recovery and concept of log – log-based recovery techniques – types of recovery – log-based immediate update recovery technique. Database Security – violations – identifications and authentication – authorization / access control – security of statistical databases – audit policy – internet applications and encryption.

TEXT BOOK

1. Gupta.G.K, “Database Management Systems”, Tata McGraw Hill, 2011.

REFERENCES

1. Silberschatz, Korth.H and Sudarshan.S, “Database System Concepts”, 6th Edition, McGraw-HillInternational, 2011.
2. Hector Garcia-Molina, Jeffrey D.Ullman, Jennifer Widom, “Database System The Complete Book, 1st Edition, Pearson 2002.
3. RamezElmasri and ShamkantB.Navathe, “Fundamentals of Database Systems”, Fifth Edition, Pearson, 2008.

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B.Tech. - III Year – II Semester	OPEN ELECTIVE- I	L	T	P	C
		3	0	0	3

(R18ECE3273) Consumer Electronics

Course Objectives:

- Students are able to understand consumer electronics fundamentals, microprocessors and microcontrollers, energy management and intelligent building perspective. Audio systems, Display systems, video systems and recording systems
- Student is able to demonstrate smart Home, Home Virtual Assistants, Home security systems and types of sensors RFID Home , kitchen electronics and smart alarms, smart toilet, smart floor and smart locks
- Students are able to discuss cordless telephones, Fax machines PDA's TABLETs Smart phones and Smart watches. Video conferencing systems, Internet enabled systems, Wi-Fi, Li-Fi, GPS and Tracking systems

UNIT I:**Consumer Electronics Fundamentals** - History of Electronic Devices- Vacuum Tubes, Transistors, Integrated Circuits- Moorse Law, Semiconductor Devices, Diodes, Rectifiers, Transistors, Logic Gates, Combinational Circuits, ADC, DAC and Microprocessors, Microprocessor Vs Microcontrollers, Microcontrollers in consumer electronics, Energy management, Intelligent Building Perspective.

UNIT II: Entertainment Electronics - Audio systems: Construction and working principle of : Microphone, Loud speaker, AM and FM receiver, stereo, 2.1 home theatre, 5.1 home theatre . Display systems: CRT, LCD, LED and Graphics displays Video Players : DVD and Blue RAY. Recording Systems: Digital Cameras and Camcorders.

UNIT III: Smart Home - Technology involved in Smart home, Home Virtual Assistants- Alexa and Google Home. Home Security Systems - Intruder Detection, Automated blinds, Motion Sensors, Thermal Sensors and Image Sensors, PIR, IR and Water Level Sensors.

UNIT IV: **Home Appliances** - Home Enablement Systems: RFID Home, Lighting control, Automatic Cleaning Robots, Washing Machines, Kitchen Electronics- Microwave, Dishwasher, Induction Stoves, Smart Refrigerators, Smart alarms, Smart toilet, Smart floor, Smart locks.

UNIT V: **Communication Systems** - Cordless Telephones, Fax Machines, PDAs- Tablets, Smart Phones and Smart Watches. Introduction to Smart OS- Android and iOS. Video Conferencing Systems- Web/IP Camera, Video security, Internet Enabled Systems, Wi-Fi, IoT, Li-Fi, GPS and Tracking Systems.

TEXT BOOKS:

1. Thomas L Floyd "Electronic Devices" 10th Edition Pearson Education Asia 2018.
2. Philp Hoff "Consumer Electronics for Engineers" - Cambridge University Press.1998.
3. Jordan Frith, " Smartphones as Locative Media ", Wiley. 2014.
4. Dennis C Brewer, " Home Automation", Que Publishing 2013.
5. Thomas M. Coughlin, "Digital Storage in Consumer Electronics", Elsevier and Newness 2012.

Course Outcomes:

C325.1. summarize the consumer electronics fundamentals and explain about microprocessors and microcontrollers, energy management and intelligent building perspective (K2-Understand)

C325.2. Demonstrate Audio systems, Display systems, video systems and recording systems (K3-Apply)

C325.3. Describe the smart Home, Home Virtual Assistants, Home security systems and Different types of sensors (K2-Understand)

C325.4. Outline the home enablement systems like RFID Home, kitchen electronics and smart alarms, smart toilet, smart floor and smart locks. (K4-Analyse)

C325.5. Discuss cordless telephones, Fax machines PDA's TABLETs Smart phones and Smart watches.

C325.6. Compare and explain Android and iOS and demonstrate Video conferencing systems, Internet enabled systems, Wi-Fi, Li-Fi, GPS and Tracking systems. (K5-Evaluate)

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B.Tech. - III Year – II Semester	OPEN ELECTIVE- I	L	T	P	C
		3	0	0	3

(R18EEE3274) Electrical Estimation & Costing

Unit I: Electrical Symbols and Diagrams: (i) Need of symbols; List of symbols for electrical equipment and accessories used in electrical works. Light, fan and power circuits, alarm and indicating circuit, contactor control circuits as per I.S.S. (ii) Type of diagrams - Wiring diagrams (multiple and single line representation) and schematic diagrams as per I.S.S. (* One Drawing Sheet for at least - 50 symbols).

Wiring materials and accessories: (1) Brief description, general specifications (as per I.S.S.) and approximate cost of different types of wires, cables, switches, distribution board, switch board, boxes, batten and its accessories, conduit and its accessories, lamp holders, socket out lets, plug ceiling roses. Fuse and energy meter used in domestic and power wiring installations.

Unit II: Light and Fan Circuits: Schematic and wiring diagrams (multiline and single line both) using junction boxes and looping systems for the following types of circuits:- (i) Light and fan controlled by necessary switches and regulators. (ii) Stair case wiring (iii) Corridor lighting (iv) One lamp controlled by three or more switches.

Unit III: Principles of Estimating and Costing: Purpose of estimating and costing, essentials of estimating and costing-market survey, price list and net prices, preparation of list of materials, calculation of material and labor cost, contingencies, overhead charges, profit and total cost. Estimation of Domestic Internal Wiring Circuits: (i) Description of various wiring systems and methods. (ii) Need of earthing and point to be earthed in internal wiring system as per IE rules. (iii) I.S. specifications, calculation of No. of points (light, fan, socket outlet), calculation of total load including domestic power, determination of no. of circuits, size of wires and cables, switches and main switch, distribution board and switch board, batten conduit and other wiring accessories.

Unit IV: Estimation of Power Wiring: I.S. specifications and I.E. rules, calculation of current for single and three phase motors. Determination of sizes of cables, conductors distribution board, main switches and starters for power circuits. Cost of equipment and accessories and schedule of materials. Estimation and cost of material and work for motors up to 20 H.P., pump sets and small workshops.

Unit V: Estimation of Overhead and Underground Distribution Lines: Main components of overhead lines-line supports, cross-arm, clamps, conductors and stay sets, lightening arrestors, danger plates, ant climbing devices, bird guards, jumpers etc., concreting of poles, earthing of transmission line, formation of lines, specification of materials for O.H. lines, I.S. specification and I.E. rules. Cost of material and work for overhead and underground lines upto 11 KV only.

Estimation of Small Sub-Station: Main equipment and auxiliaries installed on the substation. Estimation of materials required for a small distribution substation (indoor and outdoor type platform and pole mounted). Costing of material and work of above substations.

Text Books:

1. S.K Bhattacharya, “Electrical Engineering Drawing & Design Estimating”.Wiley Eastern Ltd. New Delhi.
2. Surjeet Singh, “Electrical Eesign& Drawing” S.K.Kataria& Sons New Delhi.

