ACADEMIC REGULATIONS PROGRAMME STRUCTURE AND DETAILED SYLLABUS

GR22

Bachelor of Technology
(Mechanical Engineering)

(Effective for the students admitted from the Academic Year 2022-23)

GOKARAJU RANGARAJU

INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

GOKARAJU RANGARAJU

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ACADEMIC REGULATIONS
PROGRAMME STRUCTURE
&
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Bachelor of Technology
Mechanical Engineering
(Four Year Regular Programme)
(Applicable for Batches Admitted from 2022-23)

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY
Bachupally, Kukatpally, Hyderabad, Telangana, India- 500090

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
HYDERABAD

Academic Regulations for B.Tech. (Regular) under GR22

(Applicable for Batches Admitted from 2022-23)

Under Graduate Degree Programme in Engineering and Technology (UG)

Gokaraju Rangaraju Institute of Engineering and Technology (GRIET) offers a 4-year (8 Semesters) Bachelor of Technology (B.Tech.) degree programme. The following programmes are offered in GRIET.

S.No	Department	Programme Code	Programme
1	Civil Engineering	01	B.Tech. Civil Engineering
2	Electrical and Electronics Engineering	02	B.Tech. Electrical and Electronics Engineering
3	Mechanical Engineering	03	B.Tech. Mechanical Engineering
4	Electronics and Communication Engineering	04	B.Tech. Electronics and Communication Engineering
5	Computer Science and Engineering	05	B.Tech. Computer Science and Engineering
6	Information Technology	12	B.Tech. Information Technology
7	Computer Science and Business System	32	B.Tech. Computer Science & Business System
8	Computer Science and Engineering (AIML)	66	B.Tech. Computer Science and Engineering (AIML)
9	Computer Science and Engineering (Data Science)	67	B.Tech. Computer Science and Engineering (Data Science)
10	Computer Science and Engineering (Artificial Intelligence)	61	B.Tech Computer Science and Engineering (Artificial Intelligence
11	Computer Science and Information Technology	33	B.Tech Computer Science and Information Technology

GR22 Regulations shall govern the above programmes offered by the Departments with effect from the students admitted to the programmes in 2022-23 academic year is given below.

1. **Medium of Instruction:** The medium of instruction (including examinations and reports) is English.

2. **Admissions:** Admission to the undergraduate (UG) Programme shall be made subject to the eligibility, qualifications and specialization prescribed by the Telangana State Government/JNTUH University from time to time. Admissions shall be made either on the basis of the merit rank obtained by the student in the common entrance examination conducted by the Government/University or on the basis of any other order of merit approved by the Government/University, subject to reservations as prescribed by the Government/University from time to time.

3. **Programme Pattern:**

a) Each Academic Year of study is divided into two semesters.
b) Minimum number of instruction days in each semester is 90.
c) Grade points, based on percentage of marks awarded for each course will form the basis for calculation of SGPA (Semester Grade Point Average) and CGPA (Cumulative Grade Point Average).
d) The total credits for the Programme are 160.
e) A student has a choice to register for all courses in a semester / one less or one additional course from other semesters provided the student satisfies prerequisites.
f) All the registered credits except Mandatory and Value Added Courses will be considered for the calculation of final CGPA.
g) Each semester has 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as indicated by UGC, and course structure as suggested by AICTE are followed. The terms 'subject' and 'course' imply the same meaning.
h) Course Classification: All courses offered for all undergraduate programmes in B.Tech. degree programmes are broadly classified as follows.

S. No.	Broad Course Classification	Course Group/ Category	Course Description
1	BS	Basic Science	Includes Basic Science Courses
2	ES	Engineering Science	Includes Engineering Courses
3	HS	Humanities andSocial Sciences	Includes Management Courses
4	PC	Professional Core	Includes Core Courses related to the parent discipline/department/ branch of Engineering
5	PE	Professional Elective	Includes Elective Courses related to the parent discipline/ department/ branch of Engineering
6	OE	Open Elective	Elective Courses from other technical and/or emerging subjects
7	PW	Project Work	Project work, seminar and internship in industry or elsewhere
8	MC	Mandatory Courses	Environmental Sciences, Induction training, Indian Constitution, Essence ofIndian Traditional Knowledge, Co and Extra Curricular Activities
9	VAC	Value Added Courses	Courses on current industry relevant topics improving breadth and depth in domain

4. **Award of B.Tech. Degree:** The Undergraduate Degree of B.Tech. shall be conferred by Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad, on the students who are admitted to the programme and fulfill all the following academic requirements for the award of the degree
   a) A student pursues the course of study and completes it successfully in not less than four academic years and not more than eight academic years.
   b) A student has to register for all the 160 credits and secure all credits (with CGPA $\geq$ 5).
   c) A student must fulfill all the academic requirements for the award of the degree.

5. **Attendance Requirements:**

   a) A student shall be eligible to appear for the semester-end examinations if he/she puts in a minimum of 75% of attendance in aggregate in all the courses concerned in the semester.
   b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below

75%) in a semester may be granted. A committee headed by Dean (Academic Affairs) shall be the deciding authority for granting the condonation.

c) Students who have been granted condonation shall pay a fee as decided by the Finance Committee.

d) Shortage of Attendance more than 10% (attendance less than 65% in aggregate) shall in no case be condoned.

e) Students whose shortage of attendance is not condoned in any semester are detained and are not eligible to take their end examinations of that semester. **They get detained and their registration for that semester shall stand cancelled**, including all academic credentials (internal marks etc.,) of that semester. **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 reregistered 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.

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

6. Paper Setting, Evaluation of Answer Scripts, Marks and Assessment:

a) Paper setting and evaluation of the answer scripts shall be done as per the procedures laid down by the Academic Council from time to time.

b) Distribution and Weightage of marks

S. No	Components	Internal	External	Total
1	Theory	40	60	100
2	Practical	40	60	100
3	Graphics for Engineers	40	60	100
4	Mini Project	40	60	100
5	Project Work	40	60	100

c) Continuous Internal Evaluation and Semester End Examinations: The assessment of the student's performance in each course will be based on Continuous Internal Evaluation (CIE) and Semester-End Examination (SEE). The marks for each of the component of assessment are fixed as shown in the following Table.

Assessment Procedure:

S. No	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Examinations
1	Theory	40	Internal Examination & Continuous Evaluation	1) Two mid semester examination shall be conducted for 30 marks each for a duration of 120 minutes. Average of the two mid exams shall be considered **i) Subjective – 20 marks** **ii) Objective – 10 marks** 2) Continuous Evaluation is for each unit using **i) Assignment – 05 marks** **ii) Quiz/Subject Viva-voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject – 05 marks**
		60	Semester end examination	The semester-end examination is for a duration of 3 hours
2	Practical	40	Internal Examination & Continuous Evaluation	One internal lab examination towards the end of course for a duration of 90 minutes with a viva of 5 minutes. **i) Internal Exam-10 marks** **ii) Viva voce – 10 marks** **iii) Continuous Assessment- 10 marks** **iv) G-Lab on Board(G-LOB) (Case study inter threading of all experiments of lab)/ Laboratory Project/Prototype Presentation/App Development -10 marks**
		60	Semester end examination	The semester-end examination is for a duration of 3 hours. **i) write-up (algorithm/flowchart/procedure) as per the task/experiment/program - 10 marks** **ii) task/experiment/program-15 marks** **iii) evaluation of results -15 marks** **iv) write-up (algorithm/flowchart/procedure) for another task/experiment/program- 10 marks** **v) viva-voce on concerned laboratory course - 10 marks**

3	Graphics for Engineers	40	Internal Examination & Continuous Evaluation	1) Two mid semester examination shall be conducted for 15 marks each for a duration of 90 minutes. Average of the two mid exams shall be considered 2) Day-to-Day activity -15 marks 3) Continuous Evaluation using • **Assignment – 05 marks** • **Quiz/Subject Viva-voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject – 05 marks**
		60	Semester end examination	The semester-end examination is for a duration of 3 hours

d)Mini Project:

S. No	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Examinations
1	Mini Project	40	Continuous Evaluation & Internal Evaluation	1) The supervisor continuously assesses the students for 20 marks **i) Continuous Assessment – 15 marks** • Abstract Presentation - 3 marks • Architectural Design Presentation - 3 marks • Modules Presentation - 3 marks • Execution Cycle 1 Presentation - 3 marks • Execution Cycle 2 Presentation - 3 marks **ii) Report – 5 marks** 2) At the end of the semester, Mini Project shall be displayed in the road show at the department level. Mini Project is evaluated by Mini Project Review Committee for **10 marks**. 3) Technical Event Participation in project area/MOOCs Course in project area/ Paper Publication/Publishing or Granting of a Patent/Hackathon participation/ Book Publication – **10 marks**
		60	External Evaluation	The mini project report shall be presented before Project Review Committee in the presence of External Examiner and the same is evaluated for **60 marks**.

Note:

i) Mini Project Review Committee consists of HoD, Mini Project Coordinator and Supervisor.

ii) Plagiarism check is compulsory for mini project report as per the plagiarism policy of GRIET.

e) Internship/Skill Development Course/ Industrial Training: Internship/Skill Development Course/Industrial Training shall be done by the student immediately after II-Year II Semester Examinations and pursue it during summer vacation/semester break & during III Year without effecting regular course work. Internship/Skill Development Course/Industrial Training at reputed organization shall be submitted in a report form and presented before the committee in III-year II semester before end semester examination.

f) Project Work (Phase–I and Phase-II):

S. No	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Examinations
1	Project Work (Phase- I and Phase -II)	40	Continuous Evaluation & Internal Evaluation	1) The supervisor continuously assesses the students for 20 marks **Continuous Assessment – 15 marks** • Abstract Presentation - 3 marks • Architectural Design Presentation - 3 marks • Modules Presentation - 3 marks • Execution Cycle 1 Presentation - 3 marks • Execution Cycle 2 Presentation – 3 marks **Report – 5 marks** 2) At the end of the semester, Project work shall be displayed in the road show at the department level. Project work is evaluated by Project Review Committee for **10 marks**. 3) Technical Event Participation in project area/ MOOCs Course in project area/ Paper Publication/Publishing or Granting of a Patent/Hackathon participation/Book Publication – **10 marks.**
		60	External Evaluation	The Project report shall be presented before Project Review Committee in the presence of External Examiner and the same is evaluated for **60 marks**.

Note:

i) Project Review Committee consists of HoD, Project Coordinator and Supervisor.

ii) Plagiarism check is compulsory for project work report (Phase I and Phase II) as per the plagiarism policy of GRIET.

iii) The above rules are applicable for both Phase I and Phase II.

g) The evaluation of courses having ONLY internal marks in I-Year I Semester and II Semester is as follows:

• I Year courses: The internal evaluation is for 50 marks and it shall take place during I Mid-Term examination and II Mid-Term examination. The average marks of two Mid-Term examinations is the final for 50 marks. Student shall have to earn 40%, i.e 20 marks out of 50 marks from average of the two examinations. There shall be NO external evaluation. The student is deemed to have failed, if he/she (i) is absent as per schedule, or (ii) secures less than 40% marks in this course.

• II Year II Semester *Real-Time/Field-based Research Project/Societal Related Project* course: The internal evaluation is for 50 marks and it shall take place during I Mid-Term examination and II Mid-Term examination. The average marks of two Mid-Term examinations is the final for 50 marks. Student shall have to earn 40%, i.e 20 marks out of 50 marks from average of the two examinations. There shall be NO external evaluation. The student is deemed to have failed, if he/she (i) does not submit a report on the Project, or (ii) does not make a presentation of the same before the internal committee as per schedule, or (ii) secures less than 40% marks in this course.

7. **Recounting of Marks in the End Examination Answer Books:** A student can request for recounting of his/her answer book on payment of a prescribed fee.

8. **Re-evaluation of the End Examination Answer Books:** A student can request for re-evaluation of his/her answer book on payment of a prescribed fee.

9. **Supplementary Examinations:** A student who has failed to secure the required credits can register for a supplementary examination, as per the schedule announced by the College for a prescribed fee.

10. **Malpractices in Examinations:** Disciplinary action shall be taken in case of malpractices during Mid/ End-examinations as per the rules framed by the Academic Council.

11. **Re-registration for mid examination:** A student shall be given one time chance to re-register for a maximum of two subjects in a semester:
    • If the internal marks secured by a student in Continuous Internal Evaluation marks for 40 (sum of average of 2 mid-term examinations, average of all assignments and Subject Viva-voce/ PPT/Poster Presentation/Case Study on a topic in the concerned subject) are less than 35% and failed in those subjects

    A student must re-register for the failed subject(s) for 40 marks within four weeks of commencement of the classwork when the course is offered next, it could be semester for first years and a year for others.

    In the event of the student taking this chance, his/her Continuous Internal Evaluation marks for 40 and Semester End Examination marks for 60 obtained in the previous attempt stand cancelled.

12. **Academic Requirements and Promotion Rules:**
    a) 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% (14 marks out of 40), not less than 35% (21 marks out of 60 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.

The student is eligible to write Semester End Examination of the concerned subject/course if the student scores ≥ 35% (14 marks) of 40 Continuous Internal Examination (CIE) marks.
In case, the student appears for Semester End Examination (SEE) of the concerned subject/course but not scored minimum 35% of CIE marks (14 marks out of 40 internal marks), his/her performance in that subject/course in SEE shall stand cancelled inspite of appearing the SEE.

b) A student shall be promoted to the next year only when he/she satisfies the requirements of all the previous semesters.

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 25% 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 firstsemester.
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 25% 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	Regular course of study of Third year second semester.
7	Fourth year first semester to Fourth year second semester	Regular course of study of Fourth year first semester.

c) Provision of opting 2 OE courses through online mode.
d) Choice of placement-oriented value-added courses in every semester from II year till IV year
e) Students can take a year break after second or third year to work on R&D
f) Under Mandatory Courses
i) Co-Curricular activities -- 0.5 credit for publishing paper, publishing patent, attend

seminar, technical competition and taking part in hackathon

ii) Extra-Curricular activities -- 0.5 credit for sports represent University or part or college winning team a medal or cup in outside recognized inter collegiate or above tournaments or NSS activities or donated blood two times or 2 green campus events

13. Grade Points: A 10 - point grading system with corresponding letter grades and percentage of marks, as given below, is followed

Letter Grade	Grade Point	Percentage of marks
O (Outstanding)	10	Marks >= 90
A+ (Excellent)	9	Marks >= 80 and Marks < 90
A (Very Good)	8	Marks >= 70 and Marks < 80
B+ (Good)	7	Marks >= 60 and Marks < 70
B (Average)	6	Marks >= 50 and Marks < 60
C (Pass)	5	Marks >= 40 and Marks < 50
F (Fail)	0	Marks < 40
Ab (Absent)	0	

Letter grade 'F' in any Course implies failure of the student in that course and no credits of the above table are earned.

Computation of SGPA and CGPA:

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i) $\mathbf{S_k}$ the SGPA of $\mathbf{k^{th}}$ semester (1 to 8) is the ratio of sum of the product of the number of credits and grade points to the total credits of all courses registered by a student, i.e.,

$$SGPA\ (S_k) = \sum_{i=1}^{n} (C_i * G_i) / \sum_{i=1}^{n} C_i$$

Where **Ci** is the number of credits of the $\mathbf{i^{th}}$ course and **Gi** is the grade point scored by the student in the $\mathbf{i^{th}}$ course and **n** is the number of courses registered in that semester.

ii) The CGPA is calculated in the same manner taking into account all the courses **m**, registered by student over all the semesters of a programme, i.e., up to and inclusive of $\mathbf{S_k}$, where $\mathbf{k \geq 2}$.

$$CGPA = \sum_{i=1}^{m} (C_i * G_i) / \sum_{i=1}^{m} C_i$$

iii) The SGPA and CGPA shall be rounded off to 2 decimal points.

14. Award of Class: After a student satisfies all the requirements prescribed for the completion of the Degree and becomes eligible for the award of B.Tech. Degree by JNTUH, he/she shall be placed in one of the following four classes based on CGPA secured from the 160 credits.

S. No	Class Awarded	CGPA Secured
1	First Class with Distinction	CGPA >= 8.00 with no F or below grade/detention anytime during the programme
2	First Class	CGPA >= 8.00 with rest of the clauses of S.No 1 not satisfied
3	First Class	CGPA ≥ 6.50 and CGPA < 8.00
4	Second Class	CGPA ≥ 5.50 and CGPA < 6.50
5	Pass Class	CGPA ≥ 5.00 and CGPA < 5.50

Equivalence of grade to marks

Marks % = (CGPA -0.5)*10

15. Award of 2-Year B.Tech. Diploma Certificate

1. A student is awarded 2-Year UG Diploma Certificate in the concerned engineering branch on completion of all the academic requirements and earned all the 80 credits (within 4 years from the date of admission) upto B. Tech. – II Year – II Semester if the student want to exit the 4-Year B. Tech. program and requests for the 2-Year B.Tech (UG) Diploma Certificate.

2. The student **once opted and awarded for 2-Year UG Diploma Certificate, the student will be permitted to join** in B. Tech. III Year – I Semester and continue for completion of remaining years of study for 4-Year B. Tech. Degree. ONLY in the next academic year along with next batch students. However, if any student wishes to continue the study after opting for exit, he/she should register for the subjects/courses in III Year I Semester before commencement of classwork for that semester.

3. The students, who exit the 4-Year B. Tech. program after II Year of study and wish to re-join the B.Tech. program, must submit the 2 -Year B. Tech. (UG) Diploma Certificate awarded to him, subject to the eligibility for completion of Course/Degree.

4. A student may be permitted to take one year break after completion of II Year II Semester or B. Tech. III Year II Semester (with university permission through the principal of the college well in advance) and can re-enter the course in **next Academic Year in the same college** and complete the course on fulfilling all the academic credentials within a stipulated duration i.e. double the duration of the course (Ex. within 8 Years for 4-Year program).

16. Withholding of Results: If the student has not paid dues to the Institute/ University, or if any case of indiscipline is pending against the student, the result of the student (for that Semester) may be withheld and the student will not be allowed to go into the next semester. The award or issue of the Degree may also be withheld in such cases.

17. Transitory Regulations

A. For students detained due to shortage of attendance:

1. A Student who has been detained in I year of GR20 Regulations due to lack of attendance, shall be permitted to join I year I Semester of GR22 Regulations and he is required to

complete the study of B.Tech. programme within the stipulated period of eight academic years from the date of first admission in I Year.

2. A student who has been detained in any semester of II, III and IV years of GR20 regulations for want of attendance, shall be permitted to join the corresponding semester of GR22 Regulations and is required to complete the study of B.Tech. within the stipulated period of eight academic years from the date of first admission in I Year. The GR22 Academic Regulations under which a student has been readmitted shall be applicable to that student from that semester. See rule (C) for further Transitory Regulations.

B. For students detained due to shortage of credits:

3. A student of GR20 Regulations who has been detained due to lack of credits, shall be promoted to the next semester of GR22 Regulations only after acquiring the required number of credits as per the corresponding regulations of his/her first admission. The total credits required are 160 including both GR20 & GR22 regulations. The student is required to complete the study of B.Tech. within the stipulated period of eight academic years from the year of first admission. The GR22 Academic Regulations are applicable to a student from the year of readmission. See rule (C) for further Transitory Regulations.

C. For readmitted students in GR22 Regulations:

4. A student who has failed in any subject under any regulation has to pass those subjects in the same regulations.
5. The maximum credits that a student acquires for the award of degree, shall be the sum of the total number of credits secured in all the regulations of his/her study including GR22 Regulations. **There is NO exemption of credits in any case**.
6. If a student is readmitted to GR22 Regulations and has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in GR22 Regulations will be substituted by another subject to be suggested by the college academic administration.

Note:

If a student readmitted to GR22 Regulations and has not studied any courses/topics in his/her earlier regulations of study which is prerequisite for further subjects in GR22 Regulations, then the college shall conduct remedial classes to cover those courses/topics for the benefit of the students.

18. Transfer of students from the Constituent Colleges of JNTUH or from other Colleges / Universities:

a) Transfer of students from the Constituent Colleges of JNTUH or from other Colleges/ Universities shall be considered only on case-to-case basis.

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

c) The students seeking transfer to GRIET from various other Universities/institutions have to pass the failed courses which are equivalent to the courses of GRIET, and also pass the courses of GRIET which the students have not studied at the earlier institution. Further, though the students have passed some of the courses at the earlier institutions, if the same courses are prescribed in different semesters of GRIET, the students have to study those courses in GRIET in spite of the fact that those courses are repeated.

d) The transferred students from other Universities/institutions to GRIET who are on rolls are to be provided one chance to write the CBT (internal marks) in the equivalent course(s) as per the clearance (equivalence) letter issued by the University.

19. General Rules

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

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

c. In case of any error in the above rules and regulations, the decision of the Academic Council is final.

d. The college may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the college.

Academic Regulations for B.Tech. (Lateral Entry) under GR22

(Applicable for Batches Admitted from 2023-24)

1. All regulations as applicable for B.Tech. 4-year degree programme (Regular) will hold good for B.Tech. (Lateral Entry Scheme) except for the following rules:
   a) Pursued programme of study for not less than three academic years and not more than six academic years.
   b) A student should register for all 120 credits and secure all credits. The marks obtained in all 120 credits shall be considered for the calculation of the final CGPA.
   c) Students who fail to fulfil all the academic requirements for the award of the degree within six academic years from the year of their admission, shall forfeit their seat in B.Tech. programme.

2. **Academic Requirements and Promotion Rules:**

   a) A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory or laboratories if he/she secures not less than 35% of marks in the Semester-end Examination and a minimum of 40% of the sum total of the Internal Evaluation and Semester-end Examination taken together.
   b) A student shall be promoted to the next year only when he/she satisfies the requirements of all the previous semesters.

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 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.	Regular course of study of Third year second semester.
5	Fourth year first semester to Fourth year second semester.	Regular course of study of Fourth year first semester.

3. Award of Class: After a student satisfies all the requirements prescribed for the completion of the Degree and becomes eligible for the award of B.Tech. Degree by JNTUH, he/she shall be placed in one of the following four classes based on CGPA secured from the 120 credits.

S. No	Class Awarded	CGPA Secured
1	First Class with Distinction	CGPA >= 8.00 with no F or below grade/ detention anytime during the Programme
2	First Class	CGPA >= 8.00 with rest of the clauses of S.no 1 not satisfied
3	First Class	CGPA ≥ 6.50 and CGPA < 8.00
4	Second Class	CGPA ≥ 5.50 and CGPA < 6.50
5	Pass Class	CGPA ≥ 5.00 and CGPA < 5.50

Academic Regulations for B.Tech. with Honors Programme under GR22

(Applicable for Batches Admitted from 2022-23)

1. Objectives

The key objectives of offering B. Tech. with Honors programme are:

- To expand the domain knowledge of the students laterally and vertically.
- To increase the employability of undergraduate students with expanded knowledge in one of the core Engineering disciplines.
- To provide an opportunity to students to pursue their higher studies in wider range of specialisations.

2. Academic Regulations for B.Tech. Honors degree

a) The weekly instruction hours, internal & external evaluation and award of grades are on par with regular 4-Years B.Tech. programme.

b) For B.Tech. with Honors programme, a student needs to earn additional 20 credits (over and above the required 160 credits for B.Tech. degree). All these 20 credits need to be completed in III year and IV year only.

c) After registering for the Honors programme, if a student is unable to pass all courses in first attempt and earn the required 20 credits, he/she shall not be awarded Honors degree. However, if the student earns all the required 160 credits of B.Tech., he/she will be awarded only B.Tech. degree in the concerned programme.

d) There is no transfer of credits from courses of Honors programme to regular B.Tech. degree course and vice versa.

e) These 20 credits are to be earned from the additional courses offered by the host department in the college or from a closely related department in the college as well as from the approved MOOCS platform.

f) For the courses selected under MOOCS platform following guidelines may be followed:

- Prior to registration of MOOCS courses, formal approval of the courses, by the University is essential. University before the issue of approval considers the parameters like the institute / agency which is offering the course, syllabus, credits, duration of the programme and mode of evaluation etc.
- Minimum credits for a MOOCS course must be equal to or more than the credits specified in the Honors course structure provided by the University.
- Only Pass-grade/marks or above shall be considered for inclusion of grades in the Honors grade memo.
- Any expenses incurred for the MOOCS courses are to be met by the students only.

g) The option to take the Honors programme is purely the choice of the student.

h) The student shall be given a choice of withdrawing all the courses registered and/or the credits earned for Honors programme at any time; and in that case the student will be awarded only B.Tech. degree in the concerned programme on earning the required credits of 160.

i) A student who chooses an Honors programme is not eligible to choose a Minor programme and vice-versa.

j) The B.Tech. with Honors programme shall be offered to the students who are pursuing their III year I semester if they fulfil the eligibility criteria.

k) A student can graduate with Honors if he/she fulfils the requirements for his/her regular B.Tech. programme as well as fulfils the requirements for Honors programme.

l) The department shall prepare the time-tables for each Honors programme offered at their respective departments without any overlap/clash with other courses of study in the respective semesters.

3. Eligibility conditions of the students for the Honors degree

a) A student can opt for B.Tech. degree with Honors, if she/he passed all subjects in first attempt in all the semesters till the results announced and maintaining 7.5 or more CGPA.
b) If a student fails in any registered course of either B.Tech. or Honors in any semester of four years programme, he/she will not be eligible for obtaining Honors degree. He will be eligible for only B.Tech. degree
c) Prior approval of mentor and Head of the Department for the enrolment into Honors programme, before commencement of III year I Semester (V Semester), is mandatory.
d) If more than 30% of the students in a programme fulfil the eligibility criteria (as stated above), the number of students given eligibility should be limited to 30%. The criteria to be followed for choosing 30% candidates in a programme may be the CGPA secured by the students till II year I semester.
e) The department concerned should be preferably NBA accredited and shall offer at least one M. Tech. Programme.
f) Successful completion of 20 credits earmarked for Honors programme with atleast 7.5 CGPA along with successful completion of 160 credits earmarked for regular B.Tech. Programme with at least 7.5 CGPA and passing all subjects in first attempt gives the eligibility for the award of B.Tech. (Honors) degree.
g) For CGPA calculation of B.Tech. course, the 20 credits of Honors programme will not be considered.

4.Registration for the course in Honors programme

a) At the beginning of each semester, just before the commencement of classes, students shall register for the courses which they wish to take in that semester.
b) The students should choose a course from the list against each semester (from Honors course structure) other than the courses they have studied/registered for regular B.Tech. programme. No course should be identical to that of the regular B.Tech. course. The students should take the advice of faculty mentors while registering for a course at the beginning of semester.
c) The maximum No. of courses for the Honors is limited to two (three in case of inclusion of lab) in a semester along with regular semester courses.
d) The registration fee to be collected from the students by the College is **Rs. 1000/-** per one credit.
e) A fee for late registration may be imposed as per the norms.

5. Academic Regulations for Honors degree in B.Tech. programmes

S. No.	Year / Semester	Course to be chosen from/ studied	Mode of Learning	No. of Credits
1	III-1	PE-1 or PE-2	Blended/Conventional	3
2	III-2	Research Methodologies	Conventional	3
3	III-2	PE-3	Conventional	3
4	IV-1	PE-4	Conventional	3
5	IV-1	PE-5	conventional	3
6	IV-2	Technical Paper writing	Under the mentorship of a supervisor	2
7	IV-2	PE-6 or an Interdisciplinary subject as suggested by university	MOOCS	3
Total Credits				20

Note:

i) Professional Elective (PE) course should be selected (which is not studied) from each Professional Electives list provided in regular B.Tech. course.

ii) Courses can be chosen as in above table.

a) Technical paper writing:

i) The student shall take up a problem/topic of engineering programmes (inter-disciplinary nature) and apply the knowledge which they acquired while pursuing their engineering programme. It is expected to analyse, design and develop an application for the identified problem and write a technical paper/document.

Alternatively, the student i) shall identify a research topic, analyse the problem, carryout the experiments, write a technical paper and publish in /communicate for a Scopus indexed journal/any journal with decent reputation or ii) Demonstrate a talent/an idea/development of an innovative product.

ii) The evaluation shall be done by the same committee which is constituted for project evaluation, along with the final semester project work.

iii) The students should start exploration for the Technical Paper Writing immediately after the semester exams of III-II semester. Only the evaluation part shall be carried in IV-II semester.

b) Research Methodologies course can have students from all departments (if the number of students is more, multiple parallel sessions may be conducted). The time slots in the time-tables of respective departments should be aligned. The external evaluation of Research Methodologies course shall be done by the University.

c) If the blended course option is chosen, for the subject in III-I semester, the learning should be partially in online mode and partially in offline mode. The external evaluation shall be done through the examination section of the college; however, for the internal evaluation component, online assessment should also be taken into account while finalising the internal marks by the course teacher.

Academic Regulations for B.Tech. with Minors Programme under GR22

(Applicable for Batches Admitted from 2022-23)

1. Objectives

The key objectives of offering B. Tech. with Minor program are:

- To expand the domain knowledge of the students in one of the other programmes of engineering.
- To increase the employability of undergraduate students keeping in view of better opportunity in interdisciplinary areas of engineering & technology.
- To provide an opportunity to students to pursue their higher studies in the inter-disciplinary areas in addition to their own programme of study.
- To offer the knowledge in the areas which are identified as emerging technologies/thrust areas of Engineering.

2. Academic Regulations for B.Tech. Degree with Minor programmes

a) The weekly instruction hours, internal & external evaluation and award of grades are on par with regular 4 -Years B.Tech. programme.

b) For B.Tech. with Minor, a student needs to earn additional 18 credits (over and above the required 160 credits for B.Tech. degree). All these 18 credits need to be completed in III year and IV year only.

c) After registering for the Minor programme, if a student is unable to earn all the required 18 credits in a specified duration (twice the duration of the course), he/she shall not be awarded Minor degree. However, if the student earns all the required 160 credits of B.Tech., he/she will be awarded only B.Tech. degree in the concerned programme.

d) There is no transfer of credits from Minor programme courses to regular B.Tech. degree course and vice versa.

e) These 18 credits are to be earned from the additional Courses offered by the host department in the college as well as from the MOOCS platform.

f) For the course selected under MOOCS platform following guidelines may be followed:

i) Prior to registration of MOOCS courses, formal approval of the courses, by the University is essential. University before the issue of approval considers the parameters like the institute / agency which is offering the course, syllabus, credits, duration of the programme and mode of evaluation etc.

ii) Minimum credits for MOOCS course must be equal to or more than the credits specified in the Minor course structure provided by the University.

iii) Only Pass-grade/marks or above shall be considered for inclusion of grades in minor grade memo.

iv) Any expenses incurred for the MOOCS courses are to be met by the students only.

g) The option to take a Minor programme is purely the choice of the student.

h) The student shall be given a choice of withdrawing all the courses registered and/or the credits earned for Minor programme at any time; and in that case the student will be awarded only B.Tech. degree in the concerned programme on earning the required credits of 160.

i) The student can choose only one Minor programme along with his/her basic engineering degree. A student who chooses an Honors programme is not eligible to choose a Minor programme and vice-versa.

j) A student can graduate with a Minor if he/she fulfils the requirements for his/her regular B.Tech. programme as well as fulfils the requirements for Minor programme.

k) The institute shall maintain a record of students registered and pursuing their Minor programmes, minor programme-wise and parent programme -wise. The same report needs to be sent to the University once the enrolment process is complete.

l) The institute / department shall prepare the time-tables for each Minor course offered at their respective institutes without any overlap/clash with other courses of study in the respective semesters.

3. Eligibility conditions for the student to register for Minor programme

a) A student can opt for B.Tech. programme with Minor programme if she/he has no active backlogs till II Year I Semester (III semester) at the time of entering into III year I semester.
b) Prior approval of mentor and Head of the Department for the enrolment into Minor programme, before commencement of III year I Semester (V Semester), is mandatory
c) If more than 50% of the students in a programme fulfil the eligibility criteria (as stated above), the number of students given eligibility should be limited to 50%.