Reference Books:

1. O. P. Soni,” Electrical Engg. Design & Drawing” SatyaPrakashan Delhi.

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B.Tech. - III Year – II Semester	OPEN ELECTIVE- I	L	T	P	C
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(R18INF3275) Information Technology Essentials

COURSE OBJECTIVES:

- To introduce the principles required for building web applications.
- To provide working knowledge of the technologies needed for web application development
- To know about scripting languages.
- To understand principles of database access and storage.
- To understand various applications related to Information Technology.

COURSE OUTCOMES: Student will be able to

- Design and deploy web-sites
- Design and deploy simple web-applications
- Create simple database applications
- Develop an information system
- Describe the basics of networking

UNIT I: Web Essentials - Creating a Website - Working principle of a Website - Browser fundamentals - Authoring tools - Types of servers: Application Server - Web Server - Database Server – HTML basics – HTML tags and their use

UNIT II: Scripting Essentials - Need for Scripting languages - Types of scripting languages - Client side scripting - Server side scripting - PHP - Working principle of PHP - PHP Variables - Constants - Operators – Flow Control and Looping - Arrays - Strings - Functions - File Handling - PHP and HTML - Cookies – Sessions - Authentication – Introduction to JavaScript

UNIT III: Database Essentials - Database management - Database terms - MySQL - commands – Data types – Indexes – Functions – Accessing MySQL using PHP.

UNIT IV: Networking Essentials - Fundamental computer network concepts - Types of computer networks - - Network layers - TCP/IP model - Wireless Local Area Network - Ethernet - WiFi - Network Routing - Switching - Network components

UNIT V: Application Essentials - Creation of simple interactive applications - Simple database applications - Multimedia applications - Design and development of information systems – Personal Information System – Information retrieval system – Social networking applications

TEXT BOOKS:

1. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition, O'REILLY, 2014.
2. James F. Kurose, “Computer Networking: A Top-Down Approach”, Sixth Edition, Pearson, 2012.

REFERENCES:

1. GottapuSasibhushanaRao, "Mobile Cellular Communication", Pearson, 2012.
2. R. Kelly Rainer , Casey G. Cegielski , Brad Prince, Introduction to Information Systems, Fifth Edition, Wiley Publication, 2014. 3. it-ebooks.org

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B.Tech. - III Year – II Semester	OPEN ELECTIVE- I	L	T	P	C
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(R18MED3276) Introduction to Robotics

COURSE OBJECTIVE:To impart knowledge about the basics of robot components and applications.

COURSE OUTCOMES:

1. Basics of Robot anatomy
2. Working of end effectors and drive systems
3. Kinematics and transformation analysis of robot
4. Various types of robot sensors
5. Robot cell design and applications of robot

UNIT I: Robot Basics - Robot-Basic concepts, Need, Law, History, Anatomy, specification. Robot configurations-Cartesian, cylinder, polar and articulate.Robot wrist mechanism, Precision and accuracy of robot-simple problems.

UNIT II: Robot Elements - End effectors-Classification, Types of Mechanical actuation, Gripper force analysis, Gripper design, Robot drive system-Types, Position and velocity feedback devices-Robot joints and links-Types, Motion interpolation.

UNIT III: **Robot Kinematics** - Robot kinematics – Direct and inverse kinematics – 2 and 3 DOF of kinematics analysis-Robot trajectories – Control of robot manipulators – Point to point, Contouring motion- 2D and 3D Transformation-Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation-Simple problems.

UNIT IV: Robot Sensors - Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors

UNIT V: **Robot Cell Design And Applications** - Robot work cell design and control – Safety measures in Robot – Robot cell layouts – Multiple robots and machine interference – Robot cycle time analysis – Industrial applications of robots, Nanorobots, Robot programming-Basic program.

TEXT BOOKS:

1. Deb.S.R, "Robotics Technology and Flexible Automation", Tata McGraw – Hill Publishing Company Limited, 2010.
2. Mikell. P. Groover, 'Industrial Robotics Technology', Programming and Applications, McGraw Hill Co, 2008.

REFERENCES:

1. Klafter.R.D, Chmielewski.T.A, and Noggin's., "Robot Engineering : An Integrated Approac"', Prentice Hall of India Pvt. Ltd.,1994.
2. Fu.K.S, Gonzalez.R.C&Lee.C.S.G, "Robotics control, sensing, vision and intelligence", McGraw Hill Book co, 1987
3. Craig.J.J, "Introduction to Robotics mechanics and control", AddisonWesley, 1999.
4. Ray Asfahl.C, "Robots and Manufacturing Automation", John Wiley & Sons Inc., 1985.
5. Kozyrey, Yu. "Industrial Robotics", MIR Publishers Moscow, 1985.

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		3	0	0	3

(R18HMS3277) Fundamentals of Entrepreneurship

COURSE OBJECTIVES: To create awareness on entrepreneurship among engineering students and stimulating self-motivation to start up enterprise

COURSE OUTCOMES:

1. To provide awareness about entrepreneurship
2. To develop idea generation, creative and innovative skills
3. To self-motivate the students by making aware of different opportunities and successful growth stories
4. To learn how to start an enterprise and design business plans those are suitable for funding by considering all dimensions of business.
5. To understand entrepreneurial process by way of studying different case studies and find exceptions to the process model of entrepreneurship.
6. To run a small enterprise with small capital for a short period and experience the science and art of doing business.

UNIT I: **Introduction to Entrepreneurship** - Understanding the Meaning of Entrepreneur; Characteristics and Qualities of an Entrepreneur; Entrepreneurs VsIntrapreneurs and Managers; Classification of Entrepreneurs; Factors Influencing Entrepreneurship; Entrepreneurial Environment; Entrepreneurial Growth; Problems and Challenges of Entrepreneurs; Entrepreneurial Scenario in India.

UNIT II: **Micro, Small and Medium Enterprises** (MSMEs) - MSMEs – Definition and Significance in Indian Economy; MSME Schemes, Challenges and Difficulties in availing MSME Schemes, Forms of Business; Women Entrepreneurship; Rural Entrepreneurship; Family Business and First Generation Entrepreneurs.

UNIT III: Idea Generation and Feasibility Analysis - Idea Generation; Creativity and Innovation; Identification of Business Opportunities; Market Entry Strategies; Marketing Feasibility; Financial Feasibilities; Political Feasibilities; Economic Feasibility; Social and Legal Feasibilities; Technical Feasibilities; Managerial Feasibility, Location and Other Utilities Feasibilities.

UNIT IV: **Business Model and Plan in Respective Industry** - Business model – Meaning, designing, analyzing and improvising; Business Plan – Meaning, Scope and Need; Financial, Marketing, Human Resource and Production/Service Plan; Business plan Formats; Project report preparation and presentation; Why some Business Plan fails?

UNIT V: **Financing and How to Start up Business?** - Financial opportunity identification; Banking sources; Non-banking Institutions and Agencies; Venture Capital – Meaning and Role in Entrepreneurship; Government Schemes for funding business; Pre launch, Launch and Post launch requirements; Procedure for getting License and Registration; Challenges and Difficulties in Starting an Enterprise.

TEXT BOOKS :

1. Jayshree Suresh, “Entrepreneurial Development”, Margham Publishers, Chennai, 2011.
2. Poornima M Charantimath, “Entrepreneurship development small business enterprises”, Pearson, 2013.

REFERENCES:

1. Raj Shankar, “Entrepreneurship: Theory And Practice”, Vijay Nicole imprints ltd in

collaboration with Tata Mc-graw Hill Publishing Co.ltd.-new Delhi, 2012
2. Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, "Entrepreneurship", 8th Edition, Tata Mc-graw Hill Publishing Co.ltd.-new Delhi, 2012
3. Martin Roger, "The Design of Business", Harvard Business Publishing, 2009
4. Roy Rajiv, "Entrepreneurship", Oxford University Press, 2011
5. Drucker.F, Peter, "Innovation and Entrepreneurship", Harper business, 2006.

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B.Tech. - III Year – II Semester	OPEN ELECTIVE - I	L	T	P	C
		3	0	0	3

(R18HMS3278) Day to Day Biology

COURSE OBJECTIVE: The purpose of this study is to know and understand the involvement of biology in day-to-day life. This would give insight into his or herown biological system, the diseases and disorders, antibiotics, and importance of environment in human life. This also provides application of biology in day to day life.

COURSE OBJECTIVES:

1. The student can understand the biology of human system and health.
2. This provides student with a scope for selection of healthy food and sustain environment.

UNIT I: Biology of Human Diseases and Disorders - Diabetes mellitus, communicable diseases, genetic disorders, vector borne diseases, antibiotics - mode of action.

UNIT II: **Biology for Human** - Blood pressure, immune system and immunity, cardiac infarction, in vitro fertilization, cord blood bank, stem cells.

UNIT III: **Biology of Cosmetics and Detergents** - Biology of complexion and texture, bioactive natural products in industrial use, bio surfactants, antioxidants.

UNIT IV: **Biology and Nutrition** - Dietary index, carbohydrates, proteins and fats, HDL and LDL, dairy products and application, herbal plants and home remedies.

UNIT V: **Biology and Environment** - Water pollution, air pollution, bioremediation, species biodiversity, global warming and greenhouse effect.

TEXT BOOKS:

1. Gareth J. Price, Biology: An Illustrated Guide to Science, Diagram Group, Infobase Publishing, 2006.
2. Pam Dodman, Real-Life Science Biology, Walch Publishing, 2008.

REFERENCES:

1. Biology:TheScience of Life, Stephen Nowicki, http://www.thegreatcourses.com/tgc/courses.
2. Neil Schlager, Science of everyday things: Real-Life Biology, Gale Publishing 2002.

Open Elective –II

S. No.	Course Code	Course Title	L	T	P	Credits
1	R18CIV4181	Green Building Engineering	3	0	0	3
2	R18CSE4182	Cyber Security Fundamentals				
3	R18ECE4183	Principles of Modern Communication Systems				
4	R18EEE4184	Illumination Engineering				
5	R18INF4185	E-Commerce				
6	R18MED4186	Industrial Design & Ergonomics				
7	R18HMS4187	Creative Writing				
8	R18HMS4188	Design Thinking				

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		3	0	0	3

(R18CIV4181) Green Building Engineering

Course Outcomes: On successful completion of this course the student will be able to:

1. Describe the concepts of Green building
2. Adopt Renewable energy for buildings.
3. Implement Automation techniques in buildings.
4. Describe Actuator techniques for Automation
5. Choose appropriate materials for Green buildings

UNIT 1 Concept of Green Buildings : Green building initiatives, its origin, characteristics of a green building, green buildings in India, certification of green buildings.Criteria for rating – sustainability. Depleting natural resources of building materials; renewable and recyclable resources; energy efficient materials; green cement, biodegradable materials, smart materials, engineering evaluation of these materials. Case study.

UNIT 2 Sources of Energy Renewable and non-renewable sources of energy ; coal, petroleum, nuclear, wind, solar, hydro, geothermal sources; potential of these sources, hazards, pollution; global scenario with reference to demand and supply in India. Energy arises. Carbon Emission: Forecasting, control of carbon emission, air quality and its monitoring carbon foot print; environmental issues, minimizing carbon emission.

UNIT 3 - **Intelligent Buildings** Intelligent buildings-Building automation-Smart buildings- Building services in high rise buildings-Green buildings-Energy efficient buildings for various zones-Case studies of residence, office buildings and other buildings in each zones. Case Study.

UNIT 4 Actuator Techniques Actuator and actuator materials – Piezoelectric and Electrostrictive Material – Magneto structure Material – Shape Memory Alloys – Electrorheological Fluids– Electromagnetic actuation – Role of actuators and Actuator Materials.

UNIT 5 Materials For "Green" Systems Green materials, including biomaterials, biopolymers, bioplastics, and composites Nanotech Materials for Truly Sustainable Construction: Windows, Skylights, and Lighting. Paints, Roofs, Walls, and Cooling.Multifunctional Gas Sensors, Biomimetic Sensors, Optical Interference Sensors Thermo-, light-, and stimulus-responsive smart materials.

TEXT BOOKS

1. Sustainable Construction , Charles J. Kibert.,Third Edition
2. Green Building A to Z, Jerry Yudelson.

REFERENCE BOOKS

1 Advanced Technology for Smart buildings,James Sinopoli

E BOOKS https://www.springer.com/in/book/9789811010002

https://www.elsevier.com/books/smart-buildings/casini/978-0-08-100635-1

MOOChttps://www.mooc-list.com/tags/green-building

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(R18CSE4182) Cyber Security Fundamentals

Course Objectives:

1. Understand the need for Cyber security and its related threats and attacks
2. Learn methods to become secure in the cyber world and securely communicate in the cyber world
3. Become knowledgeable about the best practices related to cyber security, regulations and laws associated with the same.

Course Outcomes:

The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context

UNIT I: Need for Cyber Security - Introduction to security- CIA triad-Case studies- security attacks-issues related to social networking - Guidelines

UNIT II: **Methods to Secureyourself in the Cyber World** - Why and What of Reversible and Irreversible Cryptographic mechanisms? Applications of Digital Signature - Good password practices

UNIT III: E-Commerce: Secure Transactions - What is E-commerce? – Online banking security-Online shopping fraudGuidelines and Recommendations

UNIT IV: EVERYDAY SECURITY - Connecting your laptop, mobile devices, PDAs to Internet-Managing your browser-Facebook Security-E-mail security – Safe guarding from Viruses: Antiviruses– Best practices and guidelines

UNIT V: CYBER SECURITY LAWS AND COMPETENT AUTHORITIES - Indian IT Act, 2008 - What is Cyber Forensics? – Functions of cybercrime cell – Responding to a cyber-attack

REFERENCES:

1. "Information Security Awareness Handbook, ISEA, Department of Electronics and Information Technology", Government of India, 2010
2. deity.gov.in/sites/upload_files/dit/.../itact2000/it_amendment_act2008.pdf
3. www.schneier.com/blog/archives/2013/03/browser_securit.html
4. www.dhses.ny.gov/ocs/awareness-training-events/news/2010-03.cfm
5. https://www.watsonhall.com/e-commerce-security/

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B.Tech. - IV Year – I Semester	OPEN ELECTIVE - II	L	T	P	C
		3	0	0	3

(R18ECE4183) Principles of Modern Communication Systems

Course Objectives:

This course aims at:

- Establishing a firm foundation for the understanding of telecommunication systems, and the relationship among various technical factors when such systems are designed and operated
- To provide the student with an understanding of the mobile Cellular communications and their evolution.
- To equip the students with various kinds of wireless networks and its operations.
- To provide students with solid foundation in orbital mechanics and launches for the satellite communication
- Radar fundamentals and analysis of the radar signals

UNIT I: The evolution of electronic communication: From smoke signals to smart phones - History of communications: Theoretical Foundations, Development & Applications - Frequencies for communication - Frequency regulations - Overview of communication transmitter and receiver.

UNIT II: Mobile Cellular Communications: Evolution to cellular networks – Cellular systems generations and standards: 1G, 2G, 3G, 4G - Cellular network components - Components of a mobile phone - setting up a call process - Making a call process - Receiving a call process - Spectrum allocation: Policies and strategies, Role of TRAI.