4. Registration for the courses in Minor Programme

a) At the beginning of each semester, just before the commencement of classes, students shall register for the courses which they wish to take in that semester.
b) The students should choose a course from the list against each semester (from Minors course structure) other than the courses they have studied/registered for regular B.Tech. programme. No course should be identical to that of the regular B.Tech. course. The students should take the advice of faculty mentors while registering for a course at the beginning of semester.
c) The maximum No. of courses for the Minor is limited to two (three in case of inclusion of lab) in a semester along with regular semester courses.
d) The registration fee to be collected from the students by the College is Rs. 1000/- per one credit.
e) A fee for late registration may be imposed as per the norms.

5. Minor courses and the offering departments

S. No.	Minor Programme	Eligible programme of students	@Offering Department	Award of Degree
1.	Artificial Intelligence & Machine Learning	All programmes, except B.Tech. in CSE (AI&ML) /B.Tech. (AI&ML)/ B.Tech. (AI)/ B.Tech. CSE(AI)	CSE	"B.Tech. in programme name with Minor in Artificial Intelligence & Machine Learning"

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

Bachupally, Kukatpally, Hyderabad–500090, India.

B. Tech Mechanical Engineering GR22 Course Structure

I B. Tech (ME) - I Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	Maths	BS	GR22A1001	Linear Algebraand Function Approximation	3	1	0	4	3	1	0	4	40	60	100
2	Chemistry	BS	GR22A1005	EngineeringChemistry	3	1	0	4	3	1	0	4	40	60	100
3	English	BS	GR22A1006	English	2	0	0	2	2	0	0	2	40	60	100
4	CSE	ES	GR22A1007	Programming for Problem Solving	2	1	0	3	2	1	0	3	40	60	100
5	ME	ES	GR22A1011	Graphics for Engineers	1	0	2	3	1	0	4	5	40	60	100
6	Chemistry	BS	GR22A1015	Engineering Chemistry Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
7	CSE	ES	GR22A1017	Programming for Problem Solving Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
8	English	BS	GR22A1016	English Language and Communication Skills Lab	0	0	1	1	0	0	2	2	40	60	100
TOTAL					**11**	**3**	**6**	**20**	**11**	**3**	**12**	**26**	**320**	**480**	**800**
9	Mgmt	MC	GR22A1022	Design Thinking	0	0	0	0	2	0	0	2	40	60	100

I B. Tech (ME) - II Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	Maths	BS	GR22A1002	Differential Equations and Vector Calculus	3	1	0	4	3	1	0	4	40	60	100
2	Physics	BS	GR22A1004	EngineeringPhysics	3	1	0	4	3	1	0	4	40	60	100
3	ME	ES	GR22A1010	EngineeringMechanics	3	1	0	4	3	1	0	4	40	60	100
4	CSE	ES	GR22A1012	Data Structures	2	1	0	3	2	1	0	3	40	60	100
5	Physics	BS	GR22A1014	EngineeringPhysics Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
6	CSE	ES	GR22A1020	Data StructuresLab	0	0	1	1	0	0	2	2	40	60	100
7	ME	ES	GR22A1021	Engineering Workshop	1	0	1.5	2.5	1	0	3	4	40	60	100
TOTAL					**12**	**4**	**4**	**20**	**12**	**4**	**08**	**24**	**280**	**420**	**700**

II B. Tech (ME) – I Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC	GR22A2038	Kinematics of Machinery	3	0	0	3	3	0	0	3	40	60	100
2	ME	PC	GR22A2039	Metallurgy andMaterial Science	3	0	0	3	3	0	0	3	40	60	100
3	EEE	PC	GR22A2014	Basic Electrical and Electronics Engineering	3	0	0	3	3	0	0	3	40	60	100
4	ME	PC	GR22A2040	Strength of Materials	3	0	0	3	3	0	0	3	40	60	100
5	ME	PC	GR22A2041	Thermodynamics	3	0	0	3	3	0	0	3	40	60	100
6	ME	PC	GR22A2042	Machine & Production Drawing Lab	0	0	2	2	0	0	4	4	40	60	100
7	ME	PC	GR22A2043	Strength of Materials Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
8	ME	PC	GR22A2044	Metallurgy andMaterial Science Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
TOTAL					**15**	**0**	**5**	**20**	**15**	**0**	**10**	**25**	**320**	**480**	**800**
9	ME	MC	GR22A2001	Environmental Science	0	0	0	0	2	0	0	2	40	60	100

II B. Tech (ME) - II Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC	GR22A2045	Thermal Engineering	3	0	0	3	3	0	0	3	40	60	100
2	ME	PC	GR22A2046	Fluid Mechanics & Fluid Machines	3	0	0	3	3	0	0	3	40	60	100
3	ME	PC	GR22A2047	Dynamics ofMachinery	3	0	0	3	3	0	0	3	40	60	100
4	Maths	BS	GR22A2009	Computational Mathematicsfor Engineers	3	0	0	3	3	0	0	3	40	60	100
5	ME	PC	GR22A2048	Manufacturing Engineering	2	1	0	3	2	1	0	3	40	60	100
6	ME	PC	GR22A2049	Thermal Engineering Lab	0	0	2	2	0	0	4	4	40	60	100
7	ME	PC	GR22A2050	Manufacturing Engineering Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
8	ME	PC	GR22A2051	Fluid Mechanics & Fluid Machines Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
TOTAL					**14**	**1**	**5**	**20**	**14**	**1**	**10**	**25**	**320**	**480**	**800**
9	Mgmt	MC	GR22A2003	Constitution of India	0	0	0	0	2	0	0	2	40	60	100
10	English	MC	GR22A2108	Effective Technical Communication	0	0	0	0	2	0	0	2	40	60	100
11	ME	MC	GR22A2109	Real-time Research Project/ Societal Related Project	0	0	2	2	0	0	4	4	50	--	50

III B. Tech (ME) – I Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC	GR22A3023	Machine Design	2	1	0	3	2	1	0	3	40	60	100
2	Mgmt	HS	GR22A2004	Economics and Accounting for Engineers	3	0	0	3	3	0	0	3	40	60	100
3	ME	PC	GR22A3024	Manufacturing Technology	3	0	0	3	3	0	0	3	40	60	100
4	ME	PC	GR22A3025	Applied Thermodynamics	2	0	0	2	2	0	0	2	40	60	100
5		PE-I		Professional Elective-I	3	0	0	3	3	0	0	3	40	60	100
6		OE-I		Open Elective-I	3	0	0	3	3	0	0	3	40	60	100
7	ME	PC	GR22A3031	Manufacturing Technology Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
8	ME	PC	GR22A3032	Computer Aided Modeling and 3D Printing Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
9	Mgmt	MC	GR22A2002	Value Ethics and Gender Culture	0	0	0	0	2	0	0	2	40	60	100
TOTAL					**16**	**1**	**3**	**20**	**16**	**1**	**6**	**23**	**320**	**480**	**800**

PROFESSIONAL ELECTIVE-I				
S.No	**BOS**	**Group**	**Course Code**	**Course Name**
1	ME	PE	GR22A3026	Robotics
2	ME	PE	GR22A3027	Advanced Strength of Materials
3	ME	PE	GR22A3028	Mechanical Vibrations
4	ME	PE	GR22A3029	Artificial Intelligence in Mechanical Engineering

OPEN ELECTIVE-I				
S.No	**BOS**	**Group**	**Course Code**	**Course Name**
1	ME	OE	GR22A3030	Industrial Automation and Control

III B. Tech (ME) – II Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC	GR22A3098	Design of Machine Elements	3	0	0	3	3	0	0	3	40	60	100
2	ME	PC	GR22A3099	Heat Transfer	2	1	0	3	2	1	0	3	40	60	100
3	ME	PC	GR22A3100	Industrial Engineering and Management	3	0	0	3	3	0	0	3	40	60	100
4		PE-II		Professional Elective-II	3	0	0	3	3	0	0	3	40	60	100
5		OE-II		Open Elective-II	3	0	0	3	3	0	0	3	40	60	100
6	ME	PC	GR22A3106	Metrology Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
7	ME	PC	GR22A3107	Heat Transfer Lab	0	0	1.5	1.5	0	0	3	3	40	60	100
8	ME	PW	GR22A3089	Mini Project with Seminar	0	0	2	2	0	0	4	4	40	60	100
TOTAL					**14**	**1**	**5**	**20**	**14**	**1**	**10**	**25**	**320**	**480**	**800**

PROFESSIONAL ELECTIVE-II			
S.No	**BOS**	**Course Code**	**Course Name**
1	ME	GR22A3101	Metrology and Surface Engineering
2	ME	GR22A3102	Material Characterization and Testing
3	ME	GR22A3103	Un-Convectional Machining Process
4	ME	GR22A3104	Intelligent Manufacturing Systems

OPEN ELECTIVE-II			
S.No	**BOS**	**Course Code**	**Course Name**
1	ME	GR22A3105	Composite Materials

IV B. Tech (ME) – I Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC	GR22A4025	CAD/CAM	3	0	0	3	3	0	0	3	40	60	100
2	ME	PC	GR22A4026	Instrumentation and Control Systems	3	0	0	3	3	0	0	3	40	60	100
3		PE-III		Professional Elective-III	3	0	0	3	3	0	0	3	40	60	100
4		PE-IV		Professional Elective-IV	3	0	0	3	3	0	0	3	40	60	100
5		OE-III		Open Elective-III	3	0	0	3	3	0	0	3	40	60	100
6	ME	PC	GR22A4034	Instrumentation and Control Systems Lab	0	0	2	2	0	0	4	4	40	60	100
7	ME	PC	GR22A4035	Computer Aided Analysis and Manufacturing Lab	0	0	2	2	0	0	4	4	40	60	100
8	ME	PW	GR22A4082	Project Work- Phase I	0	0	6	6	0	0	12	12	40	60	100
TOTAL					**15**	**0**	**10**	**25**	**15**	**0**	**20**	**35**	**320**	**480**	**800**

PROFESSIONAL ELECTIVE-III			
S.No	**BOS**	**Course Code**	**Course Name**
1	ME	GR22A4027	Refrigeration and Air Conditioning
2	ME	GR22A4028	Power Plant Engineering
3	ME	GR22A4029	Automobile Engineering
4	ME	GR22A4030	Energy Conservation and Management

PROFESSIONAL ELECTIVE-IV			
S.No	**BOS**	**Course Code**	**Course Name**
1	ME	GR22A4031	Tribology
2	ME	GR22A4032	Design of Machine Tools Engineering
3	ME	GR22A4033	Soft Computing Techniques in Mechanical Engineering
4	ME	GR22A4123	Finite Element Analysis

OPEN ELECTIVE-III			
S.No	**BOS**	**Course Code**	**Course Name**
1	ME	GR22A4027	Refrigeration and Air Conditioning

IV B. Tech (ME) - II Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Hours				Int.	Ext	Total Marks
					L	T	P	Total	L	T	P	Total			
1	ME	PC	GR22A4103	Additive Manufacturing	3	0	0	3	3	0	0	3	40	60	100
2		PE-V		Professional Elective-V	3	0	0	3	3	0	0	3	40	60	100
3		PE-VI		Professional Elective-VI	3	0	0	3	3	0	0	3	40	60	100
4	ME	PW	GR22A4145	Project Work- Phase II	0	0	6	6	0	0	12	12	40	60	100
TOTAL					**8**	**1**	**6**	**15**	**8**	**1**	**12**	**21**	**160**	**240**	**400**

S.No	BOS	Course Code	Course Name
1	ME	GR22A4104	Renewable Energy Resources
2	ME	GR22A4105	Turbomachinery
3	ME	GR22A4106	Computational Fluid Dynamics
4	EEE	GR22A3015	Electrical and Hybrid Vehicles

S.No	BOS	Course Code	Course Name
1	ME	GR22A4107	Production Planning and Control
2	ME	GR22A4108	Mechatronic Systems
3	ME	GR22A4109	Microprocessor Applications in Manufacturing
4	EEE	GR22A4110	Micro and Nano Manufacturing

PROFESSIONAL ELECTIVES – 3 THREADS

S.No.	THREAD 1: DESIGN	THREAD 2: THERMAL	THREAD3: MANUFACTURING
1	Robotics	Refrigeration and Air-Conditioning	Metrology and Surface Engineering
2	Advanced Strength of Materials	Power Plant Engineering	Production Planning and Control
3	Mechanical Vibrations	Automobile Engineering	Un-Conventional Machining Processes
4	Artificial Intelligence in Mechanical Engineering	Energy Conservation and Management	Material Characterization and Testing
5	Tribology	Renewable Energy Resources	Microprocessor Applications in Manufacturing
6	Design And Machine Tool Engineering	Turbo machinery	Micro and Nano Manufacturing
7	Soft Computing Techniques in Mechanical Engineering	Computational Fluid Dynamics	Mechatronics
8	Finite Element Analysis	Electrical and Hybrid Vehicles	Intelligent Manufacturing Systems

OPEN ELECTIVES FOR GR22 REGULATIONS

THREAD 1	THREAD 2	OFFERED BY
Soft Skills and Interpersonal Skills (GR22A3145) Human Resource Development and Organizational Behavior (GR22A4049) Cyber Law and Ethics (GR22A4077) Economic Policies in India (GR22A4147)	Data Science for Engineers (GR22A3049)	**CSE**
	Data Analytics using Open-Source Tools (GR22A3120)	
	Augmented Reality and Virtual Reality (GR22A4054)	
	Basics of Java Programming (GR22A3072)	**CSE (AIML)**
	Introduction to DBMS (GR22A3141)	
	Introduction to Data Mining (GR22A4080)	
	Programming in Python (GR22A3077)	**CSE (DS)**
	Internet of Things (GR22A3147)	
	Scripting Languages (GR22A4085)	
	Services Science and Service Operational Management (GR22A4134)	**CSBS**
	IT Project Management (GR22A4135)	
	Marketing Research and Marketing Management (GR22A4136)	
	Introduction to Data Science (GR22A3056)	**IT**
	User Centric Human Computer Interaction (GR22A3127)	
	Design Patterns (GR22A4063)	
	Non-Conventional Energy Sources (GR22A3019)	**EEE**
	Concepts of Control Systems (GR22A3095)	
	Artificial Neural Networks and Fuzzy Logic (GR22A4022)	
	Principles of Communications (GR22A3040)	**ECE**
	Sensor Technology (GR22A3113)	
	Communication Technologies (GR22A4045)	
	Industrial Automation and Control (GR22A3030)	**ME**
	Composite Materials (GR22A3105)	
	Operations Research (GR22A3018)	
	Engineering Materials for Sustainability (GR22A3009)	
	Geographic Information Systems and Science (GR22A3086)	**CE**
	Environmental Impact Assessment (GR22A4011)	
	Basics of Java Programming (GR22A3072)	**CSE (AI)**
	Introduction to DBMS (GR22A3141)	
	Introduction to Data Mining (GR22A4080)	
	Introduction to Data Science (GR22A3056)	**CSIT**
	User Centric Human Computer Interaction (GR22A3127)	
	Design Patterns (GR22A4063)	

I YEAR
I SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
LINEAR ALGEBRA AND FUNCTION APPROXIMATION

Course Code: GR22A1001 **L/T/P/C: 3/1/0/4**
I Year I Semester

Course Outcomes:
1. Work with the essential tools of vector and matrix algebra
2. Compute eigenvalues and vectors for engineering applications
3. Illustrate matrix decomposition techniques to determine the exact or approximate solutions of a linear algebraic system.
4. Develop the skill of finding multivariable function optima
5. Illustrate the concepts of function approximation with measurement of error

UNIT I
Fundamentals of Vector and Matrix algebra: Operations on vectors and matrices- Orthogonal projection of vectors- Exact and generalized inverse of a matrix- Rank of a matrix- Linear independence of vectors- Structured square matrices (Symmetric, Hermitian, skew-symmetric, skew-Hermitian, orthogonal and unitary matrices)- Vector and matrix norms
Solution of a linear algebraic system of equations (homogeneous and non-homogeneous) using Gauss elimination

UNIT II
Matrix eigenvalue problem and Quadratic forms: Determination of eigenvalues and eigenvectors of a matrix, properties of eigenvalues and eigenvectors (without proof)- Similarity of matrices- Diagonalization of a matrix- Orthogonal diagonalization of a symmetric matrix- Definiteness of a symmetric matrix
Quadratic Forms- Definiteness and nature of a quadratic form- Reduction of a quadratic form to the canonical form using an orthogonal transformation

UNIT III
Matrix decomposition and Least squares solution of algebraic systems: LU decomposition- Cholesky decomposition- Gram-Schmidt ortho normalization process- QR factorization- Eigen decomposition of a symmetric matrix- Singular value decomposition Least squares solution of an over determined system of equations using QR factorization andthe generalized inverse- Estimation of the least squares error

UNIT IV
Multivariable differential calculus and Function optimization:
Partial Differentiation- Chain rule- Total differentiation- Jacobian- Functional dependence. Multivariable function Optimization-Taylor's theorem for multivariable functions- Unconstrained optimization of functions using the Hessian matrix- Constrained optimization using the Lagrange multiplier method.

UNIT V
Function approximation tools in engineering:
Function approximation using Taylor's polynomials- Properties of Chebyshev polynomials- Uniform approximation using Chebyshev polynomials.
The principle of least squares- Function approximation using polynomial, exponential and power curves using matrix notation- Estimating the Mean squared error

Text Books:

1. Advanced Engineering Mathematics, 5th edition, R.K.Jain and S.R.K.Iyengar, Narosa publishing house
2. Higher Engineering Mathematics- B.S.Grewal- Khanna publications

References:

1. Introduction to Linear Algebra, Gilbert Strang, 5th edition, Wellesley,2017.
2. Numerical methods for scientific and engineering computation, M.K.Jain, S.R.K.Iyengar,
3. R.K.Jain- 3rd edition- New Age publishers
4. Applied Mathematics, Vol. I & II, P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, 2010

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING CHEMISTRY

Course Code: GR22A1005 **L/T/P/C: 3/1/0/4**
I Year I Semester

Course Outcomes:

1. Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Relate electromagnetic spectra used for exciting different molecular energy levels in various spectroscopic techniques and their application in medicine and other fields.
3. Recognize various problems related to electrochemistry and corrosion in industry and is able to explain different prevention techniques and apply concepts of chemistry in engineering.
4. Know the origin of different types of engineering materials used in modern technology and interpret different problems involved in industrial utilization of water.
5. Understand the processing of fossil fuels for the effective utilization of chemical energy.

UNIT I
Atomic and Molecular Structure (8Lectures)
Atomic and Molecular orbitals - Definition, examples and comparison, Molecular orbitaltheory-postulates and MO energy diagrams of N_2 and O_2.Theories of Metallic bonding – Free electron theory, Resonance theory, Molecular orbital theory, Valence Bond Theory – Postulates and Limitations, Bonding in $[Ni(CO)_4]$, $[Ni(Cl)_4]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Co(NH_3)_6]^{3+}$, and $[CoF_6]^{3-}$. Crystal Field Theory, Crystal Field Splitting oftransition metal ion d-orbitals in octahedral, tetrahedral and square planar geometries.

UNIT II
Spectroscopic Techniques and Applications (10 Lectures)
Regions of Electromagnetic spectrum. Molecular spectroscopy: Rotational Spectroscopy: Rotation of molecules, Rotational spectra of rigid diatomic molecules, Selection rules.
Vibrational Spectroscopy: The vibrating diatomic molecule, Simple and anharmonicoscillators of a diatomic molecule, Selection rules, Applications of IR spectroscopy.
NMR Spectroscopy: Criteria for NMR activity (Magnetic and non-magnetic nuclei), Basicconcepts and Principle of ^1H NMR spectroscopy, Chemical shift- Shielding and Deshielding. Magnetic Resonance Imaging.

UNIT III
Batteries and Corrosion (12 Lectures)
Batteries: Primary and Secondary types, Lithium ion and Lead acid batteries. Fuel cells: Definition, Hydrogen-Oxygen fuel cell and Microbial Fuel cell – working principle and applications.
Corrosion: Definition, causes and effects of corrosion, Theories of chemical and electro chemical corrosion with mechanism, Differential metal corrosion - Galvanic corrosion, Differential aeration corrosion - pitting corrosion, Factors affecting corrosion – Nature of metal (Position of metal, Relative areas, Purity and Passivity), Nature of Environment (pH, Temperature and Humidity), Corrosion control methods: Cathodic protection (sacrificial anodic and impressed current cathodic protection), Metallic coatings: Hot dipping-galvanization and tinning.

UNIT IV
Engineering Materials and Water Technology (8Lectures)
Semiconductors: Si and Ge - preparation, purification and crystal growth by zone refining and

Czochralski pulling methods, Doping – Epitaxy, Diffusion and Ion implantation.
Plastics: Comparison between thermoplastics and thermosets, Fabrication of plastics - compression moulding and injection moulding. Conducting polymers – Definition, classification and applications.
Water: Hardness - Causes, types and units. Boiler troubles-scales and sludges, caustic embrittlement. Water purification: Demineralization by Ion-exchange process, Desalination by reverse osmosis method.

UNIT V
Stereochemistry and Energy Resources (8Lectures)
Stereochemistry: Elements of symmetry-plane of symmetry, centre of symmetry, alternating axis of symmetry. Chirality, Enantiomers – tartaric acid, Diastereomers- 2,3-dichloropentane, Conformational analysis of n-butane. Structure, synthesis and pharmaceutical applications ofaspirin and ibuprofen.
Energy sources: Fossil Fuels: Coal –types, analysis of coal- proximate and ultimate analysis and their significance, Petroleum-its composition, Cracking – Definition, Fluid bed catalytic cracking, Knocking and its mechanism in Internal Combustion engine, Octane rating, Hydrogen gas generation by Electrolysis process.

Text Books:
1. Engineering chemistry by P.C. Jain and M. Jain; Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
2. Textbook of Engineering Chemistry by A. Jayashree, Wiley Publications

Reference Books:
1. Organic Chemistry by Morrison, Boyd & Bhattacharjee (Pearson Pubs)
2. Engineering Chemistry by O.G.Palanna, Tata McGraw Hills Private Ltd.
3. Fundamentals of Molecular Spectroscopy, by C.N. Banwell. McGraw Hill Publication
4. A Textbook of Engineering Chemistry by Shashi Chawla, Dhanpat Rai Publishing Company (P) Ltd., New Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGLISH

Course Code: GR22A1006 **L/T/P/C: 2/0/0/2**
I Year I Semester

Course Outcomes:
1. Use English Language effectively in spoken and written forms.
2. Comprehend the given texts and respond appropriately.
3. Communicate confidently in various contexts and different cultures.
4. Acquire proficiency in English including reading and listening comprehension, writing and speaking skills.
5. Listen and respond appropriately.

UNIT I
Where the Mind is without Fear poem by Rabindranath Tagore
Vocabulary: The Concept of Word Formation -- The Use of Prefixes and Suffixes.
Grammar: Identifying Common Errors in Writing with Reference to Articles andPrepositions.
Reading: Reading and Its Importance- Techniques for Effective Reading
Writing: Sentence Structures -Use of Phrases and Clauses in Sentences-Importance of Proper Punctuation - Techniques for writing precisely - Paragraph writing - Do's and Don'ts of Paragraph Writing - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT II
The Last Leaf by O. Henry Vocabulary: Synonyms and Antonyms.
Grammar: Modal Auxiliaries - Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.
Reading: Sub-skills of Reading- Skimming and Scanning
Writing: Précis Writing, Describing Objects, Places and Events – Classifying - Providing Examples or Evidence

UNIT III
'Blue Jeans' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.
Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.
Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiersand Tenses.
Reading: Improving Comprehension Skills – Techniques for Good Comprehension
Writing: Format of a Formal Letter-Writing Formal Letters E.g. Letter of Complaint, Letter of Requisition and Letter of permission, Use of phrases for formal and informal letter writing and Email etiquette

UNIT IV
'What Should You Be Eating' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.
Vocabulary: Standard Abbreviations in English and Phrasal Verbs **Grammar:** Redundancies and Clichés in Oral and Written Communication. **Reading**: Comprehension- Intensive Reading and Extensive Reading
Writing: Writing Introduction and Conclusion -Essay Writing- Argumentative andDiscursive

essay – Picture Composition

UNIT V

'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: One Word Substitutes, Technical vocabulary and their usage

Grammar: Common Errors in English

Reading: Reading Comprehension-Exercises for Practice

Writing: What is Report Writing - Technical Reports vs General Reports – Importance of Report Writing – Structure and characteristics of Report Writing - Relevance of Reports to Engineers

Text Books:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge UniversityPress.

References:

1. Swan, M. (2016). Practical English Usage. Oxford University Press.
2. Kumar, S and Lata, P. (2018). Communication Skills. Oxford University Press.
3. Wood, F.T. (2007). Remedial English Grammar. Macmillan.
4. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
5. Hamp-Lyons, L. (2006). Study Writing. Cambridge University Press.
6. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PROGRAMMING FOR PROBLEM SOLVING

Course Code: GR22A1007 **L/T/P/C: 2/1/0/3**
I Year I Semester

Course Outcomes:
1. Design algorithms and flowcharts for problem solving and illustrate the fundamentals of Clanguage.
2. Identify and apply control structures and arrays to solve problems.
3. Discover the need for strings and functions in problem solving and apply it.
4. Analyze the need for pointers and structures in C and implement for solutions.
5. Interpret working with files, preprocessor directives and command line arguments in C.

UNIT I
Introduction to Programming:
Introduction to Algorithms: Representation of Algorithm, Flowchart, Pseudo code with examples, compiling and executing programs, syntax and logical errors.
Introduction to C Programming Language: Structure of C program, keywords, variables, constants, datatypes, operators, precedence and associativity, expression evaluation, implicit and explicit type conversion, formatted and unformatted I/O.

UNIT II
Decision Making and Arrays:
Branching and Loops: Conditional branching with simple if, if-else, nested if else, else if ladder, switch-case, loops: for, while, do-while, jumping statements: goto, break, continue, exit.
Arrays: one and two dimensional arrays, creating, accessing and manipulating elements of arrays.
Searching: Introduction to searching, Linear search and Binary search.

UNIT III
Strings and Functions:
Functions: Introduction to structured programming, function declaration, signature of a function, parameters and return type of a function, categories of functions, parameter passing techniques, passing arrays and strings to functions, recursion, merits and demerits of recursive functions, storage classes.
Strings: Introduction to strings, operations on characters, basic string functions available in C - strlen, strcat, strcpy, strrev, strcmp, String operations without string handling functions, arrays of strings.

UNIT IV
Pointers and Structures:
Pointers: Idea of pointers, declaration and initialization of pointers, pointer to pointer, void pointer, null pointer, pointers to arrays and structures, function pointer.
Structures and Unions: Defining structures, declaring and initializing structures, arrays within structures, array of structures, nested structures, passing structures to functions, unions, typedef.

UNIT V
File handling and Preprocessor in C:
Files: Text and binary files, creating, reading and writing text and binary files, random accessto files, error handling in files.
Preprocessor: Commonly used preprocessor commands like include, define, undef, if, ifdef, ifndef, elif, command line arguments, enumeration data type.

TEXT BOOKS:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)

REFERENCE BOOKS:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
3. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education
4. Herbert Schildt, C: The Complete Reference, Mc Graw Hill, 4th Edition

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
GRAPHICS FOR ENGINEERS

Course Code: GR22A1011 **L/T/P/C: 1/0/4/3**
I Year I Semester

Course Outcomes:
1. Interpret industrial drawings and read working drawings.
2. Draw engineering objects like springs using AutoCAD.
3. Imagine and create multi-views of 2-d plane figures.
4. Construct and interpret multi-views of 3-d solid objects with proper dimensioning, scalingetc.
5. Draw and create pictorial views and model the industrial objects like gears and bearings with solid modelling commands available in AutoCAD tool.

UNIT I
Engineering Graphics with CAD– Introduction engineering graphics and significance of computer aided design CAD software, advanced commands, dimensioning and tolerancing, fundamentals of 2-D construction.

UNIT II
Orthographic projection – Introduction, definition, and classification of projections; pictorial and multi-view, significance of first and third angle methods of projections; **Projections of points** (in all quadrants) and **straight lines** (inclined to one reference plane only).

UNIT III
Projections of planes - definition and types of plane figures (triangle, square, pentagon, hexagon, and circle); projections of plane (inclined to one reference plane only).

UNIT IV
Projections of solids - definition and types of solid objects (prism, cylinder, pyramid, and cone); projections of solid (axis inclined to one reference plane only); creation of threads, washers, keys, and springs.

UNIT V
Isometric views – construction of isomeric views of planes (polygons) and solids (prism, cylinder, pyramid, and cone); fundamentals of 3-d drawings, world coordinate system, solid modelling and commands, creation of gears and bearings; conversion of 3-d to 2-d views and construction of 3-d view from 2-d views (simple objects)

Text Books:
1. Engineering Graphics and Design by Kaushik Kumar / Apurbakumar Roy / Chikesh
2. Engineering Drawing by N.D.BHATT/CHAROTAR PUBLISHING HOUSE PVT LTD

Reference Books:
1. Engineering Graphics Essentials with AutoCAD 2018 Instruction by Kirstie Platenberg/SDC publications.
2. Engineering Drawing by Basanth Agrawal/ C M Agrawal/ McGraw Hill Education
3. Engineering Drawing by K.Venu Gopal/New Age Publications.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING CHEMISTRY LAB

Course Code: GR22A1015 **L/T/P/C: 0/0/3/1.5**
I Year I Semester

Course Outcomes:
1. Ability to perform experiments illustrating the principles of chemistry relevant to the study of science and engineering.
2. Determination of parameters like hardness and chloride content in water, measurement of redox potentials and conductance.
3. Understand the kinetics of reactions from a change in concentrations of reactants or products as a function of time.
4. Synthesize a drug molecule as an example of organic synthesis methods widely used in industry.
5. Determination of physical properties like adsorption and viscosity.

List of Experiments:
1. Determination of Total Hardness of water by complexometric method using EDTA
2. Determination of Chloride content of water by Argentometry
3. Redox titration: Estimation of Ferrous ion using standard KMnO4 by Permanganometry
4. Estimation of HCl by Conductometric titrations
5. Estimation of Ferrous ion by Potentiometry using dichromate
6. Determination of Rate constant of acid catalyzed reaction of methyl acetate
7. Adsorption of Acetic acid by charcoal
8. Determination of Surface tension of liquid by using Stalagmometer
9. Determination of Viscosity of liquid by using Ostwald's Viscometer
10. Determination of Partition Coefficient of Acetic acid between n-butanol and water
11. Synthesis of Aspirin
12. Synthesis of Paracetamol

Reference Books:
1. Vogel's text book of Practical organic chemistry, 5th Edition.
2. Senior Practical Physical Chemistry, B.D. Khosala, A. Gulati and V. Garg (R. Chand & Co., Delhi)
3. Text book on experiments and Calculations in Engineering Chemistry-S.S.Dara.
4. An introduction to practical chemistry, K.K. Sharma and D.S. Sharma (Vikas Publications, New Delhi)

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PROGRAMMING FOR PROBLEM SOLVING LAB

Course Code: GR22A1017 **L/T/P/C: 0/0/3/1.5**
I Year I Semester

Course Outcomes:
1. Translate algorithms into a working program and analyse and debug the codes using basics of C language.
2. Develop programs by choosing appropriate control structures.
3. Select and apply the concept of arrays and strings for problem solving.
4. Demonstrate problem solving using modular programming and pointers.
5. Solve the problems using structures, files and pre-processor directives.

TASK 1
1. Write a C program to convert days into years, weeks and days.(Assume a year has 365days).
2. Write a C program to find greatest and smallest among three numbers using conditional operator.
3. Write a C program to enter P, T, R and calculate Compound Interest.

TASK 2
1. Write a C program to swap two numbers using the following:
   (i) Using third variable
   (ii) Without using third variable
   (iii) Using bitwise operators
2. Write a C program to do the following using implicit and explicit type conversion
   (i) Convert Celsius temperature to Fahrenheit
   (ii) Convert Fahrenheit temperature to Celsius
   (iii) Find area of a triangle given sides a,b,c

TASK 3
1. Write a C program to add two numbers without using arithmetic operators in C.
2. Write a C program to determine whether a number is a power of 2 or not using bitwiseoperator and ternary operator.
3. Write a C program to check whether a number is even or odd using bitwise operator andternary operator.

TASK 4
1. Write a C program to find the roots of a quadratic equation using if-else.
2. Write a C program to input electricity unit charges and calculate total electricity billaccording to the given condition: For first 50 units Rs. 0.50/unit For next 100 units Rs. 0.75/unit For next 100 units Rs. 1.20/unit For unit above 250 Rs. 1.50/unit
   An additional surcharge of 20% is added to the bill
1. Write a menu driven C program to implement a simple arithmetic calculator.
2. Write a C program to display number of days in month using switch case (The input is month number 1 -12).