UNIT III: Wireless Communication: Introduction - Bluetooth - Infrared communication - IEEE Wireless LANs (Wi-Fi) - IEEE 802.16 (WiMaX) - Future mobile and wireless networks: Introduction to 5G- device to device communication- IoT.

UNIT IV: Satellite: History of Satellite communication, Basics of Satellites, Types of Satellites, Capacity Allocation - Launch Vehicles and Orbits: Introduction to launching vehicles, Important Orbits, working of rocket, Three Pioneers of Rocketry - Basics of Global Positioning System (GPS) - Applications of GPS.

UNIT V:RADAR& NAVIGATION: Introduction, Radar Block diagram and Operation, Radar Frequencies, Applications of Radar. Navigation Systems: Introduction & methods of navigation, Instrument Landing System, Microwave landing system- Modern Navigation systems.

REFERENCES:

1. S.Haykin, ―Communication Systems, 4/e, John Wiley 2007
2. B.P.Lathi, ―Modern Digital and Analog Communication Systems, 3/e, Oxford University Press,2007
3. Rappaport Theodore S - Wireless Communications: Principles and Practice, 2/E, Pearson
4. Education India, 2010 5. Vijay. K. Garg, ―Wireless Communication and Networking, Morgan Kaufmann Publishers, 2007.
5. T.Pratt, C. Bostian and J.Allnutt; ―Satellite Communications, John Wiley and Sons, Second Edition., 2003
6. M. I .Skolnik ―Introduction to Radar Systems, Tata McGraw Hill 2006.
7. Myron Kyton and W.R.Fried ―Avionics Navigation Systems, John Wiley & Sons 1997.

Course outcomes

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

C415.1. Differentiate various elements, processes, and parameters in communication systems, and describe their functions, effects, and interrelationship (K2-Understand).

C415.2. Interpret the mobile cellular concepts, standards and all generations of cellular systems. (K2-understand)

C415.3. Describe the existing and emerging wireless standards and Compare various wireless networks and their specifications. (K5-Evaluate)

C415.4. Demonstrate the history of Satellite communication, applications and orbit concepts, Placement of a Satellite in a Geo-Stationary orbit and GPS concept (K3- Apply)

C415.5 Summarize the radar fundamentals and analysis of the radar signals. (K4- Analyze)

C415.6 Explain the Navigation systems (K2-Understand).

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(R18EEE4184) Illumination Engineering

COURSE OBJECTIVES:

- To provide an introduction to the fundamentals of illumination engineering and architectural lighting design.
- To impart lighting fundamentals, measurement, and technology and their application in the analysis and design of architectural lighting systems

COURSE OUTCOME: The students will be able to:

i. Identify the criteria for the selection of lamps and lighting systems for an indoor or outdoor space
ii. Perform calculations on photometric performance of light sources and luminaires for lighting design
iii. Evaluate different types of lighting designs and applications

UNIT I: **Introduction of Light :** Types of illumination, Day lighting, Supplementary artificial lighting and total lighting, Quality of good lighting, Factors affecting the lighting-shadow, glare, reflection, Color rendering and stroboscopic effect, Methods of artificial lighting, Lighting systems-direct, indirect, semi direct, semi indirect, Lighting scheme, General and localized.

UNIT II: Measurement of Light: Definition of luminous flux, Luminous intensity, Lumen, Candle power, Illumination, M.H.C.P, M.S.C.P, M.H.S.C.P, Lamp efficiency, Brightness or luminance, Laws of illumination, Inverse square law and Lambert's Cosine law, Illumination at horizontal and vertical plane from point source, Concept of polar curve, Calculation of luminance and illumination in case of linear source, round source and flat source.

UNIT III: Design of Interior Lighting : Definitions of maintenance factor, Uniformity ratio, Direct ratio, Coefficients of utilization and factors affecting it, Illumination required for various work planes, Space to mounting height ratio, Types of fixtures and relative terms used for interior illumination such as DLOR and ULOR, Selection of lamp and luminance, Selection of utilization factor, reflection factor and maintenance factor Determination of Lamp Lumen output taking into account voltage and temperature variations, Calculation of wattage of each lamp and no of lamps needed, Layout of lamp luminaire, Calculation of space to mounting height ratio, Indian standard recommendation and standard practices for illumination levels in various areas, Special feature for entrance, staircase, Corridor lighting and industrial building.

UNIT IV: Design of Outdoor Lighting: Street Lighting : Types of street and their level of illumination required, Terms related to street and street lighting, Types of fixtures used and their suitable application, Various arrangements in street lighting, Requirements of good street lighting, Selection of lamp and luminaire, Calculation of their wattage, Number and arrangement, Calculation of space to mounting height ratio, Calculation of illumination level available on road.

UNIT V:Design of Outdoor Lighting: Flood Lighting: Terms related to flood lighting, Types of fixtures and their suitable applications, Selection of lamp and projector, Calculation of their wattage and number and their arrangement, Calculation of space to mounting height ratio, recommended method for aiming of lamp.
Special Features of Aesthetic Lighting: Monument and statue lighting, Sports lighting, Hospital lighting, Auditorium lighting.

Text Books:

1. D.C. Pritchard Lighting, Routledge, 2016
2. Jack L. Lindsey, Applied Illumination Engineering, PHI, 1991
3. John Matthews Introduction to the Design and Analysis of Building Electrical Systems, Springer, 1993
4. M.A. Cayless, Lamps and Lighting, Routledge, 1996

References:

1. IS CODE 3646
2. IS CODE 6665

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(R18INF4185) E – COMMERCE

COURSE OUTCOMES: At the end of the course, the students will be able to :

1. Understand the E – commerce strategies and value chains
2. Understand the E-commerce services
3. Understand E - commerce infrastructure, its applications and Supply Chain Management.
4. Know the availability of latest technology and applications of E-Payment Mechanism.
5. Apply E-Commerce in business-to-business application.

UNIT 1: **Electronic Commerce:** Overview, Definition, Advantages & Disadvantages of E-Commerce, Threats of E-Commerce, Managerial Prospective, Rules & Regulation for Controlling Commerce, Relationship Between E-Commerce & Networking, Different Types of Networking for E-Commerce, internet, Intranet, EDI Systems, Wireless Application Protocol: Definition, Hand Held Devices, Mobility & Commerce Model, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement for E-Commerce, Business Model of E-Commerce; Model Based on Transaction Type, Model Based on Transaction Party- B2B, B2C, C2B, C2C, E-Governance.

UNIT 2: **E-Strategy:** Overview, Strategic Methods for developing E-Commerce. Four C's (Convergence, Collaborative, Computing, Content Management & Call Center). Convergence: Technological Advances in Convergence - Types, Convergence and its implications, Convergence & Electronic Commerce. Collaborative Computing: Collaborative Product Development, contract as per CAD, Simulations Collaboration, Security. Content Management: Definition of Content, Authoring Tools and Content Management, Content Management, Content - partnership, repositories, convergence, providers, Web Traffic.

UNIT 3: **Traffic Management:** Content Marketing Call Center: Definition, Need, Tasks Handled, Mode of Operation, Equipment, Strength & Weakness of Call Center, Customer Premises Equipment (CPE).
Supply Chain Management: E-logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution(SCE), SCEFramework, Internet's Effect on Supply Chain Power.