TASK 5
1. Write a C program check whether a given number is Perfect number or not.
2. Write a C program check whether a given number is Palindrome number or not.

3. Write a C program check whether a given number is Armstrong number or not.
4. Write a C program check whether a given number is Strong number or not.

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TASK 6

1. Write a C program to display the following patterns:

(i)
```
* * *  *
*      *
*      *
* * *  *
```

(ii)
```
        1
      2   3
    4       5       6
  7       8       9       10
```

(iii)
```
        1
      2   2
    3   3   3
  4   4   4   4
```

2. Write a C program to generate the prime numbers between x and y where x and y arestarting and ending values to be supplied by the user.
3. Write a C program to calculate the sum of following series:
   (i)S1=1+x/1!-x^2/2!+x^3/3!-x^4/4!+…..xn/n!
   (ii) S2=x^1/1+x^3/3+x^5/5+….+x^n/n

TASK 7

1. Write a C program to find sum, average and minimum and maximum in a list of numbers.
2. Write a C program to implement Linear search.
3. Write a C program to implement Binary search.

TASK 8

1. Write a C program to implement matrix addition.
2. Write a C program to implement matrix multiplication.

TASK 9

1. Write a C program to display binary equivalent of a given decimal number using functions.
2. Write a C program to implement transpose of a matrix using functions
3. Write a C program using functions that compares two strings to see whether they areidentical or not. The function returns 1 if they are identical, 0 otherwise.

TASK 10

1. Write a C program to implement factorial of a given integer using recursive and non-recursive functions.
2. Write a C program to find the GCD (greatest common divisor) of two given integers using recursive and non-recursive functions.
3. Write a C program to print first ‘n’ terms of Fibonacci series using recursive and non- recursive functions.

TASK 11

1. Write a C program to implement the following with and without string functions:
   (i) Reverse a string (ii) Concatenate 2 strings.
2. Write a C program to read a string and determine whether it is palindrome or not.
3. Write a C program to sort the ‘n’ strings in the alphabetical order.

TASK 12

1. Write a C program to implement function pointer to find sum and product of two numbers.
2. Write a C program to sort list of numbers using pointers.

TASK 13

1. Define a structure Student, to store the following data about a student: rollno(int), name(string) and

marks. Suppose that the class has 'n' students. Use array of type Student and create a function to read the students data into the array. Your program should be menu driven that contains the following options :

(i) Print all student details
(ii) Search student by rollno
(iii) Print the names of the students having the highest test score

2. Write a C program that uses structures and functions to perform addition and product of two complex numbers? (use structures and functions)

TASK 14

1. Write a C program to merge two files into a third file.
2. Write a C program to count number of characters in a file and also convert all lower case characters to upper case and display it
3. Write a C program to append a file and display it

TASK 15

1. Write a C program to find sum of 'n' numbers using command line arguments.
2. Write a C program to implement following pre-processor directives:
   i. define ii. undef iii. ifdef iv. ifndef.
3. Write a C program to create a user defined header file to find sum, product and greatest of two numbers.

Text Books:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures, Cengage Learning, (3rd Edition)

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hallof India
2. R.G. Dromey, How to solve it by Computer, Pearson (16th Impression)
3. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education
4. Herbert Schildt, C: The Complete Reference, McGraw Hill, 4th Edition

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

Course Code: GR22A1016 **L/T/P/C: 0/0/2/1**
I Year I Semester

Course Outcomes:
1. Interpret the role and importance of various forms of communication skills.
2. Demonstrate the skills needed to participate in a conversation that builds knowledgecollaboratively by listening carefully and respect others point of view.
3. Utilize various media of verbal and non-verbal communication with reference to various professional contexts.
4. Recognize the need to work in teams with appropriate ethical, social and professional responsibilities.
5. Speak and pronounce English intelligibly

English Language and Communication Skills Lab (ELCS) shall have two parts:
1. Computer Assisted Language Learning (CALL) Lab
2. Interactive Communication Skills (ICS) Lab

Exercise I
CALL Lab:
Understand: Introduction to Phonetics – Speech Sounds – Consonant and Vowel Sounds.
Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.
ICS Lab:
Understand: Ice Breaking and JAM.
Practice: Ice-Breaking Activity and JAM Session. Introducing oneself and others

Exercise II
CALL Lab:
Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.
Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms inContext.
ICS Lab:
Understand: Features of Good Conversation – Non-verbal Communication.
Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions- Telephone Etiquette

Exercise III
CALL Lab: Errors in Pronunciation-the Influence of Mother Tongue (MTI).
Understand: Intonation--Errors in Pronunciation-the Influence of Mother Tongue (MTI).
Practice: Common Indian Variants in Pronunciation–Differences in British and American Pronunciation.
ICS Lab:
Understand: Debates- argumentative vs persuasive - Public Speaking – Exposure to Structured Talks.
Practice: Debates- Making a Short Speech – Extempore.

Exercise IV
CALL Lab:
Understand: Presentation Skills – Elements of Presentation – Organizing Content – Use of Power Point – Slides Preparation

Practice: Presentation Skills
ICS Lab:
Understand: How to make informal and Formal Presentations
Practice: Collages / Poster Presentations-Power point presentations

Exercise V
CALL Lab:
Understand: Listening Skills and its importance-– Purpose- Process- Types- Barriers of Listening - Listening for General/Specific Details.
Practice: Listening Comprehension Tests.
ICS Lab:
Understand: Mind map - Story Telling - Narrating a story using mind maps
Practice: Weaving Stories

Minimum Requirement of infrastructural facilities for ELCS Lab:

1. Computer Assisted Language Learning (CALL) Lab
2. Interactive Communication Skills (ICS) Lab

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN THINKING

Course Code: GR22A1022 **L/T/P/C: 2/0/0/0**
I Year I Semester

Course Outcomes:
1. Find various DT mindsets
2. Extend DT methodology towards defining the problem
3. Identify Tools for Innovation
4. Develop Empathy Maps
5. Build Prototypes

UNIT I
Introduction to Design Thinking: LRI Assessment, Introduction to Design Thinking, Understanding the Mindsets-Empathy, Optimism, Embrace Ambiguity, Make it, Learn from Failure, Iterate, Create Confidence, Creativity Convergent & Divergent Thinking

UNIT II
Design Thinking Methodology: The 5 Stages of the Design Thinking Process- Empathise, Define (the problem), Ideate, Prototype, and Test

UNIT III
Ideation tools & exercises. Sample Design Challenge, Design Challenge Themes, Story telling and Tools for Innovation and creativity.

UNIT IV
Empathize-Understand customers, Empathy Maps, Empathise-Step into customers shoes- Customer Journey Maps, Define- Analysis & Drawing Inferences from Research

UNIT V
The Design Challenge: Define the Design Challenge, Prototyping & Iteration- Feasibility Study, Testing-Documentation and the Pitching

Text Books:
1. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School - Idris Mootee.

Reference Books:
1. Zero to One: Note on Start-Ups, or How to Build the Future
2. The Lean Startup: How Constant Innovation Creates Radically Successful Businesses
3. Start With Why: How Great Leaders Inspire Everyone To Take Action

I YEAR
II SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

Course Code: GR22A1002 **L/T/P/C: 3/1/0/4**
I Year II Semester

Course Outcomes
1. Classify the differential equations of first order and solve them analytically
2. Solve linear differential equations of higher order under various forcing functions
3. Evaluate double and triple integrals and apply them to some problems in geometry
4. Apply principles of vector differentiation and line integration for some field relatedproblems
5. Apply classical vector integral theorems for fast evaluation of work done around closed curves and flux across closed surfaces

UNIT I
ORDINARY DIFFERENTIAL EQUATIONS OF THE FIRST ORDER
Linear Differential Equations of the first order: Solution of Exact, Linear and Bernoulli equations, modelling Newton's law of cooling, growth and decay models, modelling of R-L circuit

UNIT II
ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER
Solution of homogeneous and non-homogeneous linear differential equations with constant coefficients, complimentary functions, particular integrals and the method of variation of parameters
Solution of Linear Differential Equations with variable coefficients: Cauchy's and Legendre's homogeneous equations

UNIT III
MULTIPLE INTEGRALS
Double integrals: Evaluation of Double Integrals, change of order of integration (onlyCartesian form), change of variables (Cartesian and polar coordinates)
Triple Integrals: Evaluation of triple integrals, Change of variables (Cartesian to Spherical and Cylindrical polar coordinates)
Application of double integral to find the area of a lamina and volume of a solid, application of the triple integral to find the volume of a solid

UNIT IV
VECTOR DIFFERENTIATION AND LINE INTEGRATION
Vector differentiation: Scalar and vector point functions, Concepts of gradient, divergence and curl of functions in Cartesian framework, solenoidal field, irrotational field,scalar potential
Vector line integration: Evaluation of the line integral, concept of work done by a force field, Conservative fields

UNIT V
SURFACE INTEGRATION AND VECTOR INTEGRAL THEOREMS
Surface integration: Evaluation of surface and volume integrals, flux across a surface
Vector integral theorems: Green's, Gauss and Stokes theorems (without proof) and their applications

Text Books:
1. R.K.Jain: and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa publishinghouse, Fourth edition 2014
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010

3. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006
4. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson,Reprint, 2002.

Reference Books:

1. GRIET reference manual
2. Paras Ram, Engineering Mathematics, 2nd Edition, CBS Publishes
3. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
4. Calculus Early Transcendental 9E by James Steward, Daniel Clegg, Saleem Watson, CENGAGE Publications

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING PHYSICS

Course Code: GR22A1004 **L/T/P/C: 3/1/0/4**
I Year II Semester

Course Outcomes:
1. Apply the principles of interference and diffraction of light in engineering applications.
2. Analyze the properties of Laser and its propagation in different types of optical fibers.
3. Classify materials based on the theory of Kronig Penny model.
4. Enumerate the nature and characterization of nanomaterials and its applications.
5. Use the concepts of acoustics and non-destructive testing in solving engineering problems.

UNIT I
Wave Optics: Superposition of waves, Interference of light by wave front splitting: Young's double slit experiment, Interference in thin films by reflection, Interference of light by amplitude splitting: Newton's rings, Difference between interference and diffraction, Fraunhofer diffraction from a single slit, Diffraction grating, Grating spectrum, Determination of wavelength of light using diffraction grating.

UNIT II
Lasers: Introduction, Characteristics of lasers, Lasing action, Essential components of laser, Construction and working: Ruby laser, He-Ne laser and Semiconductor laser, Applications of lasers.
Fiber Optics: Introduction, Principle and Structure of an optical fiber, Basic components in optical fiber communication system, Comparison of optical fibers over conventional cables, Types of optical fibers, Acceptance angle -Numerical aperture, Losses associated with optical fibers, Applications of optical fibers.

UNIT III
Introduction to solids: Bloch's theorem, Kronig – Penny model and its conclusions, E-K diagram, Brillion Zones, Effective mass of electron, Classification of solids on the basis of energy bands, Intrinsic and extrinsic semiconductors, Direct and Indirect band gap semiconductors.

UNIT IV
Nanomaterials: Introduction, Quantum confinement, Surface to volume ratio, Classification of Nanomaterials, Synthesis methods: Top-Down technique-Ball milling method, Bottom–Up technique-Sol-Gel method, Characterization techniques: SEM, TEM and EDAX.

UNIT V
Acoustics: Basic requirements of acoustically good hall, Reverberation and Reverberation time, Sabine's formula for Reverberation time, Measurement of absorption coefficient of a material, Factors affecting the architectural acoustics and their remedies.
Ultrasonics: Introduction, Classification of ultrasonic waves: Longitudinal waves, Transverse waves, Surface waves and Plate waves, Production of ultrasonic waves: Piezoelectric method and Magnetostriction method, Properties of ultrasonic waves, Applications of ultrasonics: SONAR and NDT - Pulse echo method.

Text Books:
1. Engineering Mechanics, 2nd edition- MK Harbola, Cengage Learning
2. Mechanics, D S Mathur and P S Hemne, S Chand
3. Engineering Physics, P.K Palanisamy, Scitech Publishers.
4. Ajoy Ghatak, "Optics", McGraw Hill Education, 2012

References:

1. H. J. Pain, “The physics of vibrations and waves”, Wiley, 2006
2. O. Svelto, “Principles of Lasers”
3. “Introduction to Mechanics”, M.K.Verma, Universities Press
4. I. G. Main, “Vibrations and waves in physics’, 3rd Edition, Cambridge University Press,2018
5. Applied Physics, T. Bhīma Sankaram, BSP Publishers.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING MECHANICS

Course Code: GR22A1010 **L/T/P/C: 3/1/0/4**
I Year II Semester

Course Outcomes:
1. Determine resultant of forces acting on a body and analyze equilibrium of a body subjectedto a system of forces.
2. Solve problem of bodies subjected to friction.
3. Find the location of centroid and calculate moment of inertia of a given section.
4. Determine the forces in the members of the trusses
5. Solve problems using work energy equations for translation, fixed axis rotation and planemotion of rigid bodies.

UNIT I
INTRODUCTION TO ENGINEERING MECHANICS - FORCE SYSTEMS
Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems; Static Indeterminacy

UNIT II
FRICTION: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw Centroid and Centre of Gravity-Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections; Centre of Gravity and its implications.

UNIT III
AREA MOMENT OF INERTIA: Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem, Mass Moment of Inertia , Inertia of Masses - Transfer Formula for Mass Moments of Inertia
– Mass moment of inertia of composite bodies.

UNIT IV
ANALYSIS OF TRUSSES: Introduction, Classification of trusses, Assumptions made in theanalysis of perfect truss, Methods of Analysis of Trusses- Method of Joints and Method of Sections. Principle of Virtual Work: Equilibrium of ideal systems, efficiency of simple machines, stable and unstable equilibriums.

UNIT V
REVIEW OF PARTICLE DYNAMICS: Rectilinear motion, Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion, Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work- kinetic energy, power, potential energy. Impulse-momentum (linear, angular), Impact (Direct and oblique).

Text Books:
1. Reddy Vijay Kumar K. and J. Suresh Kumar (2010), Singer's Engineering Mechanics–Statics & Dynamics
2. A. Nelson, "Engineering Mechanics: Statics & Dynamics", Tata McGraw-Hill Education,2009.

Reference Books:

1. Timoshenko S.P and Young D.H., "Engineering Mechanics", McGraw Hill InternationalEdition, 1983.
2. Andrew Pytel, JaanKiusalaas, "Engineering Mechanics", Cengage Learning, 2014.
3. Beer F.P & Johnston E.R Jr. "Vector Mechanics for Engineers", TMH, 2004.
4. Hibbeler R.C & Ashok Gupta, "Engineering Mechanics", Pearson Education, 2010.
5. Tayal A.K., "Engineering Mechanics – Statics & Dynamics", Umesh Publications, 2011.
6. Basudeb Bhattacharyya, "Engineering Mechanics", Oxford University Press, 2008.
7. Meriam. J. L., "Engineering Mechanics", Volume-II Dynamics, John Wiley & Sons, 2008.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DATA STRUCTURES

Course Code: GR22A1012 **L/T/P/C:2/1/0/3**
I Year II Semester

Course Outcomes:
1. Implement various sorting techniques and analyze the computational complexity of algorithms.
2. Analyze the basics of data structures and its types and translate to programs the operations on stack and queue and their applications.
3. Develop algorithms for various operations on linked lists and convert them to programs.
4. Interpret operations on non-linear data structure binary tree and BST.
5. Summarize the operations on graphs and apply graph traversals techniques and outline hashing techniques.

UNIT I
Algorithms and Complexities: Analysis of algorithms, Basic concept of order of complexity, Asymptotic Notations: Big Oh notation, Omega notation, Theta notation, little oh notation and little omega notation.
Sorting: Bubble sort, Insertion Sort, Selection Sort, Quick Sort, Merge Sort, Radix Sort, Counting sort.

UNIT II
Stacks: Introduction to Data Structures and types, Stack – Operations: pop, push, display, peek, Representation and implementation of stack operations using arrays, stack applications, recursion, infix to postfix transformation, evaluating postfix expressions.
Queues: Queue – Operations: enqueue, dequeue, display, representation andimplementation of queue operations using array, applications of queues, circular queues - representation and implementation.

UNIT III
LIST: Introduction, dynamic memory allocation, self-referential structures, single linked list, advantages and disadvantages of single linked list, single linked list vs arrays, representation of a linked list in memory, operations-insertion, deletion, display, search.
Types and applications: Circular linked list, double linked list, implementation of stack, queue using linked list.

UNIT IV
Trees: Basic tree concepts, Binary trees**:** properties, types, representation of binary trees using arrays and linked lists, traversals of binary tree.
Binary Search Tree–Representation and implementation of operations, Binary Search Tree Traversals (recursive), creation of binary tree and BST from given traversals.

UNIT V
Graphs: Definition, basic terminology, representation of graphs, graph traversal techniques – Breadth First Traversal, Depth First Traversal.
Hashing-Introduction to hashing, hash function and types, hash table, implementation, collision resolution techniques–separate chaining, linear probing, quadratic probing, double hashing (only examples – no implementation).

Text Books:
1. Data Structures, 2/e, Richard F, Gilberg, Forouzan, Cengage

2. Data Structures and Algorithms, 2008, G.A.V.Pai, TMH

Reference Books:

1. Data Structures with C, Seymour Lipschutz, TMH
2. Classic Data Structures, 2/e, Debasis, Samanta, PHI, 2009
3. Fundamentals of Data Structures in C, 2/e, Horowitz, Sahni, Anderson Freed, University Press

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING PHYSICS LAB

Course Code: GR22A1014 **L/T/P/C: 0/0/3/1.5**
I Year I Semester

Course Outcomes:
1. Estimate the frequency of tuning fork, spring constant through coupled oscillation and analyze the resonance phenomena in LCR circuit.
2. Compare the rigidity modulus of wires of different materials using Torsional pendulum.
3. Interpret the properties of light like interference and diffraction through experimentation.
4. Asses the characteristics of Lasers and infer the losses in optical fibers.
5. Identify the type of semiconductor by measuring energy gap.

List of Experiments:
1. Melde's experiment: To determine the frequency of a turning fork using Melde's arrangement.
2. Torsional pendulum: To determine the rigidity modulus of the given wire using Torsional pendulum.
3. Newton's rings: To determine the wave length of the light source by forming Newton's rings.
4. Diffraction grating: To determine the wavelength of the light source by using diffraction grating.
5. Dispersive power: To determine the dispersive power of prism by using spectrometer.
6. Determination of wavelength of light by Laser diffraction method.
7. LCR Circuit: To determine the resonant frequency and quality factor of LCR circuit in series and parallel.
8. LASER: To study the V-I characteristics of LASER source.
9. Optical fiber: To determine the bending losses of Optical fibers.
10. Energy gap of P-N junction diode: To determine the energy gap of a semiconductor diode.

Note: Any 8 experiments are to be performed.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DATA STRUCTURES LAB

Course Code: GR22A1020 **L/T/P/C: 0/0/2/1**
I Year II Semester

Course Outcomes:

1. Construct executable C programs for sorting techniques.
2. Implement stack and queue data structures and their applications.
3. Interpret various linked list operations to produce executable codes.
4. Develop working procedure for operations on BST using DMA.
5. Demonstrate graph operations and hashing techniques.

TASK 1
a. Implement Bubble sort using a C program.
b. Implement Selection sort using a C program.
c. Implement Insertion sort using a C program.

TASK 2
a. Develop a C program for Quick sort.
b. Demonstrate Merge sort using a C program.
c. Design a C program for Radix Sort.

TASK 3
a. Write a C program to implement Stack operations using arrays.
b. Write a C program to implement Queue operations using arrays.
c. Write a C program to implement Circular Queue operations using arrays

TASK 4
a. Write a C program to convert infix expression to postfix expression.
b. Write a C program to evaluate a postfix expression.

TASK 5
a. Write a C program to check for balanced parenthesis.
b. Write a C program to implement priority queue using arrays.

TASK 6
a. Implement the following operations on Single Linked List using a C program.
   i. create
   ii. insert
   iii. delete
   iv. search
   v. display

TASK 7
a. Write a C program to implement Circular Linked List operations – create, insert, delete and display.

TASK 8
a. Write a C program to implement Double Linked List operations – create, insert, delete and display.

TASK 9

a. Implement a C program for Stack using Linked list.
b. Implement a C program for Queue using Linked list

TASK 10

a. Implement the following operations on Binary Search Tree
   i. create
   ii. insert
   iii. search
   iv. delete

TASK 11

a. Implement the following operations on Binary Search Tree
   i. count-nodes
   ii. height
   iii. minimum node
   iv. maximum node

TASK 12

a. Develop a C code for preorder, inorder and postorder traversals of a Binary Search Tree using recursion.
b. Design a C program for level order traversal of a Binary Search Tree.

TASK 13

a. Write a C program to implement Adjacency Matrix of a given graph.
b. Write a C program to implement Adjacency List of a given graph.

TASK 14

a. Implement a C program for DFS traversal on graph.
b. Implement a C program for BFS traversal on graph.

TASK 15

a. Implement a C program for the following operations on Hashing:
   i. insert
   ii. delete
   iii. search
   iv. display

Text Books:

1. Data Structures, 2/e, Richard F, Gilberg, Forouzan, Cengage
2. Data Structures and Algorithms, 2008, G.A.V.Pai, TMH

References:

1. Data Structures with C, Seymour Lipschutz, TMH
2. Classic Data Structures, 2/e, Debasis, Samanta, PHI, 2009
3. Fundamentals of Data Structures in C, 2/e, Horowitz, Sahni, Anderson Freed,University Press

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING WORKSHOP

Course Code: GR22A1021 **L/T/P/C: 1/0/3/2.5**
I Year II Semester

Course Outcomes:
1. Develop various trades applicable to industries / Manufacturing practices.
2. Create Hands on experience for common trades.
3. Improve to fabricate components with their own hands.
4. Develop practical knowledge on the dimensional accuracies and dimensional tolerances possible with various manufacturing processes.
5. To build the requirement of quality of work life on safety and organizational needs.

TRADES FOR EXERCISES: At least two exercises from each trade:
1. Carpentry
2. Fitting Shop
3. Tin-Smithy
4. Casting
5. Welding Practice
6. House-wiring
7. Black Smithy
8. VIDEO LECTURES: Carpentry, Fitting operations, Tin-Smithy, Casting, Welding, Electrical and Electronics, Black Smithy, Plumbing, Power tools in construction and Wood Working, Manufacturing Methods,

Text/ Reference Books:
1. Workshop Practice /B. L. Juneja / Cengage
2. Workshop Manual / K. Venugopal /Anuradha.

Reference Books:
1. Work shop Manual - P. Kannaiah/ K. L. Narayana/SciTech
2. Workshop Manual / Venkat Reddy/BSP
3. Workshop Manual/K. Venugopal/Dr.V. Prabhu Raja/G.Sreekanjan

II YEAR
I SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
KINEMATICS OF MACHINERY

Course Code: GR22A2038 **L/T/P/C: 3/0/0/3**
II Year I Semester

Course Outcomes:
1. Identify, select, and design various types of linkage mechanisms for obtaining specific motion with lower pairs and higher pairs.
2. Analyze analytical and graphical aspects of linkage mechanisms for optimal functioning.
3. Drawing displacement diagrams and cam profile diagrams for followers executing different types of motions for various configurations of followers.
4. Evaluate gear tooth geometry and select appropriate gears for the required applications.
5. Understand the concept of friction in bearings, clutches, brakes and belt drives.

UNIT I
Classification of mechanisms, Basic kinematic concepts and definitions-Degree of freedom, mobility- Gasthof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions- Mechanical advantage-Transmission angle- Description of some common mechanisms-Quick return mechanism, straight line generators-Universal Joint-Rocker mechanisms

UNIT II
Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations-kinematic analysis of simple mechanisms-slider crank mechanism dynamics- Coincident points-Coriolis component of acceleration- introduction to linkage synthesis-three position graphical synthesis formation and path generation.

UNIT III
Classification of cams and followers-Terminology and definitions-Displacement diagrams- Uniform velocity, parabolic, simple harmonic, and cycloidal motions- derivatives of follower motions-specified contour cams-circular and tangentcams-pressure angle and undercutting, sizing of cams, graphical and analyticaldisc cam profile synthesis for roller and flat face followers.

UNIT IV
Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/ under cutting-helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

UNIT V
Surface contacts-sliding and rolling friction-friction drives-bearings and lubrication- friction clutches-belt and rope drives-friction in brakes.

Text Books:
1. Thomas Bevan, Theory of Machines, 3 edition, CBS Publishers & Distributors, 2005.
2. Cleghorn W.L. Mechanisms of Machines, Oxford University Press, 2005.

Reference Books:
1. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata Mc Graw Hill, 2009.
2. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East- West Pvt. Ltd, New Delhi, 1988.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
METALLURGY AND MATERIAL SCIENCE

Course Code: GR22A2039 **L/T/P/C: 3/0/0/3**
II Year I Semester

Course Outcomes:
1. Relate crystal structures and identify the suitable method for mechanical property measurements.
2. Relate the equilibrium transformation diagrams for various metals.
3. Utilize appropriate techniques in treating a metal with proper heat treatment operations.
4. Have knowledge on different types of ferrous and nonferrous metals.
5. Identify the suitable composite and ceramic material for the required application.

UNIT I
Structure of metals & mechanical property measurements: Bonds in Solids, crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal, determination of grain size. Imperfection in solids: Point, line, interstitial and volume defects; dislocation strengthening mechanisms and slip systems, Tensile, compression and torsion tests; Young's modulus, true and engineering stress-strain curves, Hardness: Rockwell, Brinell and Vickers and their relation to strength.

UNIT II
Alloys & Phase diagrams: Necessity of alloying, Solid solutions, Types of Solid Solutions, Hume Rothery's rule, Intermediate alloy phases, effects of various alloying elements on steels, Iron – Iron carbide phase diagram, eutectic, eutectoid, peritectic, peritectoid reactions, and micro structural aspects of ledeburite, Austenite, Ferrite, Martensite and Cementite.

UNIT III
Heat treatment of steel: Annealing, Tempering, Normalizing, Hardening, Jominey quench Test for Hardenability, Continuous cooling curves and interpretation of final microstructures, austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame, induction & cryogenic hardening.

UNIT IV
Ferrous & Non ferrous metals: Steels, Types of steels, Properties and applications ofPlain carbon steels, stainless steel and tool steels, maraging steels, cast irons; grey, white, malleable and spheroidal cast irons, copper and its alloys, aluminium and its alloys, Nickel based super alloys, Titanium and its alloys.

UNIT V
Ductile, brittle failures, composites & ceramics: Stress strain curves for brittle and ductile materials, differences between brittle and ductile fractures, Griffith criterion, Fatigue failure, SN curve, ceramics and its properties, glasses, cermets, abrasive materials, Composite materials: Classification of composites, various methods of manufacture of composites, particle–reinforced materials, fibre-reinforced materials, metal ceramic mixtures, metal–matrix composites and Carbon–Carbon composites.

Text Books:
1. W.D.Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G.Budinski and Michael K.Budinski, "Engineering Materials", Prentice Hall

Reference Books:
1. V.Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
2. U.C.Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Course Code: GR22A2014 **L/T/P/C: 3/0/0/3**

II Year I Semester

Course Outcomes:

1. Apply the application of ohms law & Kirchhoff's laws.
2. Discuss about fundamental principles of electrical machines.
3. Measure the fundamental electrical quantities using oscilloscope.
4. Illustrate the basic principles of semi conducting devices.
5. Analyze the different applications of a transistor and SCR.

UNIT I

Electrical Circuits: Basic definitions, Types of elements, Ohm's Law, , Kirchhoff's Laws, Faraday's Law, Resistive networks, Inductive networks, capacitive networks, Series, Parallel circuits and Star- delta and delta-star transformations.

UNIT II

DC Machines and AC Machines Principle of operation of DC Generator - emf equation - types– DC motor principle – types- torque equation– applications – three point starter– Principle of operation of induction motor – slip – torque characteristics – applications- Principle of operation of an alternator.

UNIT III

Transformers and Instruments Principle of operation of single phase transformers – EMF equation – losses – efficiency and regulation. Basic Principle of indicating instruments – permanent magnet moving coil and moving iron instruments. Cathode Ray Oscilloscope Principles of CRT (Cathode Ray Tube), Deflection, Sensitivity, Electrostatic and Magnetic deflection, Applications of CRO - Voltage, Current and frequency measurements.

UNIT IV

Diode and its Characteristics P-N junction diode, symbol, V-I Characteristics, Diode Applications, and Rectifiers – Half wave, Full wave and Bridge rectifiers (simple Problems).

UNIT V

Transistors P-N-P and N-P-N Junction transistors, Transistor as an amplifier, SCR, Symbol, V-I characteristics and applications.

Text/Reference Books:

1. V.K.Mehta, S.Chand& Co, Principles of Electrical and Electronics Engineering.
2. M.S Naidu and S. Kamakshaiah,Introduction to Electrical Engineering, TMH Publications.
3. Kothari and Nagarath, Basic Electrical Engineering, TMH Publications, 2nd Edition.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
STRENGTH OF MATERIALS

Course Code: GR22A2040 **L/T/P/C: 3/0/0/3**
II Year I Semester

Course Outcomes:
1. Understand the theory of elasticity including strain displacement and Hooke's law relationships.
2. Analyze the shear Force and bending moment diagrams with various types of loads.
3. Analyze the stresses due to maximum shear Force and maximum bending moment acting on the beams
4. Solve the torsion problems in bars, Calculate the slope and deflections in beams subjected to transverse loads.
5. Analyze various situations involving structural members subjected to combined stresses

UNIT I
Simple stresses & strains: Concept of stresses & strains (linear, lateral, shear, thermal and volumetric), Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Stress-strain diagrams for ductile & brittle materials, Proof stress, True stress & strain - Various strengths of material- Yield strength, Ultimate tensile strength, Factor of safety, Strain energy-Gradual, sudden and Impact Loads. Concept of stress state, relation between elastic constants, Axial forces, stresses and strains in determinate and indeterminate composite bars, bars under axial loads and self-weight.

UNIT II
Shear force and Bending moment diagrams: Shear forces and bending moments of determinate beams due to concentrated loads, uniformly distributed loads, uniformly varying loads and couples, Relation between shear Force and Bending Moment diagrams for cantilevers, simply supported beams, and their construction- Maximum bending moment & point of contraflexure.

UNIT III
Bending stresses: Theory of simple bending, assumptions, derivation of flexuralformula, Bending of common cross sections (rectangular, I,T,C) with respectivecentroidal & parallel axes, bending stress distribution diagrams, moment of resistance and section modulus.
Shear stresses: Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for I, T and C symmetrical sections, maximum and average shear stresses, shear connection between flange & web.

UNIT IV
Torsional stresses: Derivation of torsion equation, stresses, strain & deformations in solid & hollow Shafts, homogeneous & composite circular cross section subjected to twisting moment, stresses due to combined torsion, bending & axial force on shafts.
Slope and Deflection of beams: Relation between BM & slope, slope & deflection of determinate beams, double integration method (Macaulay's method), Moment Area method- derivation of formula for slope & deflection for standard cases

UNIT V
Principal stresses and strains: Normal and shear stresses on any oblique plane - Concept of principal planes, derivation for principal stresses and maximum shear stress, position of principal planes & planes of maximum shear, graphical solution using Mohr's circle of stresses, combined effect of axial force, bending moment & torsional moment on circular shafts (solid as well as hollow).