UNIT 4: **E-Payment Mechanism:** Payment through card system, E-Cheque, E-Cash, E-Payment, Threats& Protections.
E-Marketing: Home - Shopping, E-Marketing, Tele- Marketing

UNIT 5: **Electronic Data Interchange (EDI):** Meaning, Benefits, Concepts, Application, EDI Model, Protocols (UN EDI, FACT/ GTDI), ANSIX-12, Data Encryption (DES/RSA)
Risks of E-Commerce: Overview, Security for E-Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital Certificates, Digital Signatures.

Text Book:

1. Electronic Commerce - Technologies & Applications, Bhaskar Bharat, TMH

Reference Books:

1. E-commerce, MM Oka, EPH
2. Frontiers of Electronics Commerce, Kalakotia, Whinston, Pearson Education
3. Electronic Commerce, Loshinpete, Murphy P. A., Jaico Publishing Housing
4. E-Commerce, Murthy, Himalaya Publishing.

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B.Tech. - IV Year – I Semester	OPEN ELECTIVE - II	L	T	P	C
		3	0	0	3

(R18MED4186) Industrial Engineering & Ergonomics

UNIT 1: Introduction: An approach to industrial design -elements of design structure for industrial design in engineering application in modern manufacturing systems. Ergonomics and Industrial Design: Introduction -general approach to the man- machine relationship- workstation design-working position.

UNIT 2: Control and Displays: Shapes and sizes of various controls and displays-multiple, displays and control situations - design of major controls in automobiles, machine tools etc Ergonomics and Production: ergonomics and product design -ergonomics in automated systems- expert systems for ergonomic design. Anthropometric data and its applications in ergonomic, design- limitations of anthropometric data- use of computerized database.

UNIT 3: Visual Effects of Line and Form: The mechanics of seeing- psychology of seeing general influences of line and form. Color: Color and light -color and objects- color and the eye -color consistency- color terms- reactions to color and color continuation -color on engineering equipment.

UNIT 4: Aesthetic Concepts: Concept of unity- concept of order with variety -concept of purpose style and environment- Aesthetic expressions. Style-components of style- house style, observation style in capital goods, case study.

UNIT 5: Industrial Design in Practice: General Design -specifying design equipment- rating the importance of industrial design -industrial design in the design process.

REFERENCE BOOKS:

1. Industrial Design for Engineers - Mayall W.H. - London Hiffee books Ltd.-1988.
2. Applied Ergonomics Hand Book - Brain Shakel (Edited) - Butterworth scientific. London
3. Introduction to Ergonomics - R. C. Bridger - McGraw Hill Publications -1995.
4. Human Factor Engineering - Sanders & McCormick - McGraw Hill Publications – 6th edition,2002.

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B.Tech. - IV Year – I Semester **OPEN ELECTIVE - II**

L	T	P	C
3	0	0	3

(R18HMS4187) Creative Writing

COURSE OBJECTIVE: This course introduces students to the practice of creative writing in the genres of poetry and fiction. In addition to honing their skills as creative writers, students will develop a critical vocabulary that will aid them in discussing poems and fiction produced by their peers. This course allows for experimentation with writing poetry, short fiction, and creative nonfiction in a writing workshop setting. Far from undertaking the task of making student a professional writer, this class has its goal to familiarize the learner with the dynamics of imaginative literature, the synergy of form and content, and with what makes a particular work effective.

COURSE OBJECTIVES:

1. Discuss with some confidence many of the rhetorical devices, from metaphor to enjambment associated with creative writing.
2. Appreciate the complexity of Poetry, Short Fiction, and Creative Nonfiction.
3. Understand the importance of Creative Writing as a means of self-expression.
4. Read and discuss with enhanced understanding Poetry, Short Fiction, and Creative Nonfiction
5. Show improvement in writing and analytical skills.

UNIT I: **Introduction to Literary Forms** - Elements of Poetry - Rhythm and Meter Poetic Forms – Ballad, Lyrics, Elegy, Odes, Haiku, Sonnets Literary Genres- Short Fiction, Drama, and Non-Fiction

UNIT II: Poetry Writing - Appreciation of the form and content of poem Techniques - figurative language - (structure - rhythm – imagery – tone – style point of view, voice - read and discuss numerous poems)

Ballad - The Ballad of the Landlord by Langston Hughes; Lyrics - Kubla Khan by Samuel Taylor Coleridge Elegy - Elegy Written in a Country's Churchyard by Thomas Gray Odes – Ode to a Nightingale by John Keats; Haik u- This Other World by Richard Wright Sonnet - On His Blindness by John Milton Students Creative Assignment – Students will write three poems.

UNIT III: **Short Fiction / Novel** - Elements of Fiction - Character – Plot- Setting – Theme - Style; Narrator - Point of view - Tone – Suspension of Disbelief. Genres - Adventure, Comic, Fantasy, Gothic, Romance, Historical, Horror, Supernatural, Thriller, Science Fiction - Gooseberries by Anton Chekhov Short Story - My Lost Dollar by Stephen Leacock Students Creative Assignment – Students will write one Short Story

UNIT IV: **Drama** - Elements of Drama - Character Plot, Theme, Dialogue, Convention, Genre, Audience, Stagecraft, Design, ConversionsDrama – The King of the Dark Chamber by Rabindranath Tagore Students Creative Assignment- Students will write a review of the drama read in the class.

UNIT V: Non Fiction - Prose, Biography, Memoirs, and Personal Essays Walden or Life in the Woods by Henry David Thoreau Students Creative Assignment - Students will write one or two essays

REFERENCES

1. Candace H. Schaefer, Rick Diamond. 1998. The Creative Writing Guide: A Path to Poetry, Nonfiction, and Drama, Longman, New York, USA
2. Shelly Clark and MarjoneSaisa, 2009. Road Trip: Conversations with Writers, The Backwaters Press, Nebraska, USA
3. Nikki Moustaki (ed.), 1998. Writing Fiction: The Practical Guide from New York's Acclaimed Creative Writing School, Publisher: Bloomsbury, ISBN: 0156005743.

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B.Tech. - IV Year – I Semester	OPEN ELECTIVE - II	L	T	P	C
		3	0	0	3

(R18HMS4188) Design Thinking

Course Objectives:

- To create awareness of design among students of engineering
- To motivate students to think of design before implementing an engineering project
- To teach a systematic approach to identifying and defining a problem before brainstorming for a solution
- To instill a sense of significance towards applying creativity to product and service design

Course Outcomes: Upon completion of this course, the student shall be

1. Learn to identify design principles from an engineering perspective
2. Cultivate sensitivity towards design aspects in objects made by engineers and non-engineers, which are typically used in daily life
3. Understand and create visual design elements to communicate more effectively
4. Construct clear problem statements, understand the importance of validation, and design services creatively
5. Develop fundamental team skills: working in teams and managing teams, strategizing tasks, and streamlining activities pertaining to a project

Students' Responsibilities:

1. Students will form teams of 3–5 members each, while working collaboratively throughout the semester.
2. Students will present and report the tasks to the class and to the concerned faculty members and design experts, using their oral and written communication skills as well as creativity and team skills.
3. Students must proactively engage in observing the objects and processes which are part of their daily life and society from a design perspective and discuss with peers to learn collaboratively.