Text Books:

1. A Text book of Strength of Materials (in S.I units): R.K Bansal, Laxmi Publications
2. Strength of Materials: Rattan, McGraw-Hill Education (India) Pvt Limited

Reference Books:

1. Mechanics of Materials – E.P. Popov
2. Strength of Materials – Timoshenko
3. Mechanics of Solids & Structures – D, W.A. Rees
4. Strength of Materials – D.S. Prakash Rao

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
THERMODYNAMICS

Course Code: GR22A2041 **L/T/P/C: 3/0/0/3**
II Year I Semester

Course Outcomes:
1. Apply the knowledge of thermodynamics to temperature scales.
2. Solve the practical thermodynamic problems by applying first law and steady flow energy equation
3. Analyze the problems on heat engines, refrigeration and entropy by applying second law of thermodynamics
4. Evaluate the thermodynamic properties of the steam
5. Evaluate the performance of air standard cycles and vapor power cycle

UNIT I

Introductory Concepts and Energy: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Work and Heat, Point and Path function. Zeroth Law, First Law of Thermodynamics and Steady Flow Energy Equation: Zeroth Law of Thermodynamics – Concept of quality of Temperature – Principles of Thermometry –Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale – PMM I – Joule's Experiments – First law of Thermodynamics, First law applied to a Process –applied to a flow system – Steady Flow Energy Equation, Limitations of the First Law.

UNIT II

Second Law of Thermodynamics and Entropy: Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin- Planck and Clausius Statements and their Equivalence /Corollaries, PMM-II, Carnot cycle and its significance, 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

Pure Substances and Perfect Gas Laws:

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier chart – Various Thermodynamic processes and energy Transfer – Steam Calorimetry. 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 – Vander Waals Equation of State – Compressibility charts.

UNIT IV

Mixtures of Perfect Gases and Air conditioning Concepts: Mixtures of perfect Gases – Mole Fraction, Mass fraction, 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 constant, Molecular Internal Energy, Enthalpy, Specific heat and Entropy of Mixture of perfect Gases and Vapour. **Air conditioning Concepts:** Psychrometric Properties – Atmospheric air, Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity,

Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier‟s Equation – Psychometric chart.

UNIT V

Power Cycles: Gas Power cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericcson Cycle, Lenoir Cycle, Brayton and Rankine cycles - Performance Evaluation – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressure on Air standard basis.

Refrigeration Cycles: Reversed Carnot Cycle-Bell- Coleman cycle, Vapour compression cycle-performance Evaluation.

Text Books:

1. Engineering Thermodynamics / PK Nag /TMH, III Edition
2. Fundamentals of Thermodynamics – Sonntag, Borgnakke and van wylen / John Wiley & sons (ASIA) Pte Ltd.

Reference Books

1. Engineering Thermodynamics – Jones & Dugan
2. Thermodynamics – An Engineering Approach – Yunus Cengel& Boles /TMH
3. Thermodynamics – J.P.Holman / McGrawHill
4. An introduction to Thermodynamics / YVC Rao / New Age
5. Thermal Engineering by Dr R K Rajput, Laksmi Publications

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MACHINE AND PRODUCTION DRAWING LAB

Course Code: GR22A2042 **L/T/P/C: 0/0/4/2**
II Year I Semester

Course Outcomes:
1. Understand the conventions used in Machine & production drawing.
2. Construct the machine elements including couplings, cotters, riveted, and bolted joints.
3. Determine limits and fits and allocate tolerances for machine components.
4. Construct an assembly drawing using part drawings of machine components.
5. Apply concepts and methods in the preparation of production drawings.

UNIT I
CONVENTIONAL REPRESENTATION
Materials, Machine elements, screw, riveted and welded joints. Springs, gears. Electrical, hydraulic and pneumatic circuits. Types of section – drawing of sectionsand auxiliary sectional views, Stack tolerance.

UNIT II
a) Forms of screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
b) Cotter joint and knuckle joint.
c) Rivetted joints for plates.

UNIT III
a) Universal, Oldham coupling, journal and foot step bearings
b) Limits, fits and tolerance
c) Surface roughness and its indication

UNIT IV
ASSEMBLY DRAWINGS
Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. Engine parts – stuffing boxes, eccentric, petrol engine connecting rod.

UNIT V
PART DRAWINGS
Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors etc. Part Drawing Assemblies- Plummer block,Screw jack, Lathetail stock.

Text Books:

1. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers
2. Production Drawing – K.L. Narayana & P. Kannaiah/ New Age.

Reference Books:

1. Machine Drawing – Dhawan, S. Chand Publications
2. Machine drawing with Auto CAD-Pohit and ghosh, PE
3. Machine Drawing – N. D. Bhatt
4. Machine Drawing – Rajput

5. Geometric dimensioning and tolerancing-James D. meadows/ B.S Publications
6. Engineering Metrology, R.K Jain, Khanna publications

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
STRENGTH OF MATERIALS LAB

Course Code: GR22A2043 **L/T/P/C: 0/0/3/1.5**
II Year I Semester

Course Outcomes:

1. Determine the Young's modulus for ductile materials and analyze the compression strength of both ductile and brittle materials.
2. Analyze the various points on stress strain diagram and calculate the modulus of elasticity of ductile materials.
3. Calculate & compare the hardness values for various materials.
4. Experiment on a spring to interpret the stiffness and rigidity modulus.
5. Apply the concept of impact loading and to determine impact values for various materials.

List of Experiments:

Task-1: To conduct hardness test on given material using Brinnel's Hardness testing equipment
Task-2: To conduct hardness test on given material using Rockwell's Hardness testingmachine
Task-3: To conduct hardness test on given material using Vicker's Hardness testing machine
Task-4: To perform the following tests on the given material using UTM (Universal Testing Machine): Tension test to determine young's modulus and Shear test to determine ultimate shear strength
Task-5: To determine the stiffness and modulus of rigidity of the spring wire by performing Spring Test
Task-6: To perform compression test on cube to analyze compression strength of thematerial
Task-7: To determine the Young's modulus of the given structural material using Cantilever Beam set-up
Task-8: To determine the Young's modulus of given structural material using simplysupported Beam set-up
Task-9: To determine the Young's modulus of given structural material by Maxwell's Reciprocal Theorem
Task-10: To determine the Young's modulus of given structural material using Continuous Beam set-up
Task-11: To determine the Torsional strength and stiffness of a material using Torsion testing machine.
Task-12: To determine impact strength of the given material using Impact testing equipment (Izod and Charpy).

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
METALLURGY AND MATERIAL SCIENCE LAB

Course Code: GR22A2044 **L/T/P/C: 0/0/3/1.5**
II Year I Semester

Course Outcomes:
1. Relate properties to microstructure.
2. Choose suitable metals and alloys for industrial applications.
3. Find out the hardness of various treated and untreated metals.
4. Tell the chemical composition of various ferrous and nonferrous metals.
5. Select a suitable heat treatment process for a material.

List of Experiments:
1. Preparation and study of microstructure of Mild steel and Low carbon steel.
2. Preparation and study of microstructure of Medium Carbon Steel and High carbon steel.
3. Preparation and study of microstructure of Stainless steel.
4. Preparation and study of microstructure of Grey cast iron and White cast Iron.
5. Preparation and study of microstructure of Malleable cast iron and Spheroidal graphite cast iron.
6. Preparation and study of microstructure of Aluminium.
7. Preparation and study of microstructure of copper.
8. Preparation and study of microstructure of Titanium.
9. Preparation and study of the microstructure of Inconel.
10. Hardenability of steels by Jominy End Quench test.
11. Preparation and microscopic examination of heat-treated metal samples.
12. Preparation and microscopic examination of case-hardened metal samples.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY
ENVIRONMENTAL SCIENCE

Course Code: GR22A2001 **L/T/P/C:2/0/0/0**
II Year I Semester

Course Outcomes:
1. Gain a variety of experiences & acquire a basic knowledge about the environment & its allied problems
2. Interpret the key components in safe guarding the environment
3. Evolve an individual vision of harmonious interaction with natural world.
4. Appraise the quality of environment in order to create a healthy atmosphere
5. Familiarize with the individual responsibilities towards green revolution

UNIT I
INTRODUCTION AND AWARENESS ACTIVITIES
Environmental Science: Introduction, Definition, scope and importance.
AWARENESS ACTIVITIES
Small group meetings about:
- Water management
- Waste water treatment
- Projects Vs Environment
- Zero waste management
- Circular economy
- Impact of Science & Technology on Environment
- E-waste management
- Biodiversity loss
- Renewable Energy

UNIT II
SLOGAN AND POSTER MAKING EVENT
- Food waste management
- Rain water harvesting
- Climate change
- Green Power
- Water conservation
- Green at work
- Role of IT in environment and human health
- Sustainable development

UNIT III
EXPERT LECTURES ON ENVIRONMENTAL SCIENCE
- Environmental Impact Assessment
- Industrial waste treatment
- Regenerative farming/Organic farming/Vertical gardens/Hydroponics
- Circular Economy

UNIT IV CLEANLINESS DRIVE

- Indoor air pollution
- Vehicular pollution
- Visual pollution
- Waste management at home
- Composting
- Plastic recycling

UNIT V
CASE STUDIES

- HPCL and LG Polymers disasters in Vizag
- Oleum gas leak in Delhi
- Mathura Refinery & Taj Mahal
- Conservation of Hussain Sagar lake
- The Cleanliest city of India-Surat
- Green Buildings in India
- KBR park in Hyderabad (Environmental protection Vs Development)
- Fluorosis and remediation
- Evaluation of STP or ETP operation in Hyderabad
- Ecotourism & its impacts
- Positive Impact on Environment due to Lockdown Forced by Corona Pandemic

Text Books:

1. Environmental Studies for UG Courses, Erach Bharucha, UGC Publications, Delhi, 2004.
2. Textbook of Environmental Studies, Deeksha Dave, S. S. Katewa, Cengage Delmar Learning India Pvt., 2012.

Reference Books:

1. Introduction to Environmental Science, Y. Anjaneyulu, BS Publications, 2004.
2. Environmental Studies, Anubha Kaushik & C. P. Kaushik, 4th Edition, New Age International Publishers

II YEAR
II SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
THERMAL ENGINEERING

Course Code: GR22A2045 **L/T/P/C: 3/0/0/3**
II Year II Semester

Course Outcomes:
1. Ability to understand the concept on working principles and their functions of various components of internal combustion engine.
2. Ability to improve the analytical skills in finding the engineering solutions and redesign the system by combustion, electrical and electronic systems and fuel technology to improve the fuel efficiency of the engine.
3. Ability to adopt the resources available at optimum level in order to achieve the better efficiency in the performance of different types of air compressors duly reducing the operational losses.
4. Ability to explain the function and working principles of reciprocating, rotary, compressors and elaborate the factors influence performance of the compressors by analytical.
5. Ability to explain the function and working principles of dynamic and axial compressors and elaborate the factors influence performance of the compressors by analytical and graphical methods using velocity triangles.

UNIT I
Introduction and Analysis of Actual Cycles I.C. ENGINES: Classification - Working principles, Valve and Port Timing Diagrams, Air – Standard air-fuel and actual cycles. Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines. Engine systems, cooling and lubrication systems.

UNIT II
Combustion S.I. Engines: Fuel system components, Carburetor, Fuel Injection System, Ignition systems Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Type of Abnormal combustion, pre-ignition and knocking – Fuel requirements and fuel rating, anti knockadditives – combustion chamber – requirements, types.
C.I. Engines: Four stages of combustion – Delay period and its importance – Effect ofengine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

UNIT III
Testing and Performance Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heatbalance sheet and chart.

UNIT IV
Reciprocating and Rotary Compressors Compressors: Classification positive displacement and roto dynamic machinery-Power producing and power absorbing machines, fan, blower and compressor-positive displacement and dynamic types- reciprocating and rotary types.
Reciprocating: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance, stage compression, under cooling, saving of work, minimum work condition for stage compression.
Rotary (Positive displacement type): Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.

UNIT – V

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

Axial Flow Compressors: Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency- Pressure rise calculations – Polytropic efficiency.

Text Books

1. I.C. Engines / V. GANESAN- TMH
2. Thermal Engineering / Rajput / Lakshmi Publications

Reference Books

1. I C Engines – Mathur & Sharma – DhanpathRai& Sons.
2. Engineering fundamentals of IC Engines – Pulkrabek / Pearson /PHI
3. Thermal Engineering / Rudramoorthy– TMH
4. Thermodynamics & Heat Engines / B. Yadav/ Central Book

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
FLUID MECHANICS AND FLUID MACHINES

Course Code: GR22A2046 **L/T/P/C: 3/0/0/3**
II Year II Semester

Course Outcomes:
1. Apply concept of mathematics, science and engineering in fluid flows.
2. Use the governing equations of fluid flow and apply the same to simple flow problems.
3. Explain the mathematical formulation of various flow problems.
4. Analyze the boundary layer concept to the fluid flow problems.
5. Execute the concept of fluid and models of fluids for flow problems.

UNIT I
Definition of fluid, Newton's law of viscosity, Units and dimensions- Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, incompressible flow, Bernoulli's equation and its applications.

UNIT II
Exact flow solutions in channels and ducts, Couette and Poiseuille flow, laminar flow throughcircular conduits and circular annuli-concept of boundary layer– measurement of boundary layer thickness–Darcy Weisbach equation, friction factor, Moody's diagram.

UNIT III
Need for dimensional analysis–methods of dimension analysis - Rayleigh and buckingham π theorem– Similitude–types of similitude -Dimensionless parameters– application of dimensionless parameters– Model analysis.

UNIT IV
Centrifugal pumps, working principle, work done by the impeller, multi stage pumps- performance curves. Euler's equation–theory of roto-dynamic machines–various efficiencies–velocity components at entry and exit of the rotor, velocity triangles— Cavitation in pumps-Reciprocating pump–working principle, slip, percentage of slip, power required to drive the pump.

UNIT V
Basics of hydroelectric power plant - Classification of water turbines, heads and efficiencies, velocity triangles-Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles– draft tube-Specific speed,unit quantities, performance curves for turbines–governing of turbines.

Text Books:
1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by R K Rajput.Laxmi Publications(P) Ltd.,

Reference Books:
1. A Textbook of Fluid Mechanics and Hydraulic Machines by Dr R.K. Bansal, Laxmi Publications(P) Ltd.,
2. Introduction to Fluid Mechanics and Fluid Machines By S K Som, Gautam Biswas, McGrawHill.
3. Fluid Mechanics and Hydraulic machines by R K Bansal, Laxmi publications.

4. Fluid Mechanics & Hydraulic Machines: Problems & Solutions by K.Subrmanya/TMH private limited.
5. Hydraulic Machines by Banga & Sharma, Khanna Publishers.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DYNAMICS OF MACHINERY

Course Code: GR22A2047 **L/T/P/C: 3/0/0/3**
II Year II Semester

Course Outcomes:
1. Analyze complete motion analysis of machines in running condition and able to know gyroscope and its effects.
2. Design various mechanisms of machines which were used in real life and explain how to get equilibrium condition of machine members while the machine is in running condition.
3. Apply the knowledge regarding use of Governor, brakes and operation of Dynamometers.
4. Explain how to balance forces and moments produced by rotating or reciprocating masses of machine members.
5. Analyze the vibrations, which is the major disturbance in machines while in the running condition and also precautions to reduce vibration.

UNIT I
Gyroscopes: Introduction, Precisional angular motion, Gyroscopic couple, effect of gyroscopic couple on an aeroplane, effect of gyroscopic couple on a naval ship during steering, gyroscopic couple on a naval ship during pitching, Gyroscopic couple on a naval ship during rolling, stability of a four wheel drive moving in a curved path, stability of a two wheel vehicle taking a turn.

UNIT II
Static Force Analysis: Introduction, Static Equilibrium, Equilibrium of Two-force and three force members, Member with Two force.
Dynamic force Analysis: Introduction, D'Alemberts principle, Equivalent Offset inertia force, Dynamic analysis of Four bar and Single slider mechanisms, Piston effort, Turning moment on crank shaft, Inertia of connecting rod, Inertia forces in reciprocating Engines.

UNIT III
Governors: Introduction, types of governors, Watt governor, Porter governor, Proell governor, Hartnell governor, Wilson-Hartnell governor, Spring controlled gravity governor, Inertia governors, Sensitiveness of governor, Hunting, Isochronism, Stability, effort of governor, Power of governor, Controlling force.

Brakes and Dynamometers: Types of brakes: Simple block brake, band and block brake internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

UNIT IV
Balancing of Rotating Masses: Balancing of rotating masses in single and different planes.
Balancing of Reciprocating Masses: Primary, Secondary, and higher balancing of reciprocating masses, Analytical and graphical methods. Unbalanced forces and couples - examination of "V" multi cylinder in line and radial engines for primary and secondary balancing, locomotive balancing–Hammer blow, Swaying couple, variation of tractive efforts.

UNIT V
Vibrations: Free Vibration of mass attached to vertical spring – 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 Ratan/ Mc. GrawHill Publ.
2. Theory of machines/Khurmi/S.Chand.

References:

1. Theory of Machines by Thomas Bevan/ CBS
2. Theory of Machines / R.K Bansal
3. Theory of Machines Sadhu Singh Pearson's Edition
4. Theory of Machines /Shigley/ Oxford.
5. Theory of machines – PL. Balaney/khanna publishers.
6. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
COMPUTATIONAL MATHEMATICS FOR ENGINEERS

Course Code: GR22A2009 **L/T/P/C: 3/0/0/3**
II Year II Semester

Course Outcomes:
1. Apply well known techniques to find real roots of an equation and linear algebraic systems by iterative methods
2. Apply interpolation and numerical differentiation techniques for univariate data
3. Solve problems related to numerical integration and least squares approximations of a function
4. Choose appropriate numerical techniques to solve IVP and BVP in ODE
5. Distinguish between various numerical methods to solve PDE arising in the context of heat conduction

UNIT I
Root finding and Numerical solution of linear algebraic systems
Finding the real root of algebraic and transcendental equations by Regula-Falsi and Newton Raphson methods -Gauss Jacobi and Gauss Seidel iterative methods to solvea linear algebraic system with error analysis

UNIT II
Interpolation - Cubic spline- Differentiation
Interpolation with non-uniform data: Newton divided differences formula, operational calculus, Interpolation with uniform data- Newton and Gauss formulas, Fitting natural cubic spline to data Numerical differentiation for uniform and non-uniform data

UNIT III
Numerical integration and Curve approximations
Numerical integration by Trapezoidal rule, Simpson's 1/3rd and $3/8^{th}$ rules – The Principle of least squares, Fitting a straight line, parabola, exponential and power curve, Simple and Multiple linear regression with 2 independent variables

UNIT-IV
Numerical solution of initial and boundary value problems in ODE
Taylor's series method, Picard's method, Euler method, Modified Euler method and R-K fourth order methods to solve initial value problems in ODE - Finite differences method to solve boundary value problems in ODE

UNIT-V
Numerical solution initial and boundary value problems in PDE
Solution of Laplace's equation by Jacobi, Gauss-Seidel method and Successive over relaxation (SOR) methods, Solution of Heat equation by the finite difference method.

Text Books:
1.M.K.Jain, S.R.K.Iyengar, R.K.Jain-.Numerical methods for scientific and engineering computation-New Age International publishers-Fourth edition-2—3
2. Robert J.Schilling and Sandra L.Harries- Applied numerical methods for engineers using MATLAB and C-Thomson Brooks/Cole-2002.
Reference Books:
1. S.S.Sastry- Introductory methods of numerical analysis- Prentice Hall (India)- Fourth edition- 2010

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MANUFACTURING ENGINEERING

Course Code: GR22A2048 **L/T/P/C: 2/1/0/3**
II Year II Semester

Course Outcomes:
1. Impart knowledge on role and value of production and identify basic production processes.
2. Introduction to methods of joining that shows a comprehensive understanding of tools, materials, equipment, and processes.
3. Apply critical thinking skills for development and evaluating sheet metal forming processes.
4. Identify and use the materials, tools, machines, and techniques used in various forming processes.
5. Demonstrate various ways of producing plastic products and its equipment details.

UNIT I
Metal Casting Processes: Sand casting process – Sand moulds - Type of patterns – Pattern materials– Pattern allowances –Types of Moulding sand – Properties of moulding sand, Methods of Sand testing – Core making–Moulding machines–Typesof moulding machines - Melting furnaces–Working principle of Special casting processes–Shell, investment casting – Ceramic mould– Lost Wax process – Pressure die casting – Centrifugal casting – CO2 process– Sand Casting defects – Inspection methods.

UNIT II
Joining Processes: Classification of welding process- Fusion welding processes- Types of Gas welding– Equipments used–Flame characteristics–Filler and Flux materials-Arc welding equipments - Electrodes – Coating and specifications– Principles of Resistance welding–Spot, seam welding, Projection welding– Percussion welding-Flux cored–Submerged arc welding–Electro slag welding–Gas metal arc welding– TIG and MIG welding–Principle and application of special weldingprocesses-Thermit welding–Electron beam welding- LASER beam welding-Plasma arc welding–Friction welding–Diffusion welding–Weld defects–Brazing and soldering process–Methods and process capabilities–Filler materials and fluxes– Types of Adhesive bonding.

UNIT III
Bulk Deforming Processes: Hot working and cold working of metals–Forging processes–Open, impression and closed die forging–Characteristics of the process– Types of Forging Machines –Typical forging operations–Rolling of metals–Types of Rolling mills-Flat strip rolling– Shape rolling operations– Defects in rolled parts - Principle of rod and wire drawing-Tube drawing–Principles of Extrusion–Types of Extrusion–Hot and Cold extrusion–Equipments used.

UNIT IV
Sheet Metal Processes: Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations — Formability of sheet metal – Test methods– Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Introduction to Explosive forming, Magnetic pulse forming, Peen forming, Super plastic forming.

UNIT V
Manufacturing of Plastic Components: Types of plastics-Characteristics of the forming and shaping processes–Moulding of Thermoplastics–Working principles and typical applications of-Injection moulding–Plunger and screw machines–Compression moulding, Transfer moulding–Typical industrial applications–Introduction to Blow moulding–Rotational moulding–Film blowing–Extrusion-Thermoforming-Bonding of Thermoplastics.

Text books:

1. Hajra Choudhury, "Elements of Workshop Technology, Vol. I and II", Media Promotors Pvt Ltd., Mumbai, 2001
2. S.Gowri, P.Hariharan, and A.SureshBabu, "Manufacturing Technology 1", Pearson Education , 2008.

Reference books:

1. P.N. Rao,"ManufacturingTechnology",Tata McGraw-Hill Publishing Limited, II Edition, 2002.
2. B.S. Magendran Parashar & R.K.Mittal,"Elements of Manufacturing Processes",Prentice Hall of India, 2003.
3. P.C. Sharma, "A text book of production technology",S. Chand and Company, IV Edition, 2003.
4. Begman, 'Manufacturing Process", John Wilely& Sons, VIII Edition, 2005.
5. Serope Kalpajian, Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc. 2002(Second Indian Reprint).
6. Beddoes.J and Bibby M.J, 'Principles of Metal Manufacturing Processes', Elsevier, 2006.
7. Rajput R.K, 'A text book of Manufacturing Technology', Lakshmi Publications, 2007.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
THERMAL ENGINEERING LAB

Course Code: GR22A2049 **L/T/P/C: 0/0/4/2**
II Year II Semester

Course Outcomes:

1. Explain the functioning of measuring devices such as manometer, thermocouples, loading devices, fuel measurements etc. by applying the conservation laws and demonstrate the function of parts of 4 stroke diesel/petrol engines by assembling and dismantling.
2. Evaluate the properties of fuels such as flash & fire points, calorific value, Viscosity using basic concepts by conducting experimentation.
3. Assess the performance parameters of different thermal systems such as diesel/Petrol engines, refrigeration system, air compressors, Boilers etc.,
4. Enumerate and calculate the amount of dissipation of heat/energy in different ways by drawing balance sheets for an IC Engine.
5. Represent the processes, performance of the system in the form of graphs, period of suction, compression, expansion, exhaust and injection/ignition in the form of diagrams.

LIST OF EXPERIMENTS:

Task-1: Disassemble and Assemble of 4 stroke single cylinder diesel and petrol engine.
Task-2: Valve timing diagram for 4 stroke single cylinder diesel and petrol engine.
Task-3: Performance test on 4-stroke single cylinder diesel engine with Electrical loading.
Task-4: Heat balance test on 4 stroke single cylinder diesel engine with Electrical loading.
Task-5: Performance test on 4- stroke single cylinder diesel engine with Mechanical loading.
Task-6: Heat balance test on 4-stroke single cylinder diesel engine with Mechanical loading.
Task-7: Determination of the calorific value of a given fuel.
Task-8: Determination of the flash & fire points of a given fuel.
Task-9: Determination of the density and viscosity of a given oil.
Task-10: Performance test on two stage reciprocating Air Compressor
Task-11: Study of Babcock and Wilcox boiler.
Task-12: Determination of COP of a Vapour compression refrigeration system.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MANUFACTURING ENGINEERING LAB

Course Code: GR22A2050 **L/T/P/C: 0/0/3/1.5**
II Year II Semester

Course Outcomes:
1. Recommend appropriate Design and manufacture simple patterns for castings.
2. Know the principles and gain knowledge on different kinds of joining processes.
3. Acquire knowledge on Manufacturing of plastic components.
4. Acquire knowledge on different kinds of production processes available for shaping or moulding products.
5. Recognize the importance of safety devices and gain practical experience on various manufacturing processes.

Task-1: CASTING
1. Pattern Design and making-2 Exercises.
2. Moulding, Melting and Casting-1 Exercise

Task-2: WELDING
1. ARC Welding Lap Joint-1 Exercise
2. ARC Welding Butt Joint-1 Exercise
3. Spot Welding-1Exercise
4. TIGWelding-1Exercise
5. Plasma welding and Brazing - 2 Exercises (Water Plasma Device)

Task-3: MECHANICAL PRESS WORKING
1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing.
3. Bending and other operation

Task-4: PROCESSING OF PLASTICS
1. Injection Moulding
2. Blow Moulding

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
FLUID MECHANICS AND FLUID MACHINES LAB

Course Code: GR22A2051 **L/T/P/C: 0/0/3/1.5**
II Year II Semester

Course Outcomes:
1. Demonstrate practical knowledge in fluid flow principles.
2. Demonstrate the knowledge in calculating performance analysis in turbines and pumps understand to analyze practical problems in all power plants and chemical industries.
3. Conduct experiments in pipe flows and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports.
4. Analyze a variety of fluid-flow devices and utilize fluid mechanics principles in design.
5. Analyze flow rate and pressure rise, select the proper pump to optimize the pumping efficiency.

LIST OF EXPERIMENTS:
Task-1: Verification of Bernoulli's theorem and draw the HGL, TEL
Task-2: Determination of Coefficient discharge of Venturi meter and Orifice meter.
Task-3: Determination of Darcy's Friction factor in various diameters of pipes
Task-4: Determination of Minor Losses (Different Valve connections, Sudden Expansion, Sudden Contraction, Bends, joints) in various pipe fittings
Task-5: Determination of coefficient of impact of Jet on given Vanes
Task-6: Determination of overall efficiency of Pelton wheel Turbine at Constant Speed and Constant Head
Task-7: Determination of overall efficiency of Francis Turbine at Constant Speed and Constant Head
Task-8: Determination of overall efficiency of Kaplan Turbine at Constant Speed and Constant Head
Task-9: Determination of the overall efficiency of Single Stage Centrifugal pump
Task-10: Determination of the overall efficiency of Multistage Centrifugal pump
Task-11: Determination of the overall efficiency of Reciprocating pump
Task-12: Determination of the laminar and turbulent flow using Reynold's apparatus.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
CONSTITUTION OF INDIA

Course Code: GR22A2003 **L/T/P/C: 2/0/0/0**
II Year II Semester

Course Outcomes:
1. Know the importance of Constitution and Government
2. Become Good Citizens and know their fundamental rights, duties and principles.
3. Learn about the role of PM, President, Council of Ministers etc and it will help students learn about Local Administration.
4. Understand the importance of Election Commission and the Students will become aware of how a Country and State are run in Democracy.
5. Know about Secularism, Federalism, Democracy, Liberty, Freedom of Expression, Special Status of States etc.,

UNIT I
Introduction: Constitution' meaning of the term, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy

UNIT II
Union Government and its Administration: Structure of the Indian Union: Federalism, Centre - State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha

UNIT III
State Government and its Administration: Governor: Role and Position, CM and Council of ministers, State Secretariat: Organization, Structure and Functions

UNIT IV
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials.

UNIT V
Composition of Judiciary and Election Commission: Composition of Indian Judiciary, Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC.

Books Recommended:
1. 'Indian Polity' by Laxmikanth 5th Edition, McGraw Hill Edition.
2. Indian Constitution by Subhash C. Kashyap, Vision Books Publisher
3. 'Introduction to Indian Constitution' by D.D. Basu, 21st Edition, LexisNexis Publisher
4. 'Indian Administration by Avasthi and Avasthi-by Laxminarayan Agarwal publication.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
EFFECTIVE TECHNICAL COMMUNICATION

Course Code: GR22A2108 **L/T/P/C:2/0/0/0**
II Year II Semester

Course Outcomes:
1. Demonstrate proficiency in producing well-structured technical documents adhering to standard writing conventions and industry-specific guidelines.
2. Develop critical analysis skills to assess and evaluate technical documents.
3. Develop a habit of lifelong learning in technical communication, recognizing its importance in their personal and professional growth.
4. Exhibit effective oral communication skills by delivering technical presentations with clarity, coherence, and appropriate use of visual aids.
5. Exemplify intercultural competence in technical communication.

UNIT- I
Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, Factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media, Artificial Intelligence - Voice of the future, Everyday life, Communicating with Machines.

UNIT-II
Technical Writing, Grammar, and Editing- Abstract Writing, Technical writing process, forms of discourse, Collaborative writing, creating indexes, technical writing style and language, Basics of grammar, and study of advanced grammar, Introduction to Digital Humanities, Managing technical communication projects, Time estimation, Single sourcing, Localization.

UNIT-III
Self-Development and Assessment- SWOT, Self-assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, Career planning, Self-esteem, Managing Time, Personal memory, Taking notes, Complex problem-solving, Stress Management, Working with Rhythm and Balance, Emotional Intelligence, Six Hats of Thinking.

UNIT-IV
Communication and Technical Writing- Group discussion, Oral presentation, Resume writing, Interview skills, Graphic presentation, Personality Development, Technical articles, Official notes, Memos, and Minutes of meetings.

UNIT-V
Ethics- Business ethics- Corporate Social Responsibility-importance, need, stories, Engineering Ethics, Role and responsibility of engineer, Work culture in jobs.

Textbooks:
1. M Ashraf Rizvi, Effective Technical Communication, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2018.

Reference Books:
1. Raman Sharma, Technical Communication, Oxford Publication, London, 2013.
2. Meenakshi Raman, Shalini Upadhyay, SOFT SKILLS Key to Success in Workplace and Life, Cengage Learning India Pvt. Ltd., Delhi, 2018.

3. Ron Cowan, The teacher's Grammr of English, CAMBRIDGE UNIVERSITY PRESS,New Delhi,2008.
4. Shiv Khera, You Can Win, Macmillian Books, New York, 2003.
5. Arthur D. Rosenberg, David Hizer, The Resume Handbook, Adams Media, an F+W Publications Company, 57 Littlefield Street,Avon, MA02322,USA.
6. M. Kay DuPont, Business Etiquette & Professionalism, Viva Books private Limited, Hyd.,2005
7. David F. Beer and David McMurrey, Guide to Writing as an Engineer, John Willey, New York, 2004

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
REAL-TIME REASEARCH PROJECT/ SOCIETAL RELATED PROJECT

Course Code: GR22A2109 **L/T/P/C: 0/0/4/2**
II Year II Semester

Course Outcomes:

1. Predict the Field domain in the specialized area under Engineering discipline.
2. Evaluate and Obtained the category of the solution with help of Real time studies
3. Analyze and Discuss the field problems using Analysis tools /Modes/simulations and experimental investigations.
4. Implementing the solution of problem statement.
5. Prioritize the reports and deliver the final work with presentation.

III YEAR

I SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MACHINE DESIGN

Course Code: GR22A3023 **L/T/P/C: 2/1/0/3**
III Year I Semester

Course Outcomes:

1. Determine tolerances, limits of fits, and the dimensions of members subjected to bi-axial loading for real time applications
2. Solve the dimensions of the machine members subjected to variable loading combined with bi-axial loading
3. Evaluate the dimensions of the riveted, welded and bolted joints subjected to different loading
4. Analyze the keys, cotters and knuckle joints subjected to tensile and compressive loading.
5. Compute the dimensions of shaft couplings and shafts subjected to combined torsional and bending loading

UNIT I

Introduction: General considerations in design, Engineering Materials and their properties –Selection of Materials–Manufacturing consideration in design. Tolerances and fits–Principal stresses–Various theories of failure.

UNIT II

Strength of Machine Elements: Stress concentration–Theoretical stress Concentration factor - Methods of Reducing Stress Concentration–Fatigue stress concentration factor–notch sensitivity –Endurance limit–Design of members subjected to variable loading–Gerber's parabola, Goodman's line–Soderberg's line

UNIT III

Riveted Joints: Methods of Riveting-Material of Rivets-Types of Riveted Joints - Caulking and Fullering- Failures of a Riveted Joint –Strength of a Riveted Joint –Efficiency of a Riveted Joint.
Welded Joints: Types of Welded Joints. Strength of Various types of welded joints–Axially Loaded Unsymmetrical Welded joints–Eccentrically Loaded Welded Joints.
Bolted joints: Initial Stresses due to Screwing up forces–Bolted Joints under Eccentric Loading–Parallel and perpendicular to axis.

UNIT IV

Keys: Types of Keys, Design of rectangular sunk key
Cotters Joints: Types of Cotter Joints-Design of Socket and Spigot Cotter Joint–Design of Sleeve and Cotter Joint–Design of Gib and Cotter Joint-Design of Knuckle Joint

UNIT V

Shafts: Design of solid and hollow shafts for strength and rigidity–Design of shafts for combined, axial, bending and torsional loads – Shaft sizes – BIS codes.
Shaft Couplings: Rigid couplings–Muff, Split Muff and Flange couplings.
Flexible couplings–Bushed pin type coupling–Universal coupling–Oldham's coupling.

Text books:

1. Design of Machine Elements by V. B. Bhandari, McGraw Hill Publishers, Fifth Edition,2020
2. Machine Design by Dr N.C. Pandya and Dr. C.S. Shah- Charotar Publishers, 2022

References books:

1. Machine Design by Allen S Hall, Alfred R Holowenko, Herman G. Laughlin, Schaum's Outlines, McGraw Hill Edition, 2017
2. Shigleys's Mechanical Engineering Design by Richard G Budinas, J. Keith Nisbett, McGraw Hill Publisher, Eleventh Edition, 2020
3. Design of Machine elements by M. F. Spotts, 6th Edition, Pearson Education India, 2006.
4. Machine Design by R. L. Norton, 5th Edition, Pearson Education India, 2018.
5. Machine Design by R.S.Khurmi and J K Gupta, S. Chand and Company, 2022

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ECONOMICS AND ACCOUNTING FOR ENGINEERS

Course Code: GR22A2004 **L/T/P/C: 3/0/0/3**
III Year I Semester

Course Outcomes:
1. Scan the economic environment and forecast demand of products through demand forecasting techniques.
2. Plan the production levels in tune with maximum utilization of organizational resources and with maximum profitability and list out various costs associated with production and able to compute breakeven point.
3. Outline the different types markets and competition, forms of business organization and methods of pricing.
4. Analyze the profitability of various projects using capital budgeting techniques
5. Prepare the financial statements.

UNIT I

Introduction and Demand Analysis: Definition and Scope: Introduction to Economics, 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 and Cost Analysis: Production Function – Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, 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 and Forms of Business organizations: Types of competition and Markets, Features of Perfect competition, Monopoly and Monopolistic Competition. **Pricing:** Objectives and Policies of Pricing. Methods of Pricing. **Business:** Features and evaluation of different forms of Business Organization: Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises and their types.

UNIT IV

Capital Budgeting: Capital and its significance, Types of Capital, Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR) and Net Present Value (NPV) Method and Internal Rate of Return (IRR) (simple problems) and Profitability Index (PI)

UNIT V

Introduction to Financial Accounting: Accounting Concepts and Conventions - Double-Entry Book Keeping. **Accounting Cycle:** Journal, Ledger, Trial Balance, Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

Text Books

1. Aryasri: Managerial Economics and Financial Analysis, TMH, 2009.
2. Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007.
3. Financial Accounting -1: S P Jain and K. L. Narang, Kalyani Publishers,2005.

Reference Books

1. Peterson, Lewis and Jain: Managerial Economics, Pearson, 2009
2. Mithani : Managerial Economics , HPH, 2009
3. Lipsey and Chrystel, Economics, Oxford University Press, 2009
4. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.2009
5. Horngren : Financial Accounting, Pearson, 2009.
6. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MANUFACTURING TECHNOLOGY

Course Code: GR22A3024 **L/T/P/C: 3/0/0/3**
III Year I Semester

Course Outcomes:

1. Analyze tool geometry in manufacturing the component.
2. Demonstrate Lathe machines commonly found in industry including manual and computer controlled lathes.
3. Perform various operations on reciprocating metal cutting machines.
4. Execute different milling operations on various milling machines.
5. Assess various finishing processes on various machines.

UNIT I

Metal Cutting: Elementary treatment of metal cutting theory– Elements 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– tool life equation, cutting fluids, machinability– MRR- Tool materials.

UNIT II

Lathe Machines: Working principle, specification of lathe – types of lathe – work piece holders, tool holders –Taper turning methods - thread cutting – Lathe attachments. Turret and capstan lathes – collet chucks – other work holders – tool holding devices – box and tool layout. Principal features of automatic lathes – classification – Single spindle and multi- spindle automatic lathes, CNC lathes.

UNIT III

Shaping, slotting and planning machines: Principles of working – Principal parts – specification classification, operations performed. Kinematic scheme of the 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.

UNIT IV

Milling machine: working principle – specifications – classifications of milling machines-Principal features of horizontal, vertical and universal milling machines, Types geometry of milling cutter – milling cutters – Various milling operations – Accessories of milling machines, kinematic scheme of milling cutters.

UNIT V

Grinding machines: Fundamentals of grinding– 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.

Lapping, honing and broaching machines: Comparison to grinding – lapping and honing-
broaching machines-Principles of working – Principal parts – specification- classification, operations performed.

Jigs and Fixtures: Design principles of Jigs and fixtures and uses. Classification of Jigs & Fixtures – Principles of location and clamping – Types of clamping & work holding devices. Typical examples of jigs and fixtures.

Text books:

1. Workshop Technology – B.S.Raghuwanshi – Vol II – Dhanpat Rai & Company, 2017
2. Manufacturing Technology - Metal Cutting and Machine Tools , Volume 2,4th Edition,2018

References:

1. Manufacturing technology by R K Rajput-Laxmi Publications (P)Ltd,2018
2. Machine Tools – C.Elanchezhian and M. Vijayan / Anuradha Agencies Publishers,2004
3. Production Engineering by –Dr P C Sharma – S Chand & Company ltd, 2016
4. Machine Tool Technology by -Dr P C Sharma – S Chand & Company ltd,2012
5. Fundamentals of Metal Cutting and machine tools by B L Juneja., G S Sekhon , Nithin seth- New Age International Publishers,2008

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
APPLIED THERMODYNAMICS

Course Code: GR22A3025 **L/T/P/C: 2/0/0/2**
III Year I Semester

Course Outcomes:

1. Draw the thermodynamic properties diagrams based on the process flow of steam power plants
2. Apply the laws of thermodynamics to analyze the components of boilers and nozzles.
3. Differentiate between Vapour power cycles and gas power cycles for steam, gas turbine plants and their functionality
4. Infer from property charts and tables and to apply the data for the evaluation of performance parameters of the steam and gas turbine plant
5. Analyze the functionality of major components of steam and gas turbine plants and to do the analysis on the working of various propulsive devices

UNIT I

Steam Power Plant: Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration and Reheating.

Fuels and Combustion : Fuel - Types – Calorific values (Heating value) of fuels - Bomb calorimeter - Junker's Gas calorimeter– Definition of combustion of fuel -Calculation of minimum air required (on mass basis) for the complete combustion of fuel having a given composition – Products of combustion- Orsat Apparatus for flue gas analysis.

UNIT II

Boilers: Classification – Working principles with sketches including H.P. Boilers – Mountings and Accessories – Working principles- Boiler horsepower, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification – Height of chimneyfor given draught and discharge- Condition for maximum discharge- Efficiency of chimney **Steam Nozzles:** Stagnation Properties- Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in nozzle- Velocity coefficient- Condition for maximum discharge- Critical pressure ratio- Criteria to decide nozzle shape- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilson line.

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. De-Laval Turbine - its features- Methods to reduce rotor speed-Velocity compounding and Pressure compounding- Velocity and Pressure variation along the flow – Combined velocity diagram for a velocity compounded impulse turbine.

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

UNIT IV

Steam Condensers: Requirements of steam condensing plant – Classification of condensers Working principle of different types – Vacuum efficiency and Condenser efficiency – Air leakage, sources and its effects, Air pump- Cooling water requirement.

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- Combustion chambers and turbines of Gas Turbine Plant- Brief Concepts.

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, Dr.R K Rajput , Laxmi Publications, 2020 edition
2. Nag P.K, Engineering Thermodynamics, 4/E, The McGraw Hill,2008

Reference books:

1. Gas Turbine Theory, Saravanamuttoo, Cohen, Rogers, Pearson, 2014 Edition
2. Fundamentals of Engineering Thermodynamics - Rathakrishnan E/ 2nd Edition/PHI Learning Pvt. Ltd., /2005
3. Mahesh M Rathore, Thermal Engineering, McGraw Hill Publications - 2012.
4. Gas Turbines – V. Ganesan /McGraw Hill, 2007 edition
5. P.L.Ballaney, Thermal Engineering, 2/E, Khanna Publishers,2005.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ROBOTICS
(PROFESSIONAL ELECTIVE-I)

Course Code: GR22A3026 **L/T/P/C: 3/0/0/3**
III Year I Semester

Course Outcomes:

1. Classify with the Robot Anatomy and Robot Configurations
2. Develop automation and Robot applications.
3. Apply the kinematic motions of robots and knowledge about robot end effectors.
4. Integrate the Programming methods and various Languages of robots.
5. Select appropriate Sensors and their applications in robots

UNIT I

Introduction: Automation and Robotics, CAD/CAM and Robotics – An overview of Robotics – present and future applications – classification by coordinate system and control system.

UNIT II

Components of the Industrial Robotics: Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

UNIT III

Motion Analysis: Homogeneous transformations as applicable to rotation and translation – problems.

Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

UNIT IV

Differential transformation and manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problem. Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages.

UNIT V

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric and stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors.

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding AND spray painting - Assembly and Inspection.

Text books:

1. Groover, Mikell P.. Industrial Robotics: Technology, Programming, and Applications. Singapore, McGraw-Hill, 1986.
2. Robotics and Control / Mittal R K and Nagrath I J / TMH. 2007

References:

1. Fu, K. S., Gonzalez, R. C., Lee, C. S. G. (1987). Robotics: Control, Sensing, Vision, and Intelligence. United States: McGraw-Hill.
2. Coiffet, P., Chirouze, M. (2012). An Introduction to Robot Technology. Netherlands: Springer Netherlands.
3. Klafter, R. D., Chmielewski, T. A., Negin, M. (1989). Robotic engineering: an integrated approach. United Kingdom: Prentice Hall.
4. Craig, J. J. (2009). Introduction To Robotics: Mechanics And Control, 3/E. India: Pearson Education.
5. Mark W Spong, M. Vidyasagar, Robot Dynamics And Control. India, Wiley India Pvt. Limited, 2008.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ADVANCED STRENGTH OF MATERIALS
(PROFESSIONAL ELECTIVE - I)

Course Code: GR22A3027 **L/T/P/C: 3/0/0/3**
III Year I Semester

Course Outcomes:

1. Understand stress, strain and deformation of cylinders and spheres.
2. Solve for slope and deflection of fixed beams under different loading conditions.
3. Compute the slope and deflection of continuous beams under different loading conditions.
4. Obtain solutions to column buckling and strut problems.
5. Analyze stresses in curved beams and rotating discs.

UNIT I

Thin Cylinders and Spherical Shells: Stresses and strains in thin cylinders, thin spherical shell. Thick cylinders: Thick cylinders subjected to internal and external pressure and compound cylinders.

UNIT II

Fixed Beams: Fixing moments and Reactions for a fixed beam of uniform section, Effect of sinking support, slope and deflection. Construction of shear force and bending moment diagrams.

UNIT III

Continuous Beams: Reaction at the supports, and support moments Effect of sinking of supports.

UNIT IV

Columns and Struts: Columns with one end free and the other fixed, Both ends fixed, One end fixed and other hinged, Limitation of Euler's formula, Rankine's Formula, Column with initial curvature, Column carrying eccentric load, Laterally loaded columns.

UNIT V

Bending of Curved Beams: Stresses in bars of circular, rectangular and Trapezoidal sections. Stresses due to rotation: Wheel rim, disc of uniform thickness, disc of uniform strength.

Text Books:

1. Strength of materials by Dr. Sadhu Singh, Khanna Publishers, 10th edition,2010
2. Strength of materials by S.S Rattan, McGraw Hill, 3rd edition , 2017

References:

1. Strength of Materials by R.K .Rajput,6th Edition, S Chand Publishers, 2015
2. Analysis of Structures, by Vazirani and Ratwani. Vol. 1, 1993 edition,
3. Theory of structures by S.Ramamrutham and R. Narayan, Dhanpat Rai Publishers, 9th edition , 2014
4. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.
5. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MECHANICAL VIBRATIONS
(PROFESSIONAL ELECTIVE- I)

Course Code: GR22A3028 **L/T/P/C: 3/0/0/3**
III Year I Semester
Course Outcomes:

1. Acquire knowledge about the free and forced vibrations.
2. Develop mathematical model of dynamic systems with multiple degree of freedom.
3. Calculate natural frequency and period of simple vibrating mechanical systems.
4. Obtain the analytical solution for system's time response.
5. Acquire skills needed to measure and analyze vibrational signals.

UNIT I

Single degree of freedom systems – Introduction – Free and forced vibrations – Damping classification and damped systems – Transient (shock) vibrations as applied to Single degree of freedom systems.

UNIT II

Two degree of freedom systems – Principal modes – undamped and damped free and forced vibrations – undamped vibration absorbers - Transient (shock) vibrations as applied to Two degree of freedom systems.

UNIT III

Multi degree of freedom systems – free and forced vibrations in longitudinal, lateral and torsional modes – damped and undamped, critical speeds of rotors. Continuous systems - free and forced vibrations of string, bars and beams.

UNIT IV

Numerical methods in vibration analysis by matrix iteration, Rayleigh's, Stodala's, Rayeigh – Ritz and Holzer's method. Vibration measurements and analysis – Transducers and mounting methods – Data acquisition using instrumentation recorders, Time domain signal analysis, orbit analysis, filters, frequency domain analysis (Narrow band FFT analysis), Nyquist criteria.

UNIT V

Acoustics and Noise Control-Acoustic wave equation, Acoustic energy and sound intensity. Propagation of sound, Concept of Acoustic impedance. Sound power transmission, Transmission Loss. Human Response and ratings, Various Measures of Sound. Weighting filters, Loudness, Indices of Loudness. Acoustic radiation from spherical source and piston source.

Text Books:

1. Mechanical Vibrations by G.K. Grover, Nem Chand & Bros, 2009 Edition
2. Mechanical Vibration Practice with Basic Theory, V Rama Murthy, Narosa Publisher,2010, Edition

References:

1. Theory of Vibrations with Applications, by W.T. Thomson, Pearson, 2008, 5th Edition.
2. Mechanical Vibrations Schaum Outline Series by S Graham Kelly,1996, McGraw-Hill Education
3. Vibration problems in Engineering by S.P. Timoshenko, Prentice Hill Limited, 2007

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ARTIFICIAL INTELLIGENCE IN MECHANICAL ENGINEERING
(PROFESSIONAL ELECTIVE –I)

Course Code: GR22A3029 **L/T/P/C: 3/0/0/3**
III Year I Semester

Course Outcomes:

1. Describe the importance of designing the System with Artificial Neural Networks.
2. Learn different types of fuzzification and defuzzification methods.
3. Distinguish the various Neural Networks Architectures.
4. Identify a system using Fuzzy logic or Neural network
5. Analyze the parameters of Genetic Algorithm.

UNIT I:

ANN: Biological Neuron and its foundations to Intelligent Systems, Artificial Neural Networks, Single layer Multi-Layer Feed Forward Neural Networks, LMS or Delta Learning Algorithm and Back Propagation Algorithm, Feedback networks and Radial Basis Function Networks.

UNIT II:

Fuzzy Logic: Basic concepts of fuzzy logic, Properties of fuzzy sets, Knowledge base and Rule base representation, Inference Mechanism, Defuzzification Methods: Center of Sums Method (COS), Center of gravity (COG) / Centroid of Area (COA) Method, Center of Area / Bisector of Area Method (BOA), Weighted Average Method

UNIT III:

Fuzzy Neural Networks: Fuzzy Concepts in Neural Networks, Basic principles of Fuzz Neural Systems, and Neural-Fuzzy systems, Generating Fuzzy Rules

UNIT IV:

Neural Networks in Indirect Neural Control: System Identification using Neural Networks.
Fuzzy Control Systems: Problem statements, Decision Surface and Assumptions in Fuzzy Control System Design

UNIT V:

Genetic Algorithms: Introduction, Representations, The Algorithm, Cross over, Mutation, Termination Criteria, Importance of Genetic Algorithms.

TEXT BOOKS:

1. J M Zurada , “An Introduction to ANN”,Jaico Publishing House, 2012
2. Hung T. Nguyen, Nadipuram R. Prasad, Carol L. Walker and Elbert A. Walker, “A First Course in Fuzzy and Neural Control” Chapman & Hall, CRC.,2013

REFERENCES:

1. Timothy J Ross, "Fuzzy Logic with Engg.Applications", McGraw. Hill, 2018
2. Driankov, Dimitra, "An Introduction to Fuzzy Control", Narosa Publication, 2015
3. Golding, "Genetic Algorithms", Addison-Wesley Publishing Com,2019
4. Introduction to Artificial Neural Networks, by Gunjan Goswami, Publisher: S.K. Kataria & Sons; 2020 12th edition
5. Introduction to Artificial Neural Networks, Sivanandam S., Paulraj M, Vikas Publishing House, 2017

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MANUFACTURING TECHNOLOGY LAB

Course Code: GR22A3031 **L/T/P/C: 0/0/3/1.5**
III Year I Semester

Course Outcomes:

1. Apply tool geometry in manufacturing the component.
2. Operate machine tool equipment commonly found in industry including manual and computer controlled lathes, milling machines, drill presses and cutting machines
3. Perform chip formation analysis of metal cutting machines
4. Execute the finishing process on various machines
5. Apply safety principles in a work environment to minimize hazards and prevent losses to productivity

List of Experiments

1. Preparation of Work specimen for lathe, drilling, shaping, slotting and milling
2. Plane & Step Turning operation on lathe Machine
3. Taper Turning on Lathe Machine
4. Thread cutting operation on-lathe machine.
5. Knurling operation on-lathe machine.
6. Drilling operation and boring operation on lathe machine
7. Drilling and counter boring operation on lathe machine
8. Drilling and internal thread cutting using Taps
9. Edge preparation using Shaping machine
10. Key way cutting operation on Slotting machine
11. Face milling operation using Milling machine
12. Grinding of tool angles using Cylindrical /Surface Grinding Machine.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
COMPUTER AIDED MODELING AND 3D PRINTING LAB

Course Code: GR22A3032 **L/T/P/C: 0/0/3/1.5**
III Year I Semester

Course Outcomes:

1. Create and convert CAD models into various file formats which are compatible with other software.
2. Create complex geometry machine components.
3. Create engineering assemblies using appropriate assembly constraints.
4. Create detailed drawings for parts and assemblies of engineering components.
5. Model complex parts using Advance feature options and printing them using 3D Printer.

Syllabus:

Introduction to CAD Software

Part Modeling

Create 3D Part models using features such as Extrude, Revolve, fillets, chamfer, Sweep, Loft, Hole, Extrude-cut, etc.

Assembly of Parts

Create an Assembly of parts by applying constraints (relations/ Mates)

Modeling of complex Parts and surfaces

Create complex 3D parts and surfaces using parametric curves

Drafting

Create layout, orthographic views, detailing

Exercises in Modeling, Assembly, and Drafting

Task 1: Practice Exercise related to Sketch and Basic Feature Options.
Task 2: Practice Exercise related to Advanced Feature Options.
Task 3: Creating Parts related to Plummer Block Assembly.
Task 4: Creating Parts related to Pipe vice.
Task 5: Creating Parts related to Footstep Bearing.
Task 6: Assembly of Plummer Block.
Task 7: Assembly of Pipe vice
Task 8: Assembly of Footstep Bearing.
Task 9: Part and Assembly Drawings of Plummer Block Assembly.
Task 10: Part and Assembly Drawings of Pipe vice
Task 11: Part and Assembly Drawings of Footstep Bearing.
Task 12: 3D Printing of Model 1
Task 13: 3D Printing of Model 2

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
VALUE ETHICS AND GENDER CULTURE

Course Code: GR22A2002 **L/T/P/C: 2/0/0/0**
III Year I Semester

Course Outcomes:

1. To enable the student to understand the core values that shapes the ethical behavior with self-development.
2. Student will be able to realize the significance of ethical human conduct and personality development.
3. Students will be able to the ethical behavior in their professional lives.
4. Students will attain a finger grasp of how gender discrimination works in our society and how to counter it.
5. Students will develop a better understanding on issues related to gender and know how to respond gender violence to condemn it.

UNIT I

Values and Self-Development–social values and individual attitudes, Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline.

- A Case study on values and self-development

UNIT II

Personality and Behaviour Development-positive thinking, punctuality, avoiding fault finding, Free from anger, Dignity of labour, religious tolerance, Aware of self-destructive habits.

- A Case study on Personality

UNIT III

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.

- A Case study on professional ethics

UNIT IV

Introduction to Gender - Definition of Gender, Basic Gender Concepts and Terminology, Attitudes towards Gender, Social Construction of Gender.

- A Case study/ video discussion on attitudes towards gender

UNIT V

Gender-based Violence -The concept of violence, Types of Gender-based violence, the relationship between gender, development and violence, Gender-based violence from a human rights perspective.

- ❖ A Case study/ video discussion on gender-based violence in view of human rights

Textbooks

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ethics in Engineering Practice & Research, Caroline Whit beck, 2e, Cambridge University Press 2015.
3. A Bilingual Textbook on Gender" written by A. Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, GoguShyamala, Deepa Sreenivas and Susie Tharu and published by Telugu Akademi, Hyderabad,Telangana State in the year 2015.

Reference Books

1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. 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/
3. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, 4e, Cengage learning, 2015.
4. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

III YEAR
II SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN OF MACHINE ELEMENTS

Course Code: GR22A3098 **L/T/P/C:3/0/0/3**
III Year II Semester

Course Outcomes:

1. Select sliding and rolling contact bearings for all types of industrial applications.
2. Apply I.C engine reciprocating parts subjected to variable loads for automobile industry applications.
3. Solve the dimensions of I.C engine rotary parts subjected to variable loads for automobile industry applications.
4. Determine the dimensions of gears subjected to static and dynamic loading for transmission of power applications.
5. Analyze the power screws and springs considering various types of loads for shock absorption applications

UNIT I

Bearings: Introduction–Classification of bearings

Journal Bearings or Sliding contact bearings: Types of Journal bearings–bearing materials–Lubrication–Bearing characteristic number-Bearing Modulus–Full and partial bearings–Clearance ratio–Heat dissipation of bearings–Journal bearing design.

Rolling Contact Bearings: Classification-Ball and roller bearings–Static loading of Ball and Roller bearings, Bearing life. Design–Dynamic load, equivalent radial load, selection of Ball and Roller bearings.

UNIT II

IC Engine reciprocating parts: Piston-Design Considerations for a Piston, Materials for Pistons–Design of Piston and piston pin. **Cylinder:** Materials-Design of Cylinder, Cylinder head, and Cylinder liners.

UNIT III

IC Engine rotary parts: Connecting Rod-Materials–Forces Acting on the Connecting Rod–Design of Connecting Rod and its parts

Crank shafts: Materials–Design of Crankshafts: Centre Crankshaft, Side or Overhung crankshaft

UNIT IV

Gears: Introduction-classification of gears-gear materials**–Spur gears**: systems of gear teeth-Lewis equation-Dynamic load factor-compressive strength-Design spur gears: module, face width, number of teeth and center distance-Check for dynamic and wear considerations.

UNIT V

Mechanical Springs: Introduction**–**Classification**–Helical springs:** Materials-Buckling of Compression Springs-Surge in Springs. Stresses and deflections of helical compression springs–Helical Springs Subjected to Fatigue Loading-Springs in Series-Springs in Parallel-Concentric or Composite Springs–natural frequency of helical springs–Energy storage capacity–helical torsion springs–Co-axial springs, leaf springs.

Design of power screws: Design of screw-Stresses in power screws, Design of screw jack, design of nut, compound screw, differential screw –possible failures.

Text books:

1. Design of Machine Elements by V. B. Bhandari, McGraw Hill Publishers, 5th Edition,2020
2. Machine Design by Dr N.C. Pandya and Dr. C.S. Shah- Charotar Publishers, 2022

References Books:

1. Machine Design by Allen S Hall, Alfred R Holowenko, Herman G. Laughlin, Schaum's Outlines, McGraw Hill Edition, 2017
2. Shigleys's Mechanical Engineering Design by Richard G Budinas, J. Keith Nisbett, McGraw Hill Publisher, Eleventh Edition, 2020
3. Design of Machine elements by M. F. Spotts, 6th Edition, Pearson Education India, 2006.
4. Machine Design by R. L. Norton, 5th Edition, Pearson Education India, 2018.
5. Machine Design by R.S.Khurmi and J K Gupta, S. Chand and Company, 2022

Design Data Hand Book by k.Balveera Reddy and K Mahadevan, CBS Publishers 4th edition 2013

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
HEAT TRANSFER

Course Code: GR22A3099 **L/T/P/C: 2/1/0/3**
III Year II Semester

Course Outcomes:

1. Formulate and analyze a heat transfer problem involving conduction heat transfer both steady and unsteady state conditions
2. Apply the 1-D general heat conduction equation for different geometries with and without internal heat generation and transient cases
3. Recognize the significance of different types of convection and empirical correlation for solving real time problems with concepts including hydrodynamic and thermal boundary layers
4. Explore to the knowledge of heat transfer with phase change through boiling and condensation with relevant theories and correlations for analysis and analyze the performance parameters of heat exchangers using LMTD and NTU methods
5. The concept of radiation shape factor in real time applications and study to the relations for radiation heat transfer for black and Gray bodies

UNIT I
INTRODUCTION AND CONDUCTION HEAT TRANSFER

Modes and mechanisms of heat transfer – Basic laws of heat transfer -- General discussion about applications of heat transfer. 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 AND UNSTEADY STATE HEAT TRANSFER

One Dimensional Steady State Conduction Heat Transfer

One dimensional steady state conduction heat transfer through homogeneous slabs, hollow cylinders and spheres – Overall heat transfer coefficient – Electrical analogy – Critical radius of insulation. Variable Thermal conductivity–Systems with heat sources or heat generation. Extended surface (fins) heat transfer – Long fin, Fin with insulated tip and short fin, Performance of fins

One Dimensional Transient Conductive Heat Transfer

One dimensional transient conduction heat transfer in systems with negligible internal resistance. Significance of Biot and Fourier numbers. Chart solutions of transient conduction systems – Sensitivity of thermometer – Significance of time constant -- Concept of Functional Body.

UNIT III
CONVECTIVE HEAT TRANSFER

Classification of systems based on causation of flow, condition of flow, configuration of flow – Applications for developing semi empirical non- dimensional correlation for convective heat transfer – dimensional analysis – significance of non-dimensional numbers, Concepts of Continuity, Momentum and energy equation

Forced convection

External flows: Concepts about hydrodynamic and thermal boundary layer - Use of empirical correlations for convective heat transfer over flat plates, cylinders and spheres. **Internal flows:** Concepts about Hydrodynamic and thermal entry lengths – use of empirical relations for horizontal pipe flow and annulus flow.

Free convection

Development of Hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for vertical plates and pipes.

UNIT IV
HEAT TRANSFER WITH PHASE CHANGE AND HEAT EXCHANGERS

Boiling: Pool boiling – Regimes Calculations on Nucleate boiling, Critical Heat flux and film boiling. **Condensation:** Film wise and drop wise condensation – Nusselt's theory of condensation on vertical plate – Film condensation on vertical and horizontal cylinders using empirical correlations.

Heat Exchangers: Classification of heat exchangers – Overall heat transfer coefficient and fouling factor – Concepts of LMTD and NTU methods – Effectiveness of heat exchangers.

UNIT V
RADIATION HEAT TRANSFER

Emission characteristics and laws of black body radiation – Total and monochromatic quantities–laws of Planck, Wein, Kirchoff, Lambert, Stefan and Boltzmann – Heat exchange between two black bodies – Concept of shape factor – Emissivity – Heat exchange between grey bodies–radiation shields – Electrical analogy for radiation networks – Irradiation, radiosity.

TEXT BOOKS:

1. Fundamentals of Engg. Heat and Mass Transfer – R.C.Sachdeva/Sixth edition/New Age International Publishers/ 2022
2. Heat and Mass Transfer – D.S. Kumar/ 9th Edition/ S.K. Kataria & Sons/2015

REFERENCE BOOKS:

1. Heat Transfer – P.K.Nag / Tata McGraw-Hill Publishing Company Limited, 2002
2. Heat and Mass Transfer: Fundamentals and Applications -Yunus Cengel and Afshin Ghajar 6th Edition/ McGraw Hill/2020
3. Heat and Mass Transfer – R.K.Rajput / 5th Revised Edition/S.Chand & Company Ltd/ 2012
4. Fundamentals of Heat and Mass Transfer - C.P. Kothandaraman/ 4th Edition/ New Age International Publishers/2012
5. Engineering Heat and Mass Transfer - Mahesh M. Rathore/ 4th Edition/ University Science Press/ 2023

Data Book: Heat and Mass Transfer Data Book - C. P. Kothandaraman and S. Subramanyan/7th Edition/ New Age International (P) Limited 2010

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Code: GR22A3100 **L/T/P/C:3/0/0/3**
III Year II Semester

Course Outcomes:

1. Explain the concepts and principles of Industrial Engineering
2. Analyze the Plant layouts and Work study.
3. Conduct Work Measurement process and able to assess performance rating
4. Design ergonomic model and use human resources effectively
5. Apply statistical quality control and current Industrial engineering techniques

UNIT-I

INTRODUCTION: Definition of industrial engineering (I.E), development, applications, role of an industrial engineer, differences between production management and industrial engineering, quantitative tools of IE and productivity measurement. Concepts of Managements: importance, functions of management, scientific management, Taylor's principles, theory X and theory Y, Fayol's principles of management.
PRODUCTION SYSTEMS: Importance, types of production Systems: Job production, batch production, mass production and continuous production, applications

UNIT-II

PLANT LAYOUT: Factors governing plant location, types of plant layouts, advantages and disadvantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts, plant maintenance, preventive and break down maintenance.
WORK STUDY: Definition, objective and scope of Work study; Method Study: Definition, objective and scope of method study, activity recording and exam aids. Charts to record moments in shop operation – process charts, flow process charts, travel chart and multiple activity charts.

UNIT - III

WORK MEASUREMENTS: Definition, objective and benefit of work measurement. Work measurement techniques. Work sampling: need, confidence levels, sample size determinations, random observation, conducting study with the simple problems
TIME STUDY: Time Study, Definition, time study equipment, selection of job, steps in time study. factors of affecting rate of working, allowances and standard time determination. Breaking jobs into elements, recording information. Rating & standard Rating, standard performance, scale of rating,

UNIT – IV

ERGONOMICS: Introduction, Types, principles of Ergonomics, Systems approach to Ergonomic Model, Ergonomic Model and Work Design.
HUMAN RESOURCE MANAGEMENT: Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job-evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, types.

UNIT-V

STATISTICAL QUALITY CONTROL: Quality control, Quality assurance and its importance, attribute

sampling inspection with single and double sampling, Control charts – X and R – charts X and S charts and their applications, numerical examples.