UNIT 1: Design Overview and Motivation History and Context of birth of Design; Design thinking: Introduction and Motivation; Various definitions and interpretations of design, Design Vocabulary; Design in Indian Context; Art and Design: Art in Design, Design beyond Art; Design in Creative Industries

UNIT 2: Design Sensitization for Engineers- Design Engineering vs. Engineering Design, Examples of Engineering Design and Design Engineering in various engineering domains, Examples of design failures leading to bad products and services, Real-world examples of bad design that caused engineering and technological disasters, Domain-specific Engineering Design examples

UNIT 3: Design Thinking Foundations The Design Double Diamond: Discover-Define-Develop-Deliver User-centric design approaches: Importance of user-centricity for design, Empathisation, Empathy Maps, Data collection from users and for users, Data Validation Responsible Innovation and Ethical Design: Ethics as foundation for design, Concern for environment and sustainability

UNIT 4: Communication Skills for Design, Culture and Art Communication Media to express an idea: Visuals, Text, Voice and Audio, Info graphics General guidelines for a good Presentation: Target audience, slideshow templates, appropriate visual elements, presentation styles, guidelines General guidelines for a good Report: Documentation classification, standards, styles, and templates Modes of communication: Reports and documents, Presentation, poster, graphic, blog or website. Understanding Art in Design: Need for creativity, Elements of Visual Design Aesthetics: Influences and impressions of Colors, Shapes, Layouts, Patterns, and Fonts as Design Elements

UNIT 5: Applied Creativity and Design for Services Methods to brainstorm solutions for user issues; Combining solutions to workable solution concepts; Identifying the user needs in a service-driven economy; Process Flows and Customer Experience considerations for designing and improving services; 5 Why's; Service Delivery Pathways. Doing Design Looking for a problem, Ideation and Rules of Ideation, Framing and stating the problem; Basic considerations of Prototyping/ Model Building, Basics of Testing and Validation, Incorporating feedback

TEXT BOOKS:

1. Daniel Ling, "Complete Design Thinking Guide for Successful Professionals", CreateSpace Independent Publishing, 2015 (ISBN: 978-1514202739)
2. Tim Brown, "Change by Design", Harper Business, 2012 (ISBN: 978-0062337382)
3. Jimmy Jain, "Design Thinking for Startups: A Handbook for Readers and Workbook for Practitioners", Notion Press, 2018 (ISBN: 978-1642495034)
4. Beverly Rudkin Ingle, "Design Thinking for Entrepreneurs and Small Businesses: Putting the Power of Design to Work", APress, 2013 (ISBN: 978-1430261810)

REFERENCES:

1. Donald A. Norman, "The Design of Everyday Things", MIT Press, 2013 (ISBN: 978-0262525671)
2. Bruno Munari, "Design As Art", Penguin UK, 2009 (ISBN: 978-0141035819)
3. Tom Kelly, Jonathan Littman, "The Art of Innovation", HarperCollins Business, 2002 (ISBN: 978-0007102938)
4. Thomas Lockwood, "Design Thinking: Integrating Innovation, Customer Experience, and Brand Value", Allworth Press, 2009 (ISBN: 978-158115)

Open Elective –III

S. No.	Course Code	Course Title	L	T	P	Credits
1	R18CIV4291	Remote Sensing Concepts	3	0	0	3
2	R18CSE4292	Fundamentals of Soft Computing				
3	R18ECE4293	Audio & Video Engineering				
4	R18EEE4294	Non Conventional Energy Resources				
5	R18INF4295	Information Security Fundamentals				
6	R18MED4296	Total Engineering Quality Management				
7	R18HMS4297	Human Values & Professional Ethics for Engineers				
8	R18HMS4298	Science Fiction				

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B.Tech. - IV Year – I Semester **OPEN ELECTIVE - III**

L	T	P	C
3	0	0	3

(R18CIV4291) Remote Sensing Concepts

COURSE OBJECTIVES: To introduce the concepts of remote sensing processes and its components. To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

COURSEOUTCOMES:

1. At the end of the course the student will be able to understand
2. The characteristics of electromagnetic radiation and its interaction with earth features
3. The types and configuration of various satellites and sensors
4. The elements of data interpretation

UNIT I:Remote Sensing and Electromagnetic Spectrum- Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – wave theory, particle theory, Stefan – Boltzmann Law and Wien's Law – visible and non-visible spectrum – Radiation sources: active & passive; Radiation Quantities

UNIT II:EMR Interaction with Atmosphere- Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere - Scattering (Rayleigh, Mie, non-selective scattering) absorption and refraction – Atmospheric effects on visible, infrared, thermal and microwave spectrum – Atmospheric windows.

UNIT III: EMR Interaction with Earth- Energy balance equation – Specular and diffuse reflectors – Spectral reflectance &emittance – Spectro radiometer / Spectrophotometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water body – Factors affecting spectral reflectance of vegetation, soil and water body.

UNIT IV: Platforms and Sensors- Ground based platforms –Airborne platforms – Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Resolution concepts – Scanners - Along and across track scanners – Orbital and sensor characteristics of different satellites – Airborne and Space borne TIR sensors – Calibration – S/N ratio – Passive/Active microwave sensing – Airborne and satellite borne RADAR –SAR –LIDAR , UAV – High Resolution Sensors

UNIT V: Data Products and Visual Interpretation- Photographic (film and paper) and digital products – quick look products - High Resolution data products data - ordering – interpretation – basic characteristics of image elements – interpretation keys (selective and elimination) – visual interpretation of natural resources.

TEXT BOOKS:

1. Richards, Remote sensing digital Image Analysis-An Introduction Springer - Verlag 1993.
2. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York, 2002.

REFERENCES:

1. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.I, American Society of Photogrametry, Virginia, USA, 2002.
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995
3. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 2003.

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		3	0	0	3

(R18CSE4292) Fundamentals of Soft Computing

COURSE OBJECTIVES: The main objective of the Soft Computing Techniques to Improve Data Analysis Solutions is to strengthen the dialogue between the statistics and soft computing research communities in order to cross-pollinate both fields and generate mutual improvement activities.

UNIT I: **Introduction:** What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.
Neural Networks: What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons, Back Propagation networks, Architecture of Back propagation(BP) Networks, Backpropagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications.

UNIT II:**Fuzzy Systems:** Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax Composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification.

UNIT III: **Genetic Algorithm:** History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA, Multi-level Optimization.

UNIT 4: **Hybrid Systems:** Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

UNIT V: **GA based Backpropagation Networks:**
GA based Weight Determination, K - factor determination in Columns.
Fuzzy Backpropagation Networks: LR type Fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP, Application of Fuzzy BP Networks

TEXT BOOKS:

1. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications, S.Rajasekaran, G. A. Vijayalakshami, PHI.
2. Genetic Algorithms: Search and Optimization, E. Goldberg.
3. Neuro-Fuzzy Systems, Chin Teng Lin, C. S. George Lee, PHI.
4. Build_Neural_Network_With_MS_Excel_sample by Joe choong.

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(R18ECE4293) Audio and Video Engineering

Course Objectives:

- Student are able understand different amplifiers, graphic equalizer and Dolby NR recording systems TV fundamentals like concept of aspect ratio ,image continuity etc Color theory
- Student are able to discuss composite video signal ad CCIR B standard for color signal Transmission and reception, monochrome TV transmitter and receivers, Color TV transmitter and compare TV camera tubes, Color picture tube
- Student are able Illustrate of color TV receivers(PAL-D) and Differentiate between NTSC PAL and SCAM systems cable Television, MATV, CATV, CCTV, Cable TV network and DTH

UNIT I: Hi Fi Audio Amplifier - Introduction to Amplifiers: Mono, Stereo, Public Address; Difference between stereo amplifier and Mono amplifier; Block diagram of Hi Fi amplifier and explanation; Graphic equalizer concept, circuit diagram and operation. (5 Point Circuit diagram); Dolby NR recording system; Types of speaker woofer, Midrange and Tweeter; Cross over network circuit and its function.