CURRENT TRENDS IN INDUSTRIAL ENGINEERING AND MANUFACTURING: Agile manufacturing, Lean and Six Sigma, Value Engineering, Just in time, Total quality management, Enterprise resource planning, Supply Chain and Logistics Management

TEXT BOOKS

1. Industrial Engineering and Management - NVS Raju, Cengage Publishers,2011
2. Industrial Engineering and management -O.P Khanna, Dhanpat rai Publications,2018

REFERENCE BOOKS

1. Industrial Management -Dr DK Bhattacharya -S Chand First Edition,2012
2. Statistical Quality Control -M. Mahajan -Dhanpat Rai & Co. (P) Limited (1 January 2016)
3. SCHAUM'S Operations Management - J.G Monks -McGraw Hill Publishers 2020
4. Industrial Engineering and Management Science-T.R. Banga, S. C. Sharma, N. K. Agarwal - Khanna Publishers, 2008
5. Industrial Engineering and Production Management- Martand Telsang -S. Chand & Company 2006

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
METROLOGY AND SURFACE ENGINEERING
(PROFESSIONAL ELECTIVE - II)

Course Code: GR22A3101 **L/T/P/C: 3/0/0/3**
III Year II Semester

Course Outcomes:

1. Identify the uncertainties in dimensional metrology and design limits, fits and dimensional, geometrical tolerances for given applications.
2. Measure lengths and angles using line-graduated instruments, and use comparative length- measuring instruments, to measure variations in the distance between two or more surfaces.
3. Operate optical measuring instruments and to demonstrate coordinate measuring machines to record measurements of complex profiles with high sensitivity.
4. Explain the effect of surface roughness and demonstrate the surface roughness measurement methods for improving the quality.
5. Use effective methods of measuring straightness, flatness, roundness, surface profile, screw threads, gear teeth and alignment tests on milling, lathe and drilling machines.

UNIT I

Systems of limits, fits and Tolerances: Introduction, normal size, tolerance, limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard Institution system – British standard system, International Standard system for plain and screwed work.

UNIT II

Linear measurement: Length standard, line and end standard, slip gauges – calibration of the slip gauges, Dial indicator, micrometers.

Measurement of angles and tapers: Different methods – Bevel protractor – angle slip gauges – spirit levels – sine bar – Sine plate, rollers and spheres used to determine the tapers.

Limits and Gauges : Taylor's principle – Design of Go and No Go gauges, plug ring, snap, gap, taper, profile and position gauges, Geometric Dimensioning and Tolerancing.

UNIT III

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 autocollimator.

UNIT IV

Surface roughness measurement: Differences between surface roughness and surface waviness- Numerical assessment of surface finish – CLA, R.M.S Values – Rz values, Methods of measurement of surface finish-profilograph, Talysurf, ISI symbols for indication of surface finish.

Measurement through comparators: Comparators – Mechanical, Electrical and Electronic Comparators, pneumatic comparators and their uses in mass production.

UNIT V

Screw thread measurement: Element of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.

Machine tool alignment tests: Requirements of Machine Tool Alignment Tests, Alignment tests on lathe, milling, drilling machine tools.. Preparation of acceptance charts.

Gear measurement: Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch pressure angle and tooth thickness.

Coordinate Measuring Machines: Types of CMM, Role of CMM, and Applications of CMM.

Text books:

1. I.C. Gupta, "A Text Book of Engineering Metrology", Dhanpat Rai & sons,4th edition 1997.
2. R.K. Jain , "Engineering Metrology", Khanna Publishers, Edition 22nd,2022.

References:

1. Raghavendra., Krishnamurthy.,Krishnamurthy. (2013). Engineering Metrology and Measurements. India: OUP India.
2. Rajput, R. K. (2009). Engineering Metrology & Instrumentation. India: S. K. Kataria & Sons.
3. Busch, T. (1989). Fundamentals of Dimensional Metrology. United States: Delmar.
4. Grous, A. (2013). Applied Metrology for Manufacturing Engineering. Germany: Wiley.
5. Rega Rajendra, Principles of Engineering Metrology. (2008). India: Jaico Publishing House.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MATERIALS CHARACTERIZATION AND TESTING
(PROFESSIONAL ELECTIVE- II)

Course Code: GR22A3102 **L/T/P/C: 3/0/0/3**
III Year II Semester

Course Outcomes:

1. Identify the Techniques of X-ray Crystallography.
2. Illustrate principles of diffraction (Bragg's Law) and its use in crystal structure determination.
3. Interpret the properties of electrons and the effect of accelerating potential.
4. Demonstrate the basic operational modes of a SEM and TEM
5. Analyze stereographic projections and their use in characterization of crystalline materials.

UNIT I

MICRO AND CRYSTAL STRUCTURE ANALYSIS

Principles of Optical Microscopy – Specimen Preparation Techniques – Polishing and Etching – Polarization Techniques – Quantitative Metallography – Estimation of grain size – ASTM grain size numbers – Microstructure of Engineering Materials - Elements of Crystallography – X- ray Diffraction– Bragg's law – Techniques of X-ray Crystallography – Debye – Scherer camera – Geiger Diffractometer – analysis of Diffraction patterns – Interplanar spacing – Identification of Crystal Structure, Elements of Electron Diffraction.

UNIT II

ELECTRON MICROSCOPY

Interaction of Electron Beam with Materials – Transmission Electron Microscopy – Specimen Preparation – Imaging Techniques – BF & DF – SAD – Electron Probe Microanalysis – Scanning Electron Microscopy – Construction & working of SEM – various Imaging Techniques – Applications Atomic Force Microscopy- Construction & working of AFM - Applications.

UNIT III

CHEMICAL AND THERMAL ANALYSIS

Basic Principles, Practice and Applications of X-Ray Spectrometry, Wave Dispersive X-Ray Spectrometry, Auger Spectroscopy, Secondary Ion Mass Spectroscopy, Fourier Transform Infra-Red Spectroscopy (FTIR)- Proton Induced X-Ray Emission Spectroscopy, Differential Thermal Analysis, Differential Scanning Calorimetry (DSC) And Thermo Gravity metric Analysis (TGA)

UNIT IV

MECHANICAL TESTING – STATIC TESTS

Hardness – Brinell, Vickers, Rockwell and Micro Hardness Test – Tensile Test – Stress Strain plot – Proof Stress – Torsion Test - Ductility Measurement – Impact Test Charpy & Izod – DWTT - Fracture Toughness Test, Codes and standards for testing metallic and composite materials.

UNIT V

MECHANICAL TESTING – DYNAMIC TESTS

Fatigue – Low & High Cycle Fatigues – Rotating Beam & Plate Bending HCF tests – S-N curve – LCF tests – Crack Growth studies – Creep Tests – LM parameters – AE Tests-modal analysis - Applications of Dynamic Tests.

TEXT BOOKS:

1. Culity B.D., Stock S.R & Stock S., Elements of X ray Diffraction, (3rd Edition). Prentice Hall,2001.
2. Dieter G.E., Mechanical Metallurgy, (3rd Edition), ISBN: 0070168938, McGrawHill,1988.

REFERENCE BOOKS

1. Davis, H.E., Hauck G. & Troxell G.E., The Testing of engineering Materials, (4th Edition) McGraw Hill, College Divn., 1982.
2. Suryanarayana A. V. K., Testing of metallic materials, (2nd Edition), BS publications, 2007.
3. Komvopoulos, K. (2017). Mechanical Testing of Engineering Materials: Second Edition. United States: Cognella, Incorporated.
4. Zhang, S., Li, L., Kumar, A. (2008). Materials Characterization Techniques. United Kingdom: CRC Press.
5. Characterization of Materials. (2003). United Kingdom: John Wiley & Sons, Incorporated.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
UNCONVENTIONAL MACHINING PROCESSES
(PROFESSIONAL ELECTIVE- II)

Course Code: GR22A3103 **L/T/P/C:3/0/0/3**
III Year II Semester

Course Outcomes:

1. Apply advanced machining processes for technical and economic advantages over conventional processes.
2. Evaluate the mechanism of material removal rate in the ultrasonic machining process.
3. Analyze the theories of jet machining processes for higher reliability, better repeatability and higher accuracy.
4. Assess the utilization of energy for various thermo electrical processes.
5. Integrate electrochemical and chemical processes for precision and ultra precision machining.

UNIT I

Introduction: Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials Applications.

UNIT II

Mechanical processes: Ultrasonic machining – Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.

UNIT III

Abrasive jet machining, Water jet machining and abrasive water jet machine: Basic principles, equipment, process variables, mechanics of metal removal, MRR, application and limitations. Magnetic abrasive finishing, Abrasive flow finishing.

UNIT-IV

Thermo electric processes: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications. Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining –thermal features, cutting speed and accuracy of cut. Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.

UNIT V

Electro chemical & chemical processes: Fundamentals of electrochemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy economic aspects of ECM – Simple problems for estimation of metal removal rate, Electro stream drilling, Shaped tube electrolytic machining. Fundamentals of chemical machining, Chemical machining principle, maskants, etchants, advantages and applications of chemical machining. Metal removal rate, Electro stream drilling, Shaped tube electrolytic machining. Fundamentals of

chemical machining, Chemical machining principle, maskants, etchants, advantages and applications of chemical machining.

Text books:

1. Advanced machining processes by VK Jain/ Allied publishers,2009.
2. Modern Machining Process / Pandey P.C. and Shah H.S./ TMH,2017.

References:

1. New Technology / Bhattacharya A/ The Institution of Engineers, India 1984.
2. Buffa, E. S., Sarin, R. K.. Modern production/operations management. United Kingdom: Wiley,1987.
3. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller,2020.
4. Reliability Engineering & Quality Engineering by Dr. C. Nadha Muni Reddy and Dr. K. Vijaya Kumar Reddy, Galgotia Publications, Pvt., Limited, 2007
5. Production Control: A Quantitative Approach / John E. Biegel, 1971.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INTELLIGENT MANUFACTURING SYSTEMS
(PROFESSIONAL ELECTIVE- II)

Course Code: GR22A3104 **L/T/P/C: 3/0/0/3**
III Year II Semester

Course Outcomes:

1. Assess the performance of manufacturing systems
2. Develop a systematic approach for design and implementation of manufacturing systems
3. Suggest new procedures to improve the productivity of existing manufacturing systems
4. Utilize online collaboration tools to work in complex teams.
5. Apply skills to change machine as smart machine which thinks.

UNIT I

Computer integrated manufacturing systems – structure and functional areas of CIM system - AD, CAPP, CAM, CAQC, ASRS and advantages of CIM Manufacturing communication systems – MAP/TOP OSI model, data redundancy, top-down and bottom- up approach, volume of information. Intelligent manufacturing–system components, system architecture and data flow, system operation.

UNIT II

Components of knowledge based systems – basic components of knowledge based systems, knowledge representation, comparison of knowledge representation schemes, interference engine, knowledge acquisition. Machine learning – concept of artificial intelligence, conceptual learning, artificial neural networks -biological neuron, artificial neuron, types of neural networks, applications in manufacturing

UNIT III

Automated process planning – variant approach, generative approach, expert systems for process planning, feature recognition, phases of process planning Knowledge Based **System for Equipment Selection (KBSES)** – Manufacturing system design, equipment selection problem, modeling. the manufacturing equipment selection problem, problem solving approach in KBSES, structure of the KBSES

UNIT IV

Group technology: models and algorithms – visual method, coding method, cluster analysis method, matrix formation–similarity coefficient method, sorting-based algorithms, bond energy algorithm, cost based method, cluster identification method, extended ci method.

UNIT V

Knowledge based group technology- group technology in automated manufacturing system, structure of knowledge based system for group technology (KBSGT) – data base, knowledge base, clustering algorithm.

Text books:

1) Mikell P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, 8th edition, PHI,2008.
2) Yagna Narayana, “Artificial Neural Networks”, PHI,2009.

References:

1. Andre Kusaic, " Intelligent Manufacturing Systems", PHI,1989
2. Hamid R. Parsaei and Mohammad Jamshidi, "Design and Implementation of Intelligent Manufacturing Systems", PHI, 2009
3. Design And Implementation Of Intelligent Manufacturing Systems: From Expert Systems, Neural Networks, To Fuzzy Logic. (2008). India: Pearson Education.
4. Kusiak, A. (1990). Intelligent Manufacturing Systems. United Kingdom: Prentice-Hall International.
5. Automation, Production Systems, and Computer-Integrated Manufacturing. (2016). India: Pearson India.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
METROLOGY LAB

Course Code: GR22A3106 **L/T/P/C: 0/0/3/1.5**

III Year II Semester

Course Outcomes:

1. Evaluate the accuracy and tolerance of components produced and to define the measurement standards
2. Measure lengths, diameters and angles using line-graduated instruments, i. e. vernier calipers, micrometers, bevel protractor, sine bar and surface plates
3. Use comparative length-measuring instruments, i.e. dial indicator, to measure variations in the distance between two or more surfaces.
4. Use effective methods of measuring straightness, flatness, roundness, profile, screw threads and gear teeth.
5. Use contour projector and coordinate measuring machine to record measurements of complex profiles with high sensitivity**.**

List of Experiments:

1. Measurement of lengths, heights, diameters by vernier calipers and vernier height gauge.
2. Measurement of internal, external diameters using internal and external micrometers.
3. Measurement of bores by internal micrometers and dial bore indicators.
4. Using gear tooth Vernier calipers and checking the chordal addendum and chordal height of spur gear.
5. Machine tool alignment of the test on the lathe.
6. Machine tool alignment test on milling machine.
7. Tool maker's microscope and its application
8. Angle measurement by Bevel protractor, Sine bars.
9. Use of spirit level in finding the flatness of surface plate.
10. Thread measurement by three wire method or Tool maker's microscope.
11. Surface roughness measurement by Surface roughness tester.
12. Measurement of screw thread by using Profile Projector.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
HEAT TRANSFER LAB

Course Code: GR22A3107 **L/T/P/C:0/0/3/1.5**
III Year II Semester

Course Outcomes:

1. Evaluate heat transfer through conduction mode of heat transfer such as thermal conductivity of metal rod, composite material
2. Analyze the heat transfer phenomena in case of insulating material by conducting experiments on lagged pipes and concentric spheres
3. Measure the convective heat transfer coefficient in case of Natural and Forced Convection and assess the performance parameters of the pin fin
4. Apply the knowledge of physics of radiation on black and gray bodies, evaluation of Stefan Boltzmann constant.
5. Analyze the parallel and counter flow heat exchangers and find the overall heat transfer coefficient

LIST OF EXPERIMENTS:

1. Thermal Conductivity of given metal rod.
2. Composite wall Apparatus.
3. Heat transfer through lagged pipe.
4. Heat Transfer through a Concentric Sphere
5. Heat transfer in natural convection
6. Heat transfer in forced convection apparatus.
7. Heat transfer in pin-fin
8. Emissivity apparatus.
9. Stefan Boltzmann Apparatus.
10. Parallel and counter flow heat exchanger.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MINI PROJECT WITH SEMINAR

Course Code: GR22A3089 **L/T/P/C: 0/0/4/2**
III Year II Semester

Course Outcomes:

1. Formulate hypothesis for the problem statement with sound technical knowledge from selected project domain.
2. Design Engineering Solution to the problem statement with systematic approach.
3. Analyze and develop an efficient solution for implementation of the project.
4. Apply the theoretical concepts while providing solutions to the problem statement with teamwork and multidisciplinary approach.
5. Demonstrate professionalism with ethics while preparing and presenting the project work.

IV YEAR

I SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
CAD/CAM

Course Code: GR22A4025 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Course Outcomes:

1. Understand the fundamentals of CAD/CAM, 2D and 3D transformation methods
2. Apply analytical and synthetic curves to develop wire-frame models of the objects.
3. Analyze synthetic surfaces and solids entities to create surface and solid models of the objects for real time applications
4. Execute CNC, APT programming and Group Technology in industry to improve the production rate and quality.
5. Develop computer aided process plans, computer controlled inspection and testing instruments to increase the production rate and quality of the product.

UNIT I

Introduction to CAD/CAM: Definition, Fundamentals of CAD, Product cycle, Types of Productions, Design Process, Applications of Computer to design process, CAD/CAM Hardware, Basic structure, CPU, Memory types, input devices, output devices. CAD software, Functions of Graphic software, Transformation-scaling, rotation and translation, segmentation, windowing, clipping, hidden surface removal.

UNIT II

Geometric Modeling: Types of Geometric models, Representation of curves-parametric and non-parametric representation of curves, orders of continuity of curves.

Wireframe Modeling–Analytical entities-synthetics entities:Hermitte cubic curve, Bezier curve, B-Spline and NURBS.

UNIT III

Surface Modelling-Analytical surface entities-plane surface, ruled surfaces, tabulated cylinder, surface of revolution, Synthetics surfaces: Hermitte bi-cubic, Bezier, B-spline and NURBS surfaces, Special surfaces: Blending surface, Coons patch, Sculptured surface.

Solid Modeling–Analytical and synthetic solid entities. Boundary, CSG and Sweep representations.

UNIT IV

Computer Numerical Control(CNC): CNC basic elements and structure, CNC coordinates, motion control systems, applications, benefits. CNC Manual Part Programming, Computer Aided Part Programming-APT programming.

Group Technology (GT): Part family, part classification and coding systems, GT cells, advantages and applications.

UNIT V

Computer Aided Processes Planning (CAPP): Retrieval type and Generative type, benefits. **Computer Aided Quality Control (CAQC):** Terminology in quality control, the computer in QC, contact inspection methods, non-contact inspection methods-optical inspection methods-non-optical inspection methods, computer aided testing, integration of CAQC with CAD/CAM.

Computer integrated manufacturing systems: Types of Manufacturing systems-FMS,Material handling systems, CIMS benefits.

Text books:

1. CAD/CAM by Mikell P. Groover and E.W. Zimmers.Jr, Pearson Education, Economy Edition, 2003
2. CAD / CAM Theory and Practice by Ibrahim Zeid and R Sivasubramanian, McGraw Hill, 2009

References books:

1. Automation, Production systems and Computer Integrated Manufacturing by Mikell P. Groover, Fourth Edition, 2006
2. CAD/CAM/CIM by P. Radhakrishnan and S. Subramanyan, V. Raju, Fourth Edition, New Age Publisher, 2018
3. CAD/CAM/CIM by Dr. K.C Jain, Vikas Gohil, Khanna Publisher, 2014
4. CAD/CAM: Concepts and Applications by Chennakesava R.Alavala, PHI, 2008
5. Computer Numerical Control Concepts and Programming by Warren S Seames, Cengage Learning Publisher, 2007

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INSTRUMENTATION AND CONTROL SYSTEMS

Course Code: GR22A4026 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Course Outcomes:

1. Illustrate various measuring systems and the errors of measurement.
2. Explain the concepts of measurement of displacement and temperature
3. Demonstrate various theories of pressure, level of flow measurement.
4. Describe the concepts of measurement of acceleration, vibration, speed and humidity.
5. Analyze the concept of different elements of control systems of various industrial applications.

UNIT I

Introduction to Measuring Instruments: Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Static performance characteristics, 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 Piezoelectric, Inductive, capacitance, resistance, ionization and Photoelectric transducers, Calibration procedures.

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

UNIT III

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.

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).

UNIT IV

Measurement of Speed: Mechanical Tachometers – Electrical tachometers – Stroboscope, Non Contact type of tachometer

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

Measurement of humidity – Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter.

UNIT V

Stress Strain measurements: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge Rosettes.

Measurement of Force, Torque and Power- Elastic force meters, load cells, Torsionmeters, Dynamometers.

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

Text books:

1. Measurement Systems: Applications and design by D.S Kumar, Mcgraw Hill, 2016
2. Mechanical Measurements / BeckWith, Marangoni, Linehard, PHI / PE, 2010

References:

1. Measurement systems: Application and design, Doeblin Earnest. O. Adaptation by Manik and Dhanesh/ TMH, 1990
2. Instrumentation and Control systems/ S.Bhaskar/ Anuradha Agencies, 2008
3. Experimental Methods for Engineers / Holman, Mcgraw Hill, 2011
4. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers, 1995
5. Instrumentation and mech. Measurements by A.K. Tayal ,Galgotia Publications, 1999

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
REFRIGERATION AND AIR CONDITIONING
(PROFESSIONAL ELECTIVE- III)

Course Code: GR22A4027 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Course Outcomes:

1. Explain the conventional and alternative refrigerants and air refrigeration methods
2. Understand various refrigeration systems and its components.
3. Apply the theoretical and mathematical principles to simple, complex Vapour compression and Vapour absorption refrigeration systems.
4. Discuss about Psychrometry properties, different processes of Air-Conditioning systems in various applications.
5. Evaluate the practice of thermal and environmental conditions, seasonal efficient system

UNIT I

Introduction

Introduction to Refrigeration, Necessity, Methods of refrigeration, Unit of refrigeration; Coefficient of performance (COP), Refrigerants- Classification, Nomenclature, Desirable properties, Comparative study, secondary refrigerants, Introduction to eco-friendly Refrigerants.

Air Refrigeration Systems: Reversed Carnot refrigeration cycle. Temperature Limitations, Bell Coleman air refrigeration cycle, Necessity of cooling the Aeroplane, Aircraft refrigeration systems, Simple cooling and Simple evaporative types, Boot strap and Boot strap evaporative types, Regenerative type and Reduced Ambient type system, Comparison of different systems.

UNIT II

Vapour Compression (VC) Refrigeration Systems: Simple Vapour Compression (VC) **Refrigeration systems**- Limitations of Reversed Carnot cycle with Vapour as the refrigerant; Analysis of VC cycle considering degrees of sub cooling and superheating; VC cycle on P- V, T-S and P-H diagrams; Effects of operating conditions on COP.

UNIT III

Vapour Absorption Refrigeration Systems: Vapour Absorption Refrigeration Systems – Basic Systems, Actual COP of the System, Relative merits and demerits, Properties of aqua ammonia; Electrolux Refrigeration. Steam Jet Refrigerating System- Introduction, Analysis, Relative merits and demerits. Cascade Refrigerating Systems- Necessity, Selection of Pairs of refrigerants for the system, Concept of cascade temperature, Analysis, Multi-staging.

UNIT IV

Psychrometry and Air Conditioning Processes: Properties of Air-water vapour mixture- GibbsDalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Wet bulb temp, Psychometric chart, Psychrometry of air-conditioning processes, Basic processes in conditioning of air; Psychometric processes in air washer-Problems

Air- Conditioning Load Calculations: Outside and inside design conditions; Sources of heating load; Sources of cooling load; Heat transfer through structure, Solar radiation, Electrical applications, Infiltration and ventilation, Heat generation inside conditioned space; Apparatus selection; Comfort chart-Problems

UNIT V

Air Conditioning Systems with Controls and Accessories: Classifications, Layout of plants; Equipment selection; Air distribution system; Duct systems Design; Filters; Refrigerant piping; Design of summer air-conditioning and Winter air conditioning systems; Problems.

Refrigeration and Air Conditioning Equipment: Type of compressors and their performance curves; Types of Condensers, Heat transfer in condensers; Types of expansion devices; types of evaporators, Cooling and Dehumidifying coils- Problems.

TEXT BOOKS:

1. A course in Refrigeration and Air Conditioning – Arora and Domkundwar, Dhanpat Rai and sons.2003 edition
2. Refrigeration and Air conditioning –C.P. Arora, TMH, New Delhi.2016 edition

REFERENCES:

1. Refrigeration and Air Conditioning by R K Rajput, S K kataria & sons, 2010.
2. Refrigeration and Air Conditioning / Manohar Prasad / New Age International, 1989
3. Principles of Refrigeration, by Dossat, Prentice Hall,1997.
4. Refrigeration and air conditioning, by Stoecker, McGraw hill Edu.,2004.
5. Basic refrigeration and air conditioning/PN Ananthanarayanan/McGraw hill education, 2013

Data book: Refrigeration and Psychrometric Properties (With Charts and Tables) by C P Kothandaraman

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
POWER PLANT ENGINEERING
(PROFESSIONAL ELECTIVE -III)

Course Code: GR22A4028 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Course Outcomes:

1. Describe various energy sources and combustion processes in steam power plants.
2. Interpret diesel and gas turbine power plants layout with auxiliaries.
3. Demonstrate hydro projects classifications, fusion and fission reactions in nuclear power plants and types of reactors.
4. Identify the advantages of combining the operation of different power plants and the importance of measuring and instrumentation in a power plant.
5. Utilize the concepts of power plant economics and assess the impact of its effluents on the environment.

UNIT I

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.

UNIT II

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT III

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), Gas Cooled and Liquid Metal Cooled Reactors, safety measures for nuclear power plants.

UNIT IV

Hydroelectric power plants, classification, typical layout and components, construction and working, principles of wind, tidal, solar Photo Voltaic and solar thermal, geothermal, biogas and fuel cell power systems.

UNIT V

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Text Books:

1. A Course In Power Plant Engineering by – Arora and Domkundwar, Dhanpatrai & Co.2011
2. Power Plant Engineering, by P.K.Nag, TataMcHill-2008.

Reference books

1. A Text Book of Power Plant Engineering, by R K Rajput, Lakshmi Publications, 2008.
2. Power Plant Engineering, by P.C.Sharma, S.K.Kataria Publications, 2009.
3. Power Plant Engineering, 2nd ed.,Elliot T.C., Chen K and Swanekamp R.C., McGraw Hill,1998
4. An Introduction to Power Plant Technology, by G.D. Rai, Khanna publications-1996.
5. Power Plant Technology, El Wakil M.M., Tata McGraw Hill, 2010.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
AUTOMOBILE ENGINEERING
(PROFESSIONAL ELECTIVE – III)

Course Code: GR22A4029 **L/T/P/C: 3/0/03**
IV Year I Semester

Course Outcomes:

1. Identify the various components of an automobile and different drive system
2. Demonstrate the working of various fuel systems in SI and CI engines and also the environmental implications of automobile emissions.
3. Design the vehicle architecture and working of controlling systems for IC & HEV vehicles.
4. Describe each component of transmission system of an automobile viz clutch, gear box, propeller shaft and differential, also analyze the geometry of the steering mechanism
5. List the different types of suspension system and braking system of an automobile and importance of each type based on real time applications

UNIT I

Introduction, Engine and Lubrication systems: Components of four wheeler automobile – chassis and body – power unit –power transmission – rear wheel drive, front wheel drive, 4 wheel drive – types of automobile engines, Engine construction, turbo charging and super charging, Engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation – engine service, re-boring, decarburization, Nitriding of crank shaft.

UNIT II

Fuel System in S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters– carburetor – types – air filters – petrol injection-Multi point fuel injection(MPFI).

Fuel System in C.I. Engines: Requirements of diesel injection systems, types of injection systems, fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. CRDI engines, cooling systems.

Emissions: Emission from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Energy alternatives – Photovoltaic, hydrogen, Biomass, alcohols, LPG and CNG.

UNIT III

Electric and Hybrid Vehicles: History, Components of Electrical Vehicle, Comparison with IC engines, EV classification & EV terminology, Types of Electric Vehicles and components, EV Architecture-(BEV), (HEV), (PHEV).

Electric Drive and Controller: Types of Motors, Selection and sizing of Motors, Motor Controllers, Component sizing, Electrical connection of motor

UNIT IV

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.

Steering System: Steering geometry – camber, castor, king pin rake, combined angle toein, center point

steering. Types of steering mechanism–Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT V

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

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

Text books:

1. Automotive Mechanics-Vol.1 & Vol.2, by Kirpal sing, Standard Publishers, New Delhi 2008.
2. Automobile Engineering, (3rd edition), by William crouse, TMH Distributors, New Delhi, 2017
3. Electric and Hybrid Vehicles, 2nd edition, AK Babu, Khanna Publishing, 2022

Reference Books:

1. Automobile Engineering, by Newton's Steeds & H.Garrett, C. Heitner, Butterworth International Publisher, London, 2016.
2. Automobile Engineering by S.K. Gupta, S Chand Publications , Volume 1 and Volume 2, 2020 edition
3. Automotive Mechanics – William H Crouse, Donald L Anglin, Tata Mac Graw Hill ,10th edition , 2017
4. Modern Electric, Hybrid Electric & Fuel cell vehicles- Mehrdad Ehsani, CRC Press, 2005

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENERGY CONSERVATION AND MANAGEMENT
(PROFESSIONAL ELECTIVE- III)

Course Code: GR22A4030 **L/T/P/C:3/0/0/3**
IV Year I Semester

Course Outcomes:
1. Distinguish energy accounting and balancing
2. Implement methodologies for energy savings
3. Interpret different heat treatment furnace
4. Understand Energy consumption and auditing
5. Summarize on combustion thermodynamics and kinetics

UNIT I
Energy - Power – Past & Present scenario of World; National Energy Consumption Data – Environmental aspects associated with energy utilization –Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing

UNIT II
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope on Encon in Illumination.

UNIT III
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and energy conservation measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT IV
Energy efficiency in Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets. Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concepts

UNIT V
Energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Benchmarking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering

Text books:
1. Callaghan, P.W. Design and Management for Energy Conservation, Pergamon Press, Oxford,1981.
2. Witte. L.C., P.S. Schmidt, D.R. Brown, Industrial Energy Management and Utilisation, Hemisphere Publ, Washington, 1988.

References:
1. Dryden. I.G.C., The Efficient Use of Energy Butterworths, London, 1982
2. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website of Bureau of Energy Efficiency (BEE), A statutory body under Ministry of Power, Government of India, 2004.

3. Murphy. W.R. and G. Mc KAY, Energy Management", Butterworths, London 1987.
4. Turner. W.C., Energy Management Hand book, Wiley, New York, 1982.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
TRIBOLOGY
(PROFESSIONAL ELECTIVE-IV)

Course Code: GR22A4031 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Course Outcomes:

1. Know broad based understanding of the interdisciplinary subject 'tribology' and its technological significance
2. Apply the principles of lubrication, lubrication regimes, theories of hydrodynamic, elasto hydro dynamic and mixed/ boundary lubrication
3. Apply the basic theories of friction to predictions about the frictional behavior of commonly encountered sliding interfaces.
4. Analyze about consequences of wear, wear mechanisms, wear theories and analysis of wear problems.
5. Characterize features of rough surface and liquid lubricants as they pertain to interface sliding.

UNIT I

Introduction to Tribology: Properties of oils and equation of flow, Viscosity, Newton's Law of viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Lubrication principles, classification of lubricants.

UNIT II

Hydrodynamic Lubrication: Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, mechanism of pressure development in an oil film, Reynold's investigation and Reynold's equation in 2D.

UNIT III

Idealized Journal Bearing: Introduction to idealized journal bearing, load carrying capacity, condition for equilibrium, Sommerfeld's numbers and significance of it; Partial bearings, end leakages in journal bearing, numerical problems. Slider / Pad Bearing with a Fixed and Pivoted Shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, numerical examples.

UNIT IV

Oil Flow and Thermal Equilibrium of Journal Bearing: Oil flow through bearings, self- contained journal bearings, bearings lubricated under pressure, thermal equilibrium of journal bearings. Hydrostatic Lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing.

UNIT V

Bearing Materials: Commonly used bearings materials, properties of typical bearing materials. Advantages and disadvantages of bearing materials.

Behavior of tribological Components: Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. Tribological measures, Material selection, improved design, surface engineering.

Text books:

1. Fundamentals of Tribology, Basu S K., Sengupta A N., Ahuja B.B., , PHI 2006
2. Introduction to Tribology Bearings, Mujumdar B. C., S. Chand company pvt. Ltd 2008.

References:

1. Theory and Practice of Lubrication for Engineers, Fuller, D., New York company 1998
2. Principles and Applications of Tribology, Moore, Pergamaon press 1998
3. Tribology in Industries, Srivastava S., S Chand and Company limited, Delhi 2002
4. Lubrication of bearings – Theoretical Principles and Design, Redzimovskay E I., Oxford press company 2000

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN OF MACHINE TOOL ENGINEERING
(PROFESSIONAL ELECTIVE – IV)

Course Code: GR22A4032 **L/T/P/C: 3/0//0/3**
IV Year I Semester

Course Outcomes
1. Understand the basic working principles of different machine tools with kinematic mechanisms.
2. Distinguish the functional and operational requirements of different machine tools
3. Describe machine tool structures for strength and rigidity
4. Design speed and feed gear boxes for a particular configuration.
5. Interpret the various drive controls used in machine tools

UNIT I
Basic features Classification of machine tools-Basic features of construction and fundamental kinematic mechanisms of general purpose, special purpose machine tools, transfer machines, Automatic and N.C. machines. Mechanisms used for converting rotary to linear motion Mechanisms for intermittent motion.

UNIT II
Kinematics, Drives of Machine tools Selection of range of speeds and feeds. Layout in G.P, A.P. and Logarithmic progression, standardisation of speeds and feeds. Productivity loss. Selection of highest and lowest speeds, range ratio. Design of ray diagram and structural diagrams for machine tool gear boxes. Sliding, clustered and clutched drives, support drive.

UNIT III
Feed gear boxes Norton and Meander drive pre-selection of speed, stepped and stepless regulation. Strength, rigidity and design analysis Analysis of beds, frames, columns. Materials for structures. Methods to improve the rigidity of structures. Types of Guideways-overall compliance of machine tools. Thermal effects-functional accuracy of machine tools
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UNIT IV
Spindle units Spindle units of lathe, drilling, milling and grinding machines, materials for spindles. Spindle design. Effect of clearance on the rigidity of spindle. Hydrodynamic, hydrostatic, rolling bearings. Selection of bearings.

UNIT V
Hydraulic controls Various controls used in machine tools. Hydraulic and pneumatic systems used in machine tools-positive displacement pumps - properties of fluids — relief valves, check valves, flow control valves, multi-position valves, filters, accumulators. Hydraulic circuit for surface grinding machine, hydro copying system.

Text Books
1. Principles of Machine Tools by Sen G.S., & Battacharya, New Central Book Agency,2018
2. Design of Machine Tools by Basu S.K., Allied Publishers.2016

Reference Books
1. Introduction to Fluid Power Circuits and Systems by Russe W. Henke, Addison Wesley,2017
2. Machine Tool Design by N. K. Mehta. McGraw Hill Publishing,2012
3. Design Principles of Metal-Cutting Machine Tools by F. Koenigsberger, 2013
4. Machine Tool Design by Acherkan, Mir publishing,1969

5. Design of Machine Tools by D. K Pal, S. K. Basu Oxford publishers ,2008

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SOFT COMPUTING TECHNIQUES IN MECHANICAL ENGINEERING
(PROFESSIONAL ELECTIVE -IV)

Course Code: GR22A4033 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Course Outcomes:
1. Describe the role of artificial intelligence techniques in real world
2. Apply fuzzy logic controller for Mechanical engineering problems
3. Identify different neural network controller for Mechanical engineering problems
4. Evaluate and compare performance of different optimization techniques for Mechanical engineering problems.
5. Analyze the real time applications in Material Characterization, Heat exchangers and design aspects.

UNIT- I
INTRODUCTION TO SOFT COMPUTING
Introduction to Soft Computing: Computing System, "Soft" Computing Versus "Hard" Computing, Soft Computing Methods, Recent trends in Soft Computing, Characteristics of Soft Computing, Applications of Soft Computing Techniques.

UNIT- II
FUZZY LOGIC: I
(Introduction): Fuzzy Logic Basic Concepts, Fuzzy Sets and Crisp Sets, Fuzzy Set Theory and operations, Properties of Fuzzy Sets, Fuzzy and Crisp Relations, Fuzzy to Crisp conversation

UNIT -III
Fuzzy Logic: II
(Fuzzy Membership, Rules): Membership Functions, Interference in Fuzzy Logic, Fuzzy if then else Rules, Fuzzy Implications and Fuzzy Algorithms, Fuzzification and Defuzzification, Fuzzy Controller, application of fuzzy logic controller in Mechanical Engineering.

UNIT IV – NEURAL NETWORKS
Basic concepts and major classes of neural networks, supervised and unsupervised learning, Single-layer perceptron, multi-layer perceptron, Back Propagation Neural network, Recurrent neural networks, support vector machine, Application of neural network modelling / control problems in Mechanical Engineering.

UNIT – V
OPTIMIZATION TECHNIQUES:
Geometric Programming, Genetic algorithms, Evolutionary Algorithm, Simulated Annealing, Ant colony optimization, Application of soft computing techniques to solve design, thermal and manufacturing related problems with Case Studies.

Text Books:
1. Pratihar, D. K. (2015). Soft Computing: Fundamentals and Applications. United Kingdom: Alpha Science International, Limited.
2. Goldberg, D. E. (1989). Genetic Algorithms in Search, Optimization, and Machine Learning. United Kingdom: Addison-Wesley..

References
1. Principles of soft computing (with cd). (2007). India: wiley india pvt. limited.

2. Padhy, N. P., Simon, S.P. (2015). Soft computing: with matlab programming. India: oxford university press.
3. Rajasekaran, S., Pai, G. A. V. (2004). Neural networks, fuzzy logic and genetic algorithm: synthesis and applications (with cd). india: phi learning.
4. Kumar, K.V. (2009). Neural networks & Fuzzy logic. India: S. K. kataria & sons.
5. Kasabov, N. K. (1996). Foundations of neural networks, fuzzy systems, and knowledge engineering. Cambridge: cambridge.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
FINITE ELEMENT ANALYSIS
(PROFESSIONAL ELECTIVE- IV)

Course Code: GR22A4123 **L/T/P/C:3/0/0/3**
IV Year I Semester

Course Outcomes:

1. Discuss the fundamental understanding of the theory of the finite element method
2. Develop proficiency in the application of the finite element method to realistic 1-D engineering problems
3. Describe the principle of mathematical modeling of 2-D engineering problems
4. Interpret the complete idea on heat transfer applications of finite element method
5. Explain the limitations of the FE method and understand the concept of dynamic problems.

UNIT I

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, potential energy method, Variational formulation of boundary value problems, Basic concept of Finite Element Method.

UNIT II

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanic.

UNIT III

Two dimensional equation, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors; beam equations, transverse deflection, longitudinal vibration and mode shapes, natural frequencies…

UNIT IV

Application to thermal problems, assembly of elemental matrices, solutions of problem from heat transfer, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

UNIT V

Natural coordinate systems, iso-parametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, Introduction to FE software.

Text Books:

1. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.
2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.
3. Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann,2004
4. Chandraputla and Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INSTRUMENTATION AND CONTROL SYSTEMS LAB

Course Code: GR22A4034 **L/T/P/C: 0/0/4/2**
IV Year I Semester

Course Outcomes:

1. Analyze errors, integrate and interpret different types of measurements
2. Review, prepare and present technological developments
3. Establish a course of action to solve problems
4. Illustrate load, flow, speed, vibration, temperature and pressure measurements.
5. Understand and analyze Instrumentation and Control systems and their applications of various industries.

List of Experiments:

Task 1: Calibration of Pressure Gauge for pressure measurement
Task 2: Calibration of Thermistor for temperature measurement
Task 3: Study and Calibration of LVDT Transducer for displacement measurement
Task 4: Calibration of Strain Gauge for strain measurement
Task 5: Calibration of Thermocouple for temperature measurement
Task 6: Calibration of Capacitive Transducer for angular displacement measurement
Task 7: Study and Calibration of Photo and Magnetic speed pickups for measurement of speed
Task8: Calibration of RTD (Resistance Temperature Detector) for temperature measurement
Task 9: Study and Calibration of Rotameter for flow measuremen
Task 10: Study and use of Vibrometer for the measurement of vibration amplitude at various loads
Task 11: Study and calibration of Mc Leod Gauge for low pressure measurement
Task 12: Calibration of Load Cell for load measurement

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
COMPUTER AIDED ANALYSIS AND MANUFACTURING LAB

Course Code: GR22A4035 **L/T/P/C:0/0/4/2**
IV Year I Semester

Course Outcomes:

1. Implement finite element method to design engineering components and solve engineering problems
2. Analyze 1-D and 2-D problems in solid mechanics and heat transfer
3. Perform model analysis on structures
4. Develop the CNC programs for turning and milling operations using basic codes and cycles
5. Create the components by performing the operations on CNC Turning and Milling machines.

List of experiments:

Task 1: Simulation of 1-D Structural Problem: Analysis of Truss members subjected to concentrated loads

Task 2: Simulation of 1-D Structural Problem: Analysis of Simply supported Beam subjected to concentrated load, bending moment, and uniform distributed load

Task 3: Simulation of 2-D Structural Problem: Analysis of Bracket subjected to pressure load using plane stress conditions

Task 4: Simulation of 2-D Structural Problem: Analysis of Bracket subjected to pressure load using symmetric boundary condition

Task 5: Simulation of 2-D Structural Problem: Analysis of Shaft subjected to pressure load using axisymmetric boundary conditions

Task 6: Thermal Problem 1: Thermal analysis of a Composite Slab

Task 7: Thermal Problem 2: Thermal analysis with conduction and convection boundary conditions

Task 8: Dynamics Problem 1: Model analysis of a beam

Task 9: Simulation and Execution of CNC program on turning machine using G70 AND G71 Turning cycle

Task 10: Simulation and Execution of CNC program on Turning machine using G74 drilling cycle, G75 grooving cycle, G76 threading cycle and G70 AND G71 Turning cycle

Task 11: Simulation and Execution of CNC program on Milling machine using G91 surface milling cycle for given different profiles

Task 12: Simulation and Execution of CNC program on Milling machine – drilling holes on plate

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PROJECT WORK - PHASE I

Course Code: GR22A4082 **L/T/P/C: 0/0/12/6**
IV Year I Semester

Course Outcomes:

1. Formulate hypothesis for the problem statement with sound technical knowledge from selected project domain.
2. Design Engineering Solution to the problem statement with systematic approach.
3. Analyze and develop an efficient solution for implementation of the project.
4. Apply the theoretical concepts while providing solutions to the problem statement with teamwork and multidisciplinary approach.
5. Demonstrate professionalism with ethics while preparing and presenting the project work.

IV YEAR

II SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ADDITIVE MANUFACTURING

Course Code: GR22A4103 **L/T/P/C: 3/0/0/3**
IV Year II Semester

Course Outcomes:
1. Demonstrate appropriate level of understanding on principles of additive manufacturing processes.
2. Choose appropriate materials for additive manufacturing processes
3. Appraise operating principles, capabilities and limitations of additive manufacturing system.
4. Apply suitable CAD tools and CAD interface for additive manufacturing process.
5. Develop physical prototypes by identifying suitable process with optimum process parameters

UNIT I
INTRODUCTION
Overview – History – Classification – Subtractive vs Additive Manufacturing, AM vs Reverse Engineering, Additive Manufacturing Process chain, AM technology in product development – Materials for AM – Tooling – Application Domain.

UNIT II
LIQUID BASED PROCESSES
Liquid based process: Introduction, Working Principle, Architecture of Equipment, Materials, Process parameters, Process Capabilities, Applications for SLA process, Solid Ground Curing, Rapid Freeze Prototyping, Solid Object Ultraviolet–Laser Printer.

UNIT III
SOLID BASED PROCESSES
Solid based process: Introduction, Working Principle, Architecture of Equipment, Materials, Process parameters, Process Capabilities, Applications for fused deposition modeling, laminated object modeling, Multi-Jet Modeling System, Plastic Sheet Lamination and Shape Deposition Manufacturing Process.

UNIT IV: POWDER BASED PROCESSES
Powder based process: Introduction, Working Principle, Architecture of Equipment, Materials, Process parameters, Process Capabilities, Applications for selective laser sintering, Three-Dimensional Printing, Laser Engineered Net Shaping, Multiphase Jet Solidification, Direct Shell Production Casting.

UNIT V: APPLICATIONS AND CASE STUDIES
Application-Material Relationship, Finishing Processes, Applications in Design, Applications in Engineering, Analysis and Planning, Applications in Manufacturing and Tooling, Aerospace Industry, Automotive Industry, Biomedical Industry, Jewelry Industry, Coin Industry.

Text Books:
1. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2015.
2. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, Third edition, World Scientific Publishers, 2010.

Book References:
1. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2011.
2. Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
3. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC Press,

2000
4. Srivatsan, T. S., and T. S. Sudarshan, eds. "Additive manufacturing: innovations, advances, and applications." (2015).
5. Gebhardt, Andreas, and Jan-Steffen Hötter. Additive manufacturing: 3D printing for prototyping and manufacturing. Carl Hanser Verlag GmbH Co KG, 2016.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
RENEWABLE ENERGY RESOURCES
(PROFESSIONAL ELECTIVE- V)

Course Code: GR22A4104 **L/T/P/C: 3/0/0/3**
IV Year II Semester

Course Outcomes:

1. Understand status of renewable and non-renewable sources of energy in india.
2. Formulate the energy-efficiency calculations of various solar energy systems.
3. Analyze the application of wind energy and wind energy conversion systems.
4. Develop capability to do basic design of biogas plants.
5. Illustrate the applications of different renewable energy sources like ocean thermal, hydro, geothermal energy.

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 forcooking, 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 by Twidell and Weir, Taylor and Francis, 2nd Special Indian Edition, 2009 Edition

2. Non- conventional Energy Sources, G.D. Rai, Khanna Publishers, 2004,3rd Edition.

References

1. Energy Resources Utilization and Technologies, Y. Anjaneyulu and Tuluri Francis, BS Publications, 2012.
2. Principles of Solar Engineering, Frank Krieth and John F Kreider, Hemisphere Publications, 1978, 5th Edition
3. Non-Conventional Energy by Ashok V. Desai, New Age International Publisher, 1990, 2nd Edition.
4. Non-Conventional Energy Systems, K.M. Mittal, A H Wheeler Publishing Co Ltd, 1999, First Edition
5. Renewable Energy Technologies by R. Ramesh, K. Uday Kumar, M. Anandakrishnan, Narosa Publishing House, 1997

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
TURBO MACHINERY
(PROFESSIONAL ELECTIVE - V)

Course Code: GR22A4105 **L/T/P/C: 3/0/0/3**
IV Year II Semester

Course Outcomes:

1. Apply thermodynamics and kinematics principles to turbo machines.
2. Analyze the performance of compressors and Turbines.
3. Ability to select turbo machine for given application.
4. Predict performance of turbo machines using model analysis.
5. Understand mechanisms behind working of Turbines and Optimize the efficiencies.

UNIT-I
Definition and classification of turbine machines; principles of operation; specific work and its representation on T-s and h-s diagrams; losses and efficiencies; energy transfer in turbomachines

UNIT-II
Euler equation of turbomachinery; Variation of velocity head and pressure head for forward, radial, backward curved vanes. Performance characteristics of fluid machines

UNIT- III
Flow mechanism through the impeller – velocity triangles, ideal and actual flows, slip and its estimation; degree of reaction – impulse and reaction stages; significance of impeller vane angle.

UNIT -IV
Similarity; specific speed and shape number; cavitations in pumps and turbines; performance characteristics of pumps and blowers; surge and stall ; thin aerofoil theory ; cascade mechanics

UNIT -V
Steam turbines – flow through nozzles, compounding, effect of wetness in steam turbines; gas turbines ; hydraulic turbines – Pelton , Francis and Kaplan turbines drat tube , performance and regulation of hydraulic

Text Books:
1. Yahya , S.M , Turbines , Compressors and Fans , Tata McGraw Hill , 1998
2. Dixon, S.L. Fluid Mechanics, Thermodynamics of Turbomachinery, Third Edition, Pergamon Press , 1998

Reference Books:
1. B. K. Venkanna, “Fundamentals of Turbomachinery”, First Edition, PHI Learning Pvt. Ltd.,2013 Edition.
2. Gopalakrishnan, G and Prithviraj , D.Treatise on Turbo machines , Schitech Publications , 2002
3. Shepherd , D.G. Principles of Turbomachinery , Macmillan Publishing company , 1957
4. Casnady , G.T, Theory of Turbo machines , McGraw Hill , 1964
5. V. Kadambi & Manohar Prasad, “An Introduction to Energy Conversion Vol. III, Turbomachinery”. First Edition, Wiley Eastern Limited, 2009 Edition

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
COMPUTATIONAL FLUID DYNAMICS
(PROFESSIONAL ELECTIVE- V)

Course Code: GR22A4106 **L/T/P/C: 3/0/0/3**
IV Year II Semester

Course Outcomes:

1. Classify the partial differential equations to understand the behavior of the equations
2. Analyze the semi implicit and explicit algorithms for staggered grid and non-staggered grids
3. Calculate the flow field with SIMPLE and SIMPLER schemes
4. Compare the various discretization schemes for convection diffusion equation
5. Assess the pressure velocity coupling, coupled velocity and temperature field.

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 and 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, and Direct Methods for banded matrices.

UNIT II

Finite Difference Applications: Heat conduction and Convection – steady state 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 modelling, conservative property, the upwind scheme. 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 IV

Steady flow, dimensionless form of Momentum and Energy equations, Stokes equation, conservative body force fields, stream function - Vorticity formulation.

UNIT V

Finite Volume Method for correction problems: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, upwind interpolation, linear interpolation and QUICK scheme, pressure velocity coupling, staggered, SIMPLE AND SIMPLER schemes. FVM for diffusion problems, FVM for 1-D steady state diffusion problems, FVMfor 2D diffusion problems.

Text books:

1. Computational Fluid Dynamics - Basics with Applications - John. D. Anderson, JR. McGraw Hill Education (India) Edition 2012.

2. Numerical heat transfer and fluid flow - Suhas V Patankar, Hemisphere Publishers, 1st edition, 2009

References:

1. Computational Fluid flow and Heat transfer - K. Muralidhar and T. Sundararajan, Narosa Publisher. 2nd edition, 2003.
2. Fundamentals of Computational Fluid Dynamics – Tapan K. Sengupta, Willey Universities Press, 2012
3. Introduction to Computational Fluid Dynamics, An: The Finite Volume Method, 2007
4. Computational Fluid Dynamics - T. J. Chung, Cambridge University Press, 2nd Edition, 2014.
5. Introduction to computational fluid mechanics - Niyogi, Chakravarty, Laha, Pearson publisher. 1st edition. 2009.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ELECTRICAL AND HYBRID VEHICLES
(PROFESSIONAL ELECTIVE-V)

Course Code: GR22A3015 **L/T/P/C:3/0/0/3**
IV Year II Semester

Course Outcomes:
1. Knowledge on Electric vehicles and their significance.
2. Interpretation on electric vehicle battery technology and control systems.
3. Able to classify drives in hybrid vehicles their principles and merits
4. Identify different power sources used in hybrid vehicles
5. Evaluate Electric propulsion systems and fuel cells.

UNIT - I INTRODUCTION:
Electric vehicles; early systems, charging techniques for lead acid batteries, charging techniques for nickel based batteries, charging techniques for non-aqueous batteries, Battery state of charge measurement, battery management, connection methods, battery exchange. Economic and environmental comparison of alternative vehicle options. Electric vehicles; configuration of EVs, performance, traction motor characteristics, tractive effort and transmission requirements.

UNIT- II BATTERIES:
Storage batteries; advanced lead acid, metal foil lead acid, nickel - iron, nickel - zinc, nickel - cadmium, sodium - sulphur, sodium - nickel chloride, lithium - iron sulphide, lithium - solid polymer, lithium - ion, aluminium - air and zinc - air. ELECTRIC PROPULSION SYSTEMS: DC motor drives, chopper control of DC motors. Drive train configuration and design objectives, control strategies. EV conversion process. Controller; overview, solid state controller

UNIT - III HYBRID DRIVES:
Introduction, features, functional classification, start/stop system, mild hybrid, full hybrid, plug-in-hybrid, batteries for hybrid vehicles, optimization of hybrid configurations. Changing modes for conductive charging. Super capacitor, fuels cells, solar cells, the flywheel, the hydraulic accumulator, compressed air storage, thermal energy storage, non battery energy sources.

UNIT - IV HYBRID ELECTRIC VEHICLES(HEVS) AND DRIVE STRUCTURES:
Concept of electric drive train, architecture of hybrid electric drive train, series hybrid drive, parallel hybrid electric drive train, parallel hybrid drivetrain with torque coupling, power split hybrid drive, speed coupling, hybrid drive train with torque and speed coupling. Control of hybrid vehicles.

UNIT - V FUEL CELLS:
Fundamentals, operating principles of fuel cells, fuel cell system characteristics, fuel cell technologies, non-hydrogen fuel cells, fuel cell hybrid electric drive train design, Electric and Hybrid Vehicles - Case Studies: Honda Insight, Chevrolet Volt, GM EV1, Nissan Leaf, Toyota RAV 4 EV and Ford; Think City

Text Books
1. Iqbal Husain, "Electric and Hybrid vehicles Design Fundamentals", CRC Press, second edition 2013
2. James Larminie, John Lowry, "Electric vehicle technology Explained" 2nd Ed.,Wiley 2012

Reference Books
1. Vehicular Electrical Power Systems – Emadi Ehsani, John M Miller, 2003 , CRC Publishers
2. Electronic Engine Controls – Steve V Hatch ,Cengage learning Publishers, 2009

3. Electric and Hybrid vehicles by Francia Pistoia, Elsevier Publisher, 2016
4. Fuel cells principles and applications - B.Vishwanath, M. Aulice Scibion, University Press, 2016
5. Electrical vehicle machine and drives – K.T.Chau , Wiley, 2018

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PRODUCTION PLANNING AND CONTROL
(PROFESSIONAL ELECTIVE -VI)

Course Code: GR22A4107 **L/T/P/C:3/0/0/3**
IV Year II Semester

Course Outcomes:

1. Develop knowledge on objectives, functions, applications of Production Planning and Control
2. Assess various techniques of forecasting both Qualitative and Quantitative
3. Apply routing and scheduling techniques to understand the scheduling processes
4. Analyze the problems in Line Balancing and the methods of aggregate planning
5. Implement computer based production planning and control for dispatching industrial applications.

UNIT I

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

UNIT II

Forecasting: Importance of forecasting – types of forecasting, their uses – general principles of forecasting techniques- Qualitative methods and quantitative methods MRP: Introduction to MRP and ERP, LOB (Line Of Balance). JIT – Japanese concepts.

UNIT III

Routing and Scheduling: Routing- Definition – routing procedure – Route sheets – Bill of material – factors affecting routing procedure, Schedule – definition – difference with loading, Factors affecting scheduling.

UNIT IV

Scheduling: Scheduling policies – techniques, standard scheduling methods- job shop, flow shop. Line balancing, aggregate planning – methods for aggregate planning – Chase planning, expediting, control aspects.

UNIT V

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

Text books:

1. Production Planning and Control-M.Mahajan –Dhanpat Rai and Co,2012.
2. Production Planning and Control – Jain and Jain – Khanna publications,2016.

References:

1. Production Planning and Control by SK Mukhopadhyaya,PHI.2009
2. Production Planning and Control by R.Paneer Selvam,PHI 2009
3. Operations Management by Chase ,PHI, 2006
4. Management Science- A R Aryasri-4e-TMH,2008
5. Operations management – Heizer – Pearson,2015

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MECHATRONIC SYSTEMS
(PROFESSIONAL ELECTIVE- VI)

Course Code: GR22A4108 **L/T/P/C: 3/0/0/3**
IV Year II Semester

Course Outcomes:

1. Be proficient in Programming Micro controllers.
2. Select appropriate sensors, transducers and actuators to monitor and control the behaviour of a process or product.
3. Apply design principles of electrical, mechanical, hydraulic and pneumatic systems to develop actuators and motion controllers.
4. Develop PLC system and programs for a given task.
5. Integrate mechanical electronics, control engineering in design of mechatronics systems.

UNIT I

Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface.

UNIT II

Sensors and transducers: Classification, Development in Transducer technology, Opto- electronics-Shaft encoders, CD Sensors, Vision System, etc.

UNIT III

Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems.

UNIT IV

Smart materials: Shape Memory Alloy, Piezoelectric and Magneto strictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.;

UNIT V

Micro-mechatronic systems: Microsensors, Microactuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

Text Books:

1. Mechatronics System Design, Devdas Shetty and Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)
2. Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
3. A Textbook of Mechatronics, R.K.Rajput, S. Chand and Company Private Limited
4. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MICROPROCESSOR APPLICATIONS IN MANUFACTURING
(PROFESSIONAL ELECTIVE- VI)

Course Code: GR22A4109 **L/T/P/C: 3/0/0/3**
IV Year II Semester

Course Outcomes:

1. Gain knowledge on digital electronics concepts.
2. Understand the instruction cycles and timings of microprocessors.
3. Demonstrate programs with microprocessor's according to the required application.
4. Relate interface, Microprocessor's with various input and output devices.
5. Analyze the concepts of interrupts and handle the microprocessor systems without interrupts.

UNIT I

Number Systems, codes, digital electronics: Logic Gates, combinational circuits design, Flip-flops, Sequential logic circuits design: Counters, Shift registers. Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals.

UNIT II

Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing.

UNIT III

Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255).

UNIT IV

Interfacing Analog to Digital Converter AND Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features

UNIT V

Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, Z- Transform, Digital Filters, Implementation of Digital Algorithm.

Text Books:

1. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited, 2016
2. Digital Computer Electronics: An Introduction to Microcomputers, Albert Paul Malvino,Tata McGraw-Hill Publishing Company Ltd. 2013

REFERENCES

1. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.2008
2. Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition, 2007).

3. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall.2005

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MICRO AND NANO MANUFACTURING
(PROFESSIONAL ELECTIVE VI)

Course Code: GR22A4110 **L/T/P/C: 3/0/0/3**
IV Year II Semester

Course outcomes:
1. Summarize different techniques used in micro and nano manufacturing.
2. Extensive idea on the conventional techniques used in micro manufacturing
3. Illustrate non-conventional micro-nano manufacturing and finishing approaches
4. Comprehend micro and nanofabrication techniques and other processing routes in micro and nano manufacturing.
5. Categorize different techniques used in micro joining and the metrology tools in micro and nano manufacturing.

UNIT I
Introduction to Precision engineering: macro milling and micro drilling, Micro-electromechanical systems – merits and applications, Micro phenomenon in Electro-photography – applications. Introduction to Bulk micromachining, Surface micromachining- steps, Micro instrumentation – applications, Micro Mechatronics, Nano finishing – finishing operations. Introduction to Micro-energy and chemical system (MECS), Space Micro-propulsion, e-Beam Nanolithography – important techniques, Introduction to Nanotechnology

UNIT II
Introduction to mechanical micromachining: Micro drilling – process, tools and applications. Micro turning- process, tools and applications, Diamond Micro turning – process, tools and applications Micro milling and Micro grinding – process, tools and applications, Nano- Plastic forming and Roller Imprinting

UNIT III
Introduction to Non-conventional micro-nano manufacturing Process: principle and applications – Abrasive Jet Micro Machining, WAJMM Micro EDM, Micro WEDM, Micro EBM – Process principle, description and applications Micro ECM, Micro LBM - Process principle, description and applications Focused ion beams - Principle and applications.

UNIT IV
Introduction to Micro and Nano Finishing Processes: Magnetorheological Finishing (MRF) processes, Magnetorheological abrasive flow finishing processes (MRAFF) – process principle and applications ,Magnetorheological Jet finishing processes Working principle and polishing performance of MR Jet Machine Elastic Emission Machining (EEM) – machine description, applications Ion Beam Machining (IBM) – principle, mechanism of material removal, applications Chemical Mechanical Polishing (CMP) – Schematic diagram, principle and applications

UNIT V
Introduction to Micro Fabrication: basics, flowchart, basic chip making processes Introduction to Nanofabrication, Nanofabrication using soft lithography – principle, applications – Examples (Field Effect Transistor, Elastic Stamp) Manipulative techniques – process principle, applications Introduction to Carbon nano materials – CN Tubes CN Tubes – properties and applications CN Tube Transistors – Description only Diamond - Properties and applications CVD Diamond Technology LIGA Process

Text Books:

1. Mark. J. Jackson, Micro and Nano-manufacturing, Springer, 2006.
2. Mark. J. Jackson, Micro-fabrication and Nano-manufacturing - Pulsed water drop micromachining CRC Press 2006.

References:

1. Nitaigour Premchand Mahalik, Micro-manufacturing and Nanotechnology, 2006.
2. V.K.Jain, Micro-manufacturing Processes, CRC Press, 2012.
3. Davim, J. Paulo, and Mark J. Jackson, eds. Nano and micromachining. ISTE, 2009.
4. Sidpara, Ajay M., and Ganesh Malayath. Micro Electro Discharge Machining: Principles and Applications. CRC Press, 2019.
5. Sidpara, Ajay M., and Ganesh Malayath. Micro Electro Discharge Machining: Principles and Applications. CRC Press, 2019.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PROJECT WORK - PHASE II

Course Code: GR22A4145 **L/T/P/C: 0/0/12/6**
IV Year II Semester

Course Outcomes:

1. Formulate hypothesis for the problem statement with sound technical knowledge from selected project domain.
2. Design Engineering Solution to the problem statement with systematic approach.
3. Analyze and develop an efficient solution for implementation of the project.
4. Apply the theoretical concepts while providing solutions to the problem statement with teamwork and multidisciplinary approach.
5. Demonstrate professionalism with ethics while preparing and presenting the project work.

OPEN ELECTIVES

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SOFT SKILLS AND INTERPERSONAL SKILLS
(OPEN ELECTIVE)

Course Code: GR22A3145 **L/T/P/C:3/0/0/3**

Course Outcomes:

- Develop soft skills communication skills, leadership skills etc.
- Implement goal setting techniques to build a promising career and evaluate the power of confidence building and self-esteem with examples.
- Design formal report and proposals with appropriate formal expressions.
- Create healthy workplace environment by treating others with respect and dignity.
- Describe team dynamics and exchange ideas about the elements of positive teamwork.

Unit 1: Soft Skills

- Introduction to soft skills, Definition of Soft skills, Importance of soft skills
- Communication skills, Usage of English in Business/Corporate scenario
- Nonverbal communication - Proxemics
- Presentation skills

Unit 2: Team Building & Leadership Qualities

- Qualities of a good leader
- Problem solving and Decision Making
- Strategic management
- Crisis management

Unit 3: Personality Development

- Motivation
- Goal setting
- Self-esteem
- Team skills

Unit 4: Developing Reports and Proposals

- Understanding reports and proposals
- Planning reports and proposals
- Writing beginning, body and ending
- Formats of reports and proposals

Unit 5: Interpersonal Skills

- Understanding professional relationships
- Networking professionally
- Showing basic office courtesies
- Interview skills

Text Books:

1. Soft Skills-Key to success in workplace and life Meenakshi Raman, Raman Upadhyay, CENAGE

Reference Books:

1. Soft skills for Everyone - Jeff Butterfield, CENAGE Learning
2. Soft skills for Interpersonal Communication - S.Balasubramaniam (ORIENT BLACKSWAN)

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
HUMAN RESOURCE DEVELOPMENT AND ORGANIZATIONAL BEHAVIOUR
(OPEN ELECTIVE)

Course Code: GR22A4049 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. To acquaint the student with the determinants of intra -individual, inter-personnel and inter-group behaviour in organizational setting.
2. To Understand individual behavior in organizations, including diversity, attitudes, job satisfaction, emotions, moods, personality, values, perception, decision making, and motivational theories and apply in the organizational context.
3. To assess the group behavior in organizations, including communication, leadership, power and politics, conflict, and negotiations in the framework of organization and to familiarize the concepts, techniques and practices of human resource development in the current organizational view.
4. To impart and apprise the capable of applying the principles and techniques as professionals for developing human resources in an organization.
5. To report the current trends and applications in HRD and Balanced Scorecard to measures the performance and to develop, implement, and evaluate organizational human resource development strategies aimed at promoting organizational effectiveness in different organizational environments.

Unit I - Introduction to OB : Organizational Behaviour- Concept and Emergence of OB Concept; Nature and Theoretical frameworks; Models of Organizational Behaviour, Challenges and Opportunities for Organizational Behavior;

Unit II- Individual Behaviour: Individual Behaviour: Personality, Learning, Values and Attitudes, Perception, Stress at work. Management's assumptions about people- McGregor's Theory X and Theory Y. Motivation - Maslow's Need Hierarchy, Herzberg's Two Factors Theory, Vroom's Expectancy Theory.

Unit III-Inter-personal and Group Behaviour: Interpersonal communication and Feedback; Transactional Analysis (TA); Johari Window. Group Behaviour: Group Dynamics, Cohesiveness and Productivity; Management of Dysfunctional groups; Group Decision Making. Leadership- Concept and Styles.

Unit IV -Introduction to Human Resource Development: Concept; Relationship between human resource management and human resource development; HRD mechanisms, processes and outcomes; HRD matrix; Roles and competencies of HRD professionals; Challenges in HRD, steps in HRD Process.