UNIT II: TV Fundamentals - Concept of Aspect ratio, image continuity, interlace scanning, scanning periods, horizontal and vertical, vertical resolution, horizontal resolution; Vestigial sideband transmission, bandwidth for Colour signal, picture tube, brightness, contrast, viewing distance luminance, hue, saturation, compatibility; Colour theory, primary colors and secondary colors, additive Colour mixing subtractive Colour mixing; Composite Video Signal, Pedestal height, Blanking pulse, Colour burst, Horizontal sync pulse details, Vertical sync pulse details, Equalizing pulses, CCIR B standards for Colour signal transmission and reception.

UNIT III: TV Transmitters and Receiver - Audio and Video signal transmission; Positive and Negative modulation; Merits and Demerits of Negative modulation; Introduction to television camera tube (a) Vidicon; (b) Plumbicon; (c) Solid State camera based on CCD; Color Picture tube (a) PIL, (b) Delta gun picture tube; Block diagram of monochrome TV transmitter; Block diagram of Colour TV transmitter; Block diagram of monochrome TV Receiver.

UNIT IV: Colour TV - Block Diagram and operation of color TV receiver (PAL D type); Explain – YagiUda Antenna; Explain block diagram of PAL-D decoder with circuit diagram of chroma signal amplifier, Burst pulse blanking, Colour killer control, Basic Circuit for Separation of U and V signals. AGC Amplifier.Colour signal matrixing, RGB drive amplifiers; EHT generation: circuit explanation for line output stage using transistor or IC in Colour TV; Comparisons between NTSC, PAL and SCAM Systems.

UNIT V: Cable Television - Working principle and specification of following components : Dish antenna, LNBC, Multiplexer, Attenuators Connectors (two ways and three ways), Amplifier and cable; MATV,CATV and CCTV;Design concept for cable TV network; Block diagram of dB meter with working principle; Direct to Home System (DTH) Introduction and Block Diagram.

References :

1. Television & Radio Engineering (A.M. Dhake) Tata McGraw Hill.
2. Television Engg and Video System (R.G. Gupta) Tata McGraw Hill.
3. Audio Video Systems (R.G. Gupta) Tata McGraw Hill.
4. Modern TV Pratice (R.R. Gulati) New Age International.
5. Basic Radio and Television (S. Sharma) Tata McGraw Hill.
6. Colour Television Principles and Pratice (R.R. Gulati) New Age International.
7. Basic Television and Video System (Bernard Grob) Tata McGraw Hill.
8. Mono Chrome and Colour Television (R.R. Gulati0 New Age International.
9. Modern CD Player Servicing Manual (ManoharLotia) BPB Publication.

Course Outcomes:

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

C423.1. Explain and differ ate the different amplifiers, graphic equalizer and Dolby NR recording systems (K3-apply)

C423.2. Describe the TV fundamentals like concept of aspect ratio, image continuity etc Color theory (K2-Understand)

C423.3. Discuss about composite video signal ad CCIR B standard for color signal Transmission and reception (K2-Understand)

C423.4. Discuss monochrome TV transmitter and receivers, Color TV transmitter and compare TV camera tubes, Color picture tube (K5-Evaluate)

C423.5. Diagram Illustrate of color TV receivers (PAL-D) and Differentiate between NTSC PAL and SCAM systems (K4-Analyse)

C423.6. Explain about cable Television, MATV, CATV, CCTV, Cable TV network and DTH (K2-Understand)

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(R18EEE4294) Non Conventional Energy Resources

This course helps the students to understand the importance, availability, conversion technologies of renewable energy resources and its applications

1. To emphasis the current energy status and role of non-conventional and renewable energy sources.
2. To familiarize various aspects of Solar energy and utilization
3. To familiarize various aspects of Wind energy and utilization
4. To familiarize various aspects of Biomass energy and utilization
5. To emphasize the significance of Green Energy Technologies.

UNIT I: SOLAR ENERGY - Solar radiation its measurements and prediction - Solar thermal collectors - Flat plate collectors, Concentrating collectors – Applications - Heating, Cooling, Desalination, Drying, Cooking, etc - Principle of photovoltaic conversion of solar energy - Types of solar cells and fabrication - Photovoltaic applications - Battery charging, Domestic lighting, Street lighting and water pumping.

UNIT II:WIND ENERGY - Wind energy - Energy chains - Application - Historical background, Merits and limitations - Nature of wind - Planetary and local day / night winds - Wind energy quantum - Power in wind- Turbine efficiency - Torque Thrust calculations Velocity at different heights - Site selection - Components of Wind Energy Conversion System (WECS).

UNIT III: BIOMASS ENERGY - Energy from Biomass - Biomass as Renewable Energy Source - Types of Bio mass Fuels - Solid, Liquid and Gas - Biomass Conversion Techniques- Wet Process, Dry Process-Photosynthesis - Biogas Generation - Factors affecting Biodigestion - Classification of bio gas plant - Continuous, Batch and Fixed Dome types - Advantages and Disadvantages.

UNIT IV: TIDAL, OTEC, HYDEL AND GEOTHERMAL ENERGY - Tidal energy: Tide – Spring tide, Neap tide – Tidal range – Tidal Power – Types of tidal power plant – Single and dual basin schemes – Requirements in tidal power plant - Ocean Thermal Energy Conversion (OTEC): Principle - Open and closed OTEC Cycles - Hydel Energy: Micro hydro - Geothermal Energy: Geothermal energy sources - Power plant and environmental issues.

UNIT V:NEW ENERGY SOURCES - Hydrogen as a renewable energy source - Sources of Hydrogen - Fuel for Vehicles - Hydrogen Production - Direct electrolysis of water, thermal decomposition of water, biological and biochemical methods of hydrogen production - Storage of Hydrogen - Gaseous, Cryogenic and Metal hydride - Fuel Cell – Principle of working, construction and applications.

TEXT BOOKS

1. Rai.G.D, “Non- conventional resources of energy”, Khanna publishers, Fourth edition, 2010.
2. Khan. B.H, “Non-Conventional Energy Resources”, The McGraw Hills, Second edition, 2009.

REFERENCES

1. Rao.S&Parulekar, “Energy Technology”, Khanna publishers, Fourth edition, 2005.
2. Pai.B.R and Ram Prasad.M.S, “Power Generation through Renewable Sources of Energy”, Tata McGraw Hill, New Delhi, 1991.
3. Bansal.N.K, Kleeman and Meliss, “Renewable energy sources and conversion Techniques”,

Tata McGraw hill, 1990.
4. Godfrey Boyl "Renewable Energy: Power Sustainable Future",Oxford University Press, Second edition, 2006.
5. Ryan O'Hayre, Suk-Won Cha and Whitney colella, "Fuel Cell Fundamentals", Second edition, 2009.
6. John W Twidell and Anthony D Weir, "Renewable Energy Resources", Taylor and Francis, 2006.
7. Freris.L.L, "Wind Energy Conversion systems", Prentice Hall, UK, 1990.

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(R18INF4295) Information Security Fundamentals

COURSE OBJECTIVES:

1. To provide impeccable knowledge on various technical aspects of Information Security & Computer Security principles
2. To provide foundation for understanding the key issues associated with protecting Computer Systems & Information Assets.
3. To provide competency in designing consistent & reasonable Information security system with appropriate Scanning & Enumeration mechanisms, determining the level of protection and Response to security incidents.

UNIT I:Introduction to Information Security - Introduction to Information Security, Need for Security - Threats to security & Attacks, Computer System Security and Access Controls - System access and data access.

UNIT II:Communication Security - Introduction to cryptography, cryptosystems, Encryption & Decryption Techniques - classical encryption techniques, communication channel used in cryptographic system, various types of ciphers, Cryptanalysis, Hash function and Data integrity, Security of Hashing function.

UNIT III: Network - Introduction to Network Security, Email Security, IP Security, Web Security, Kerberos, X.509 techniques.

UNIT IV: Scanning & Enumeration Technology - Malicious software, Firewalls, Honey pots, Intrusion Detection system, Intrusion Prevention system

UNIT V: Ethics In Information Security - Implementing Information Security, Legal Ethical & Professional issues in Information Security.

TEXT BOOKS:

1. Matt Bishop, “Computer Security: Art and Science”, Addison-Wesley Professional, First Edition, 2003. ISBN: 0201440997.
2. William Stallings, “Cryptography and Network Security”, Pearson Education, Fourth Edition, 2006. ISBN: 8177587749

REFERENCES:

1. Michael E. Whitman, Herbert J. Mattord ,“Principles of Information Security” Cengage Learning, Fourth Edition, 2010, ISBN: 1111138214
2. Charlie Kaufman, Radia Perlman, Mike Speciner, “Network security: private communication in a public world”, Second Edition, ISBN: 0130460192.
3. Dieter Gollmann ,”Computer Security “, Third Edition, ISBN: 0470741155.

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		3	0	0	3

(R18MED4296) Total Engineering Quality Management

COURSE OBJECTIVE: To understand the Engineering and Management aspects of Planning, Designing, Controlling and Improving Quality in Manufactured products.

COURSE OUTCOMES:

1. To understand the fundamentals of quality
2. To understand the role of TQM tools and techniques in elimination of wastages and reduction of defects
3. To develop quality as a passion and habit

UNIT I: **Quality Gurus And TQM Kitemarks** - Evolution of TQM – Quality Guru's – Edward Deming – Joseph Juran – Philip Crosby – Genichi Taguchi – Walter Shewart – Criteria for Deming's PrizeUNIT II - PRODUCT DESIGN AND ANALYSIS (9 hours) Basic Design Concepts and TQM – Design Assurance – Design Validation – Failure Mode Effect Analysis – Fault Tree Analysis – Design for Robustness – Value Analysis

UNIT-III: **Process Improvement and Modern Production Management Tools** - Six Sigma Approach – Total Productive Maintenance – Just-In-Time – Lean Manufacturing Paradigms

UNIT IV: **Quality Improvement Tools and Continuous Improvement** - Q-7 Tools – New Q-7 Tools – Quality Function Deployment – Kaizen – 5S – PokaYoke

UNIT V: Quality Management Systems - Quality Management Systems – Introduction to ISO9000 – TS16949:2002 and EMS14001 certifications.

TEXT BOOKS

1. Total Engineering Quality Management, Sunil Sharma, 1st Edition, MacMillan India Limited.
2. Total Quality Management, Poornima M. Charantimath, 2nd Edition, Pearson Education.

REFERENCES

1. "Quality and Performance Excellence", James R Evans, Edition, 7th Edition, Cengage Learning.
2. "Quality Management", Howard S Gitlow, Alan J Oppenheim, Rosa Oppenheim, David M Levine,3rd Edition , Tata McGraw Hill Limited.
3. "Fundamentals of Quality Control & Improvement", AmitavaMitra, 3rd Edition, Wiley Publications, 2012.

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B.Tech. - IV Year – I Semester	OPEN ELECTIVE - III	L	T	P	C
		3	0	0	3

(R18HMS4297) Human Values & Professional Ethics for Engineers

Course Objectives:

1. To know the different moral and ethical issues through various prominent theories.
2. To educate the code of ethics as well as the industrial standards and how they can be used for ensuring safety and reducing the risk.
3. To vocalize the Rights and Responsibilities of individuals.
4. To enable the students to imbibe and internalize the Values and Ethical Behavior in the personal and Professional lives.

Course Outcome: The students will understand the importance of Values and Ethics in their personal lives and professional careers. The students will learn the rights and responsibilities as an employee, team member and a global citizen.

UNIT – I Introduction to Professional Ethics: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

UNIT – II Basic Theories: Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

UNIT – III Professional Practices in Engineering: Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession. Central Responsibilities of Engineers – The Centrality of Responsibilities of Professional Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walk away Collapse.

UNIT – IV Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation. Ethics in changing domains of research – The US government wide definition of research misconduct, research misconduct distinguished from mistakes and errors, recent history of attention to research misconduct, the emerging emphasis on understanding and fostering responsible conduct, responsible authorship, reviewing & editing.

UNIT – V Global issues in Professional Ethics: Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; War Ethics; Bio Ethics, Intellectual Property Rights.

TEXT BOOKS:

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.

REFERENCES

1. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, 4e ,Cengage learning, 2015.
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

SRI INDU COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous Institution under UGC, New Delhi)

B.Tech. - IV Year – I Semester **OPEN ELECTIVE - III**

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(R18HMS4298) Science Fiction

COURSE OBJECTIVES: To help learners understand the link between Science and Technology and Humanities, especially Fiction form in Literature, with a view to instilling in them a sensitivity to the current issues of the world and probable issues that will crop up in the future world and imbibe in them a fine sensibility to appreciate and handle with balance the borderline problems of interdisciplinary nature with integrity and responsibility.

COURSE OUTCOMES:

1. To enable the learners to appreciate the literary form of Science Fiction
2. To give them a firsthand linguistic experience of the various types of Science Fiction novels
3. To equip the learners with the discretion to distinguish between a successful/effective science fiction novel and the one not so
4. To enhance the learners' communication skills and to develop their potential for creative writing
5. To spark off the dormant researcher in the learner so that he/she will use it for the betterment of the world

UNIT I: Science Fiction – an Introduction - 1. What is science fiction? Characteristics. 2. Classification 3. Types 4. A Historical Overview

UNIT II: **Novels of other Worlds** - 1. Utopian Science Fiction Novels Huxley, Aldous. Island.1932; Harper Perennial Classics, 2002. 2. Dystopian Science Fiction Novels Huxley, Aldous. Brave New World.Chatto and Windus, 1962.

UNIT III: **Novels of other Beings** - 1. Robots and Science Fiction Asimov, Isaac.I Robot.Granada, 1950. 2. Aliens and Science Fiction Card, Orson Scott. Ender's Game. Starscape, 2002.

UNIT IV: **Novels of Time Travel** -1. Travel into future a. H. G. Well's Time Machine. 2. Travel into past a. Asimov, Isaac and Robert Silverberg. Child of Time.Tor, 1993.

UNIT V : Novels on Women's Issues - 1. Man Controlling Women a. Shelley, Mary. Frankenstein.1818; Barnes and Noble, 2009. 2. Varied Identities of Women b. RUSS, JOANNA. THE FEMALE MAN. BEACON PRESS, 2000

REFERENCES

1. Seed, David. "Science Fiction: A Very Short Introduction". OUP, 2011.
2. Roberts, Adam. "Science Fiction". 2 revised. Routledge, 2005.
3. Moylan, Tom and RaffaellaBaccolini. "Dark Horizons: Science Fiction and the Dystopian Imagination". Routledge, 2003.
4. Little, Judith.A. "Feminist philosophy and science fiction: utopias and dystopias", Prometheus Press, 2007.
5. Atwood, Margaret. "In Other Worlds".Anchor, 2012.
6. Reid, Robin.A. "Women in Science Fiction and Fantasy".Greenwood Press, 2009. 7. Schneider, Susan. "Science Fiction and Philosophy: From Time Travel to Superintelligence", Wiley Blackwell, 2009.
7. Drout, Michael D.C. From "Here to Infinity: An Exploration of Science Fiction Literature",. 7 CDs. Published in 2006 by Recorded Books.
8. Melzer, Patricia. "Alien Constructions: Science Fiction and Feminist Thought", University of Texas Press, 2006.