Unit V-HRD Applications and Trends: Coaching and mentoring; Career management and development; Competency mapping; Balanced Score Card. HRD in Organizations: Selected cases covering HRD practices in government Organizations, manufacturing and service industries and MNCs.

Text Books:

1. Robbins, Stephen P. and Timothy A. Judge, Organizational Behaviour, Prentice -Hall, New Delhi.
2. Werner J. M., DeSimone, R.L., Human resource development, South Western.

Reference Books:

1. Luthans, Fred, Organizational Behaviour, McGraw-Hill, New York.
2. Gregory, Moorhead and Ricky W. Griffin, Managing Organizational Behaviour, Thomson South

Western Publication.
3. Pareek, Udai and V. Sisodia, "HRD in the New Millennium, Tata McGraw - Hill Publishing Co. Ltd., New Delhi, 1999.
4. Haldar, U. K., Human resource development, Oxford University Press India.
5. Rao, T.V., Future of HRD, Macmillan Publishers India.
6. Rao, T.V., HRD Score Card 2500: Based on HRD audit, Response Books, SAGE Publications.
7. Mankin, D., Human resource development, Oxford University Press India.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
CYBER LAW AND ETHICS
(OPEN ELECTIVE)

Course Code: GR22A4077 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Students identify and analyze statutory, regulatory, constitutional, and organizational laws that affect the information technology professional.
2. Students locate and apply case law and common law to current legal dilemmas in the technology field.
3. Students apply diverse viewpoints to ethical dilemmas in the information technology field and recommend appropriate actions.
4. Students will be able understand cybercrime and ethical practices and the student will be able to know and learn web technologies and related issues.
5. The student will be in position to interface with various issues pertaining to Intellectual Property, copy rights, patents rights etc. and provide an overview of cybercrime and framework.

Unit I - The Legal System: Sources of Law and The Court Structure: Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law- Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers. (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court), Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration.

Unit II - Introduction cyber law: Computers and its Impact in Society, Overview of Computer and Web Technology, Need for Cyber Law, Cyber Jurisprudence at International and Indian Level. , NITI Aayog and some current aspects.

Unit –III - Constitutional & Human Rights Issues in Cyber space : Freedom of Speech and Expression in Cyberspace, Right to Access Cyberspace, Access to Internet, Right to Privacy, Right to Data Protection.

Unit –IV Cyber Crimes & Legal Framework: Cyber Crimes against Individuals, Institution and State, Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber Pornography, Identity Theft & Fraud, Cyber terrorism, Cyber Defamation, Different offences under IT Act

Unit –V Intellectual Property Issues in Cyber Space: Interface with Copyright Law, Interface with Patent Law, Trademarks & Domain Names Related issues.

Text Books:

1. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
2. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012)
3. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)
4. Jonthan Rosenoer, Cyber Law, Springer, New York, (1997).
5. Sudhir Naib, The Information Technology Act, 2005: A Handbook.
6. S. R. Bhansali, Information Technology Act, 2000
7. University Book House Pvt. Ltd. Jaipur (2003).
8. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ECONOMIC POLICIES IN INDIA
(OPEN ELECTIVE)

Course Code: GR22A4147 **L/T/P/C: 3/0/0/3**

Course Outcomes:
1. Familiarize with the nature of business environment and its components.
2. The students will be able to demonstrate and develop conceptual framework of business environment.
3. Understand the definition of ethics and the importance and role of ethical behaviour in the business world today.
4. Explain the effects of government policy on the economic environment.
5. Outline how an entity operates in a business environment.

Unit 1: Business environment-factors effecting Business Environment-need for industrial policies, Overview of Indian Economy, Trends towards market economy, problems of underdevelopment – meaning, Main problems, reasons, of underdevelopment.

Unit 2: Factors and measure, Meaning of Economic development, National income, Per capital income, Quality of life, Capital Formation – Savings, Investment.

Unit 3: NITI Aayog and Planning in India, Niti Aayog and its function, how is Niti Aayog different from planning commission, Meaning, Importance, Main reasons of adopting, planning in India, Objectives of planning, Economic development, moderation, stability, self-sufficiency, employment etc, foreign aid, Employment. Allocation of Resources,

Unit 4: Private and Public Sector, Public Sector – role and growth, Achievements of the public sector, Private Sector – Importance Problems, New foreign Trade Policy.

Unit 5: Present Economic Policy, Main feature, Globalization, Expansion of Private sector, more market orient approach. Public distribution system, Industrial policies before and after 1991, Industrial Licensing, Monetary and Fiscal Policy, elements of Indian current GDP and review of current budget.

Text Books:
1. Francis Cherunilam: Business Environment: Text and Cases. 18/e. Himalaya. 2009.
2. Misra and Puri: Indian Economy, Himalaya, 2009.

Reference Books:
1. Indian Economy- A. N. Agarwal
2. Indian Economy – Mishra &Puri
3. Indian Development and planning – M. L. Jhingan
4. Indian Economy – R. S. Rastogi Yozna and Kurukshetra Magazines

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DATA SCIENCE FOR ENGINEERS

Course Code: GR22A3049 **L/T/P/C:3/0/0/3**

Course Outcomes:

1. Illustrate a flow process for data science problems.
2. Demonstrate the mathematical foundations for data science.
3. Analyze the data science process and predictive modelling.
4. Develop R codes for data science solutions.
5. Correlate results to the solution approach followed.

UNIT I

Introduction to R, Variables and datatypes in R, Data frames, Recasting and joining of dataframes, Recasting and joining of dataframes, Arithmetic, Logical and Matrix operations in R, Advanced programming in R : Functions, Control structures, Data visualization in R Basic graphics.

UNIT II

Linear Algebra and Statistics for Data Science: Solving Linear Equations, Linear Algebra Distance, Hyperplanes and Halfspaces, Eigenvalues, Eigenvectors, Statistical Modelling, Random Variables and Probability Mass/Density Functions, Sample Statistics.

UNIT III

Introduction to Data Science, Solving Data Analysis Problems - A Guided Thought Process, Predictive Modelling, Linear Regression, Model Assessment, Diagnostics to Improve Linear Model Fit.

UNIT IV

Simple Linear Regression Model Building, Cross Validation, Multiple Linear Regression Modelling Building and Selection.

UNIT V:

Classification, K - Nearest Neighbors (KNN), K - Nearest Neighbors implementation in R, K - means Clustering, K - means implementation in R.

Text Books:

1. Data Science for Engineers, 1st Edition, Raghunathan Rengaswamy, Resmi Suresh, CRC Press, Taylor & Francis Group.
2. Introduction to Linear Algebra, Fifth Edition, Gilbert Strang, ISBN: 978-09802327-7-6.
3. Applied Statistics and Probability for Engineers, Douglas Montgomery, George C Runger, Fifth Edition, John Wiley & Sons, Inc.

Reference Books:

1. Hands On Introduction To Data Science Hardcover – 2 April 2020 by Chirag Shah (Author)
2. Essential Math for Data Science: Take Control of Your Data with Fundamental Linear Algebra, Probability, and Statistics by Thomas Nield (Author)

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DATA ANALYTICS USING OPEN SOURCE TOOLS
(OPEN ELECTIVE)

Course Code: GR22A3120 **L/T/P/C: 3/0/0/3**

Course Outcomes:
1. Interpret about graphics techniques in data analysis.
2. Implement data modeling techniques for a dataset.
3. Develop the simulation for mining and clustering the data.
4. Infer the data using business intelligence and predictive analytics
5. Implement the data analytics using Programming Environments

UNIT I
Graphics: A Single Variable – Dot and Jitter Plots, Histograms and Kernel Density Estimates, The Cumulative Distribution Function, Rank-Order Plots and Lift Charts, Summary Statistics and Box Plots, Practice using Numpy, Two Variables- Scatter Plots, Smoothing, Logarithmic Plots, Banking, Practice using Matplotlib, Time As A Variable- Time-Series Analysis, More Than Two Variables- False-color plots, Multiplots.

UNIT II
Modeling Data: Guesstimation and the back of the envelope- Principles, Perturbation Theory and Error Propagation, Models from scaling arguments- Models, Arguments from Scale, Mean-Field Approximations, Common Time-Evolution Scenarios, Arguments from probability models- The Binomial Distribution and Bernoulli Trials, The Gaussian Distribution and the Central Limit Theorem, Power-Law Distributions and Non-Normal Statistics, Bayesian Statistics.

UNIT III
Mining Data: Simulations- Monte Carlo Simulations, Resampling Methods, Discrete Euent Simulations with *SimPy*, Finding Clusters- Distance and Similarity Measures, Clustering Methods, Pre and Postprocessing, *Pycluster,* Seeing the Forest for the trees- PCA, Kohonen Maps, PCA with R.

UNIT IV
Applications: Reporting, Business intelligence and Dashboards- Corporate Metrics and Dashboards, Data Quality Issues, Financial calculations and modeling- The Time Value of Money ,Uncertainty in Planning and Opportunity Costs, Cost Concepts and Depreciation, Predictive analytics- algorithms for classification.

UNIT V
Programming Environments and Data analytics
Programming Environments: Software Tools, A Catalog of Scientific Software - Matlab, R, Python
Results from Calculus: Common Functions, Calculus, Useful Tricks -Binomial theorem, Linear transformation.
Working with data: Sources for Data, Cleaning and Conditioning, Sampling, Data File Formats, TheCare and Feeding of Your Data Zoo.

Text Books:

1. Philipp K. Janert, Data Analysis with Open Source Tools, O'Reilly Media, Inc, November 2010: First

Edition.

Reference Books:

1. G James, D. Witten, T Hastie, and R. Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer, 2013
2. Chambers, John, Software for Data Analysis Programming with R, Springer, 2008
3. Trevor Hastie Robert Tibshirani Jerome Friedman, The Elements of Statistical Learning, Data Mining, Inference, and Prediction (2nd Edn.), Springer, 2014
4. Mark Gardener, Beginning R: The Statistical Programming Language, Wiley, 2013
5. Upadhyaya and A. Upadhyaya, Material Science and Engineering, Anshan Publications, 2007

GOKARAJU RANGARAJUINSTITUTE OF ENGINEERING AND TECHNOLOGY
AUGMENTED REALITY AND VIRTUAL REALITY
(OPEN ELECTIVE)

Course Code: GR22A4054 **L/T/P/C:3/0/0/3**

Course Outcomes:
1. Analyze about augmented reality.
2. Identify AR devices for various applications.
3. Analyze about virtual reality.
4. Interpret about usage of VR devices and human factors involved.
5. Apply AR & VR technology in various domains.

UNIT I
Introduction to Augmented Reality, The Relationship Between Augmented Reality and Other Technologies, Augmented Reality Concepts, How Does Augmented Reality Work?, Ingredients of an Augmented Reality Experience.

UNIT II
Augmented Reality Hardware, Major Hardware Components for Augmented Reality Systems, Augmented Reality Software, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.

UNIT III
Virtual Reality: The Three I's of Virtual Reality, A Short History of Early Virtual Reality, Early Commercial VR Technology, VR Becomes an Industry, The Five Classic Components of a VR System.
Input Devices: Trackers, Navigation, and Gesture Interfaces: Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces

UNIT IV
Output Devices: Graphics, Three-Dimensional Sound, and Haptic Displays: Graphics Displays,Sound Displays, Haptic Feedback.
Human Factors in VR: Methodology and Terminology, User Performance Studies, VR Healthand Safety Issues, VR and Society

UNIT V:
Augmented Reality Applications, What Makes a Good Augmented Reality Application? Application Areas: Education, Gaming, Robotics, Health care, Manufacturing, Evaluating Augmented Reality Applications.

Text Books:
1. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
2. Burdea, G. C. and P. Coffet. Virtual Reality Technology, Second Edition. Wiley IEEE Press, 2003/2006.

Reference Books:
1. LaValle, "Virtual Reality", Cambridge University Press, 2016.
2. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
3. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.

4. Anand R., “Augmented and Virtual Reality”, Khanna Publishing House, Delhi.

GOKARAJU RANGARAJUINSTITUTE OF ENGINEERING AND TECHNOLOGY
BASICS OF JAVA PROGRAMMING
(OPEN ELECTIVE)

Course Code: GR22A3072 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Apply knowledge on key attributes of Object-Oriented Programming (OOP) and control structures
2. create and manipulate classes and objects, employ various methods and method utilization.
3. Demonstrate expertise in both array-based and string-based structures.
4. understanding of Java's inheritance and interface concepts
5. proficient at organizing Java code using packages and exception handling

UNIT I:
Java Programming Fundamentals: Java Language, Key Attributes of Object-Oriented Programming, Java Development Kit, Simple Program, Create Blocks of Code, Keywords, Identifiers, The Java Class Libraries.
Data Types and Operators: Java's Primitive Types, Literals, Variables, Scope and Lifetime of Variables, Operators- Arithmetic, Relational, Logical, Bitwise, Assignment. Type conversion in Assignments, Using a Cast, Operator Precedence.
Program Control Structures: if, switch, for, enhanced for, while, do-while, break, continue.

UNIT II:
Introduction to Classes, Objects and Methods: Class Fundamentals, Objects creation, Reference Variables and Assignment, Methods, returning a Value, Using Parameters, passing objects to methods, passing arguments, Method Overloading, Constructors, Parameterized Constructors, Overloading Constructors. new Operator, this Keyword, Command-Line Arguments.

UNIT III:
Arrays: Introduction to Arrays, 1D Arrays, Multidimensional Arrays, Irregular Arrays, Using the Length Member. Arrays class of util package.
Strings: String class, constructors, length(), string literals, concatenation, Character extraction, string comparison, searching strings, modifying, data conversion, changing the case, joining, split(). String Buffer class: constructors, length(), capacity(), ensure Capacity(), set Length(), charAt(), setCharAt(), getChars(), append(), insert(), reverse(), delete(), deleteCharAt(), replace().

UNIT IV:
Inheritance: Basics, Inheritance Types, Using Super, Multilevel Hierarchy, Super class References and Subclass Objects, Method Overriding, Abstract Classes, Using final. **Interfaces:** Fundamentals, Creating and Implementing an Interface, Using Interface References, Implementing Multiple Interfaces, Extending Interfaces, Nested Interface.

UNIT V:
Packages: Package Fundamentals, Member Access, Importing Packages, Static import. **Exception Handling:** Exception Hierarchy, Fundamentals, Handling errors, Multiple Catch, Throwing and Rethrowing an Exception, Throwable, using finally, using throws, Creating Exception Subclasses.

Text Books:
1. Herbert Schildt, Dale Skrien, Java Fundamentals A Comprehensive Introduction, 1/e, Tata McGraw Hill, 2017.

2. Herbert Schildt, The Java complete References, 9/e, Tata McGraw Hill,2014.

Reference Books:

1. Y. Daniel Liang , An Introduction to JAVA Programming, 10/e, Tata McGraw Hill.

2. Kathy Sierra, Head First Java, 2/e, Shroff Publishers, 2012.

3. Balagurusamy, Programming with JAVA, 2/e, Tata McGraw Hill, 2014.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INTRODUCTION TO DBMS
(OPEN ELECTIVE)

Course Code: GR22A3141 **L/T/P/C: 3/0/0/3**

Course Outcomes:
1. Identify the role of Database System Applications and the design issues related.
2. Design the logical model for the applications.
3. Construct a Database Schema, manipulate data using a SQL.
4. Apply the Schema Refinement techniques for a database design for optimized access.
5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.

UNIT I

Introduction to Database And System Architecture: Database Systems and their Applications, Database Vs File System, View of Data, Data Models, Database Languages- DDL and DML, Transaction Management, Database users and Administrators, Database System Structure.

UNIT II

Introduction to Database Design: ER Diagrams, Entities, Attributes and Entity sets, Relationships and Relationship set, Extended ER Features, Conceptual Design with the ER Model, Logical database Design.

Relational Model: Introduction to Relational Model, Basic Structure, Database Schema, Keys, Relational Algebra

UNIT III

SQL Queries and Constraints: SQL Data Definition, Types of SQL Commands, Form of Basic SQL Query, SQL Operators, Set Operators, Nested Queries, Aggregate Operators, NULL values, Integrity Constraints Over Relations, Joins, Introduction to Views, Destroying
/ Altering Tables and Views, Cursors, Triggers.

UNIT IV

Schema Refinement and Normal Forms: Introduction to Schema Refinement, Functional Dependencies, Properties of Decomposition, Reasoning about FD, Normal Forms.

UNIT V

Transaction Management: Transaction Concept, Transaction State, Concurrent Executions, Serializability, Testing for Serializability.
Concurrency Control: Lock based Protocols, Timestamp based protocols,
Recovery System: Recovery and Atomicity, Log based recovery, Shadow Paging, Recovery with concurrent Transactions.

Text Books:
1. "Data base Management Systems", Raghurama Krishnan, Johannes Gehrke,TATA McGraw Hill 3rdEdition
2. "Data base System Concepts", Silberschatz, Korth, McGraw hill, V Edition.
3. "Introduction to Database Systems", C.J.Date Pearson Education.

Reference Books:
1. "Database Systems design, Implementation, and Management", Rob & Coronel 5th Edition.

2. “Database Management Systems”, P. Radha Krishna HI-TECH Publications 2005.
3. “Database Management System”, Elmasri Navate, Pearson Education.
4. “Database Management System”, Mathew Leon, Leo

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INTRODUCTION TO DATA MINING
(OPEN ELECTIVE)

Course Code: GR22A4080 **L/T/P/C:3/0/0/3**

Course Outcomes:

1. Learn the concepts of database technology evolutionary path which has led to the needfor data mining and its applications.
2. Apply pre-processing statistical methods for any given raw data.
3. Apply Apriori and FP growth algorithms for forming strong association rules.
4. Extract knowledge and implementation of data mining techniques
5. Apply the data mining algorithm for solving practical problems.

UNIT I

Introduction: Fundamentals of data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or a Data Warehouse System, Major issues in Data Mining.

UNIT II

Data Preprocessing: Need for Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction.

Introduction to Data Warehouse: Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Marts.

UNIT III

Mining Frequent Patterns, Associations: Basic Concepts, Market Basket Analysis, Efficient and Scalable Frequent Item set Mining Methods, Mining various kinds of Association Rules.

UNIT IV

Classification: Issues Regarding Classification, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification.

Prediction: Issues Regarding Prediction, Regression techniques.

Accuracy and Error measures: Evaluating the accuracy of a Classifier or a Predictor.

UNIT V

Cluster Analysis Introduction: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods - k-Means and k-Medoids, Hierarchical Methods – Agglomerative, BIRCH.

Textbooks:

1. Data Mining– Concepts and Techniques - Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, Second Edition,2006.
2. Introduction to Data Mining – Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Pearson education.

Reference Books:

1. Data Mining Techniques – Arun K. Pujari, Second Edition, Universities Press.
2. Data Warehousing in the Real World, Sam Aanhory and Dennis Murray, PearsonEdn Asia.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PROGRAMMING IN PYTHON
(OPEN ELECTIVE)

Course Code: GR22A3077 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Demonstrate the concepts of control flow, data structures and Functions in Python
2. Design python programs using functional programming
3. Implement the file handling operations, exception handling mechanism
4. Design python programs using object oriented programming and multithreaded programming concepts
5. Develop GUI based applications using Tkinter

UNIT I

Basic features of Python-Interactive execution, comments, types, variables, operators, expressions, Statements-assignment, input, print, Control flow-Conditionals, Loops, break statement, continue statement, pass statement, Functions, definition, call, scope and lifetime of variables, keyword arguments, default parameter values, variable length arguments, recursive functions.

UNIT II

Sequences-Strings, Lists and Tuples-basic operations and functions, iterating over sequences, Sets and Dictionaries- operations and functions, Functional programming-mapping, filtering and reduction, Lambda functions, List comprehensions. Scope, namespaces and modules, import statement, creating own modules, avoiding namespace collisions when importing modules.

UNIT III

Files-operations-opening, reading, writing, closing, file positions. Exceptions – raising and handling exceptions, try/except statements, finally clause, standard exceptions, custom exceptions. , iterators and generators, Python program examples.

UNIT IV

Object oriented programming- classes, constructors, objects, class variables, class methods, static methods, operator overloading. Inheritance-is-a relationship, composition, polymorphism, overriding, multiple inheritance, abstract classes, multithreaded programming, Python program examples.

UNIT V

GUI Programming with Tkinter, Widgets (Buttons, Canvas, Frame, Label, Menu, Entry, Text, Scrollbar, Combobox, Listbox, Scale), event driven programming-events, callbacks, binding, layout management-geometry managers: pack and grid, creating GUI based applications in Python.

Text Books:

1. Exploring Python, Timothy A. Budd, McGraw Hill Publications.
2. Introduction to Programming using Python, Ys.Daniel Liang, Pearson.
3. Python Programming, Sheetal Taneja and Naveen Kumar, Pearson.

Reference Books:

1. Introduction to Computer Science using Python, Charles Dierbach, Wiley India Edition.
2. Fundamentals of Python, K. A. Lambert, B.L. Juneja, Cengage Learning.

3. Think Python, how to think like a computer scientist, Allen B. Downey, SPD, O'Reilly.
4. Core Python Programming, Wesley J. Chun, second edition, pearson.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INTERNET OF THINGS
(OPEN ELECTIVE)

Course Code: GR22A3147 **L/T/P/C: 3/0/0/3**

Prerequisites
Students are expected to have knowledge on Operating systems, Virtualization and Networking

Course Outcomes:
1. Learn characteristics, applications, components and challenges of Internet of Things (IOT)
2. Create understanding of IOT networking concepts – terminologies, stack components , infrastructure and data protocols
3. Create understanding of the concept of Cloud based IOT technologies, cloud service providers and security aspects
4. Develop skills in understanding and programming the Arduino and Raspberry Pi hardware platforms
5. Make the student understand the requirements, components ,challenges and develop various application areas - smart homes, smart grids, smart health care, smart cities and industrial IOT

UNIT I

Introduction to IOT: Characteristics of IOT, Applications of IOT, IOT Categories, IOT Enablers and Connectivity Layers, Sensors, Actuators, IOT Components & Implementation, Challenges for IOT

UNIT II

IOT Networking & Connectivity Technologies: Connectivity terminologies-IOT Node, LAN,WAN, Gateway, IOT protocol Stack vs. Web Stack, IOT Identification and Data Protocols-IPV4,IPV6,HTTP,MQTT,COAP,AMQP,DDS Connectivity Technologies – Zigbee, Bluetooth, LoRa

UNIT III

Cloud for IOT: IOT with Cloud-Challenges, Cloud service providers for IOT-Overview, Cloud service model, Cloud Computing – Security aspects, Case Study, Fog computing, Edge computing

UNIT IV

Hardware Platforms: Programming with Arduino-Features of Arduino, Components of Arduino Board, Arduino IDE, Program Elements, Raspberry Pi – Introduction, Architecture, PIN Configuration, Implementation of IOT with Raspberry Pi

UNIT V

IOT Applications : Smart Homes-Smart Home Origin, Technologies, Implementation, Smart Grids-Characteristics, Benefits, Architecture, Components, Smart Cities-Characteristics, Frameworks, Challenges, Industrial IOT-Requirements, Design Considerations, Applications

Text Books:
1. Internet of Things, Jeeva Jose, Khanna Publishing, 2018
2. Internet of Things, Abhishek S Nagarajan, RMD Sundaram, Shriram K Vasudevan, Wiley, 2019
3. IOT Fundamentals: Networking Technologies, Protocols and Use Cases for IOT, Rowan Trollope, David Hanes, Patrick Gassetete, Jerome Henry,Pearson Education Limted, 2017

Reference Books:
1. The Internet of Things, Michael Miller, Pearson Education Limited, 2015

IoT Applications, Security Threats, and Countermeasures, Padmalaya Nayak, Niranjan Ray, P. Ravichandran, Taylor &Francis,2021
2. Internet of Things: Architecture, Implementation and Security, MayurRamgir, Pearson Education Limited, 2019
3. IOT Fundamentals: Networking Technologies, Protocols and Use Cases for IOT, Rowan Trollope, David Hanes, Patrick Gassetete, Jerome Henry, Pearson Education Limited, 2017

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SCRIPTING LANGUAGES
(OPEN ELECTIVE)

Course code: GR22A4085 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Analyze a problem, identify and define the computing requirements appropriate to its solution.
2. Design Web pages with DB.
3. Implement the PHP Authentication Methodologies.
4. Implement PHP Encryption functions and Mcrypt Package
5. Understand the syntax and functions in Perl and Python.

UNIT- I

PHP Basics

PHP Basics- Features, Embedding PHP Code in your Web pages, outputting the data to the browser, Data types, Variables, Constants, expressions, string interpolation, control structures. Function, Creating a Function, Function Libraries, Arrays, strings and Regular Expressions.

UNIT -II

MySQL Basics

Introduction to MYSQL: Database Concepts, General Overview of MySQL database, Installation. Connecting and disconnecting from MySQl Server, Querying the database, Data Definition Language, Functions and Logical operators, Access privilege system.

UNIT -III

Advanced PHP Programming

Advanced PHP Programming: PHP and Web Forms, Files, PHP Authentication and Methodologies -Hard Coded, File Based, Database Based, IP Based, and Uploading Files with PHP, Sending Email using PHP, PHP Encryption Functions, the Mcrypt package.

UNIT- IV

PERL: Names and Values, Variables, Scalar Expressions, Control Structures, arrays, list, hashes, strings, pattern and regular expressions, subroutines.

Advanced PERL: Finer points of looping, pack and unpack, file system, data structures, packages, modules, objects, interfacing to the operating system.

UNIT -V

Python: Introduction to Python language, Python-syntax, statements, functions, Built-in-functions and Methods, Modules in Python, Exception Handling.

Text Books:

1. The World of Scripting Languages, David Barron, Wiley India. Beginning PHP and MySQL, 3rd Edition, Jason Gilmore, Press Publications (Dream tech.).
2. Python Web Programming, Steve Holden and David Beazley ,New Riders Publications.

Reference Books:

Open Source Web Development with LAMP using Linux ,Apache,MySQL,Perl and
1. PHP, Lee and B.Ware(Addison Wesley) Pearson Education.
2. Programming Python,M.Lutz,SPD.
3. PHP 6 Fast and Easy Web Development ,Julie Meloni and Matt Telles, Cengage

4. Learning Publications.
5. PHP 5.1,I.Bayross and S.Shah,The X Team,SPD.
6. Core Python Programming,Chun,Pearson Education.
7. Guide to Programming with Python,M.Dawson,Cengage Learning.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SERVICES SCIENCE AND SERVICE OPERATIONAL MANAGEMENT
(OPEN ELECTIVE)

Course Code: GR22A4134 **L/T/P/C: 3/0/0/3**

Pre-Requisite(s): Fundamentals of Management, Operations Research

Course Outcomes:
1. Understand concepts of services and their significance in the economy and society and distinguish it from goods.
2. Understand the service strategy, design, and development.
3. Comprehend ways to design services and able to understand service guarantee, recovery, and failures.
4. Forecast the service demand, supply and facilitate various methods to operate and manage services.
5. Understand the service productivity and how innovation can be approached from services point of view

UNIT I
Introduction: Service operations, Role of service in economy and society, Indian service sector
Nature of Services and Service Encounters: Differences between services and operations, Service package, characteristics, various frameworks to design service operation system, Kind of service encounter, importance of encounters
Service-Dominant Logic: From Goods-Dominant logic to Service-Dominant logic, Value Co- creation

UNIT II
Service Strategy and Competitiveness: Development of Strategic Service Vision (SSV), Data Envelopment Analysis
New Service Development: NSD cycle, Service Blueprinting, Elements of service delivery system
Service Design: Customer Journey and Service Design, Design Thinking methods to aid Service Design
Locating facilities and designing their layout: models of facility locations (Huff's retail model), Role of service-scape in layout design
Service Quality: SERVQUAL, Walk through Audit, Dimensions of Service quality & other quality tools

UNIT III
Service Guarantee & Service Recovery: Service guarantee and its types; Service failure – reasons for failure and service recovery strategies

UNIT IV
Forecasting Demand for Services: A review of different types of forecasting methods for demand forecasting.
Managing Capacity and Demand: Strategies for matching capacity and demand, Psychology of waiting, Application of various tools used in managing waiting line in services.
Managing Facilitating Goods: Review of inventory models, Role of inventory in services **Managing service supply relationship:** Understanding the supply chain/hub of service, Strategies for managing suppliers of service
Vehicle Routing Problem: Managing after sales service, understanding services that involve transportation of people and vehicle, Techniques for optimizing vehicle routes

UNIT V
Service Innovation: Services Productivity, Need for Services Innovation

Student Project:

Option 1: Choose any service organization around and present it from the perspective of: nature of service, classification of service, blueprint or service design analysis, service quality, and any additional perspective you would like to add.

Option 2: Choose any latest research paper in services and explain your understanding and feedback on the same.

Text Books:

1. Fitzsimmons & Fitzsimmons, Service Management: Operations, Strategy, Information Technology, McGraw Hill publications (7th edition)

Reference Books:

1. Wilson, A., Zeithaml, V. A., Bitner, M. J., & Gremler, D. D. (2012). Services marketing: Integrating customer focus across the firm. McGraw Hill.
2. Lovelock, C. (2011). Services Marketing, 7/e. Pearson Education India
3. Reason, Ben, and Lovlie, Lavrans, (2016) Service Design for Business: A Practical Guide to Optimizing the Customer Experience, Pan Macmillan India,
4. Chesbrough, H. (2010). Open services innovation: Rethinking your business to grow and compete in a new era. John Wiley & Sons.

GOKARAJU RANGARAJUINSTITUTE OF ENGINEERING AND TECHNOLOGY
IT PROJECT MANAGEMENT
(OPEN ELECTIVE)

Course Code: GR22A4135 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Learn the techniques to effectively plan manage, execute the projects.
2. Learn the techniques to control projects within time and cost targets with a focus on Information Technology and Service Sector.
3. Learn various agile methodologies.
4. Apply agile project management techniques such as Scrum on real time applications.
5. Develop real time applications using agile project management techniques such as DevOps.

UNIT I

Project Overview and Feasibility Studies- Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal

Project Scheduling: Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity.

UNIT II

Cost Control and Scheduling: Project Cost Control (PERT/Cost), Resource Scheduling & Resource Leveling

Project Management Features: Risk Analysis, Project Control, Project Audit and Project Termination.

UNIT III

Agile Project Management: Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL).
Other Agile Methodologies: Introduction to XP, FDD, DSDM, Crystal

UNIT IV

Scrum: Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro perspective), various roles (Roles in Scrum), Best practices of Scrum.

UNIT V

DevOps: Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test-Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring.

Text Books:

1. Mike Cohn, Succeeding with Agile: Software Development Using Scrum
2. Notes to be distributed by the course instructor on various topics

Reference Books:

1. Roman Pichler, Agile Product Management with Scrum
2. Ken Schwaber, Agile Project Management with Scrum (Microsoft Professional)

GOKARAJU RANGARAJUINSTITUTE OF ENGINEERING AND TECHNOLOGY
MARKETING RESEARCH AND MARKETING MANAGEMENT
(OPEN ELECTIVE)

Course Code: GR22A4136 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. The students understand the significance of marketing management concepts, marketing environment, consumer behavior elements and strategies related to STP.
2. The student will be able to understand various product management strategies and the importance of branding and packing.
3. Comprehend the dynamics of marketing mix elements such as pricing, distribution, and promotion mix elements to leverage marketing concepts for effective decision making.
4. Students will demonstrate analytical skills in identification and resolution of problems pertaining to marketing management and marketing research and uses of various statistical tools in marketing research.
5. Understanding the concepts of internet marketing and the fundamentals of business-to- business marketing strategy, CRM strategies.

UNIT I

Marketing Concepts and Applications: Introduction to Marketing & Core Concepts, Marketing of Services, Importance of marketing in service sector.
Marketing Planning & Environment: Elements of Marketing Mix, Analyzing needs & trends in Environment - Macro, Economic, Political, Technical & Social
Understanding the consumer: Determinants of consumer behavior, Factors influencing consumer behavior
Market Segmentation: Meaning & Concept, Basis of segmentation, selection of segments, Market Segmentation strategies, Target Marketing, Product Positioning

UNIT II

Product Management: Product Life cycle concept, New Product development & strategy, Stages in New Product development, Product decision and strategies, Branding & packaging

UNIT III

Pricing, Promotion and Distribution Strategy: Policies & Practices – Pricing Methods & Price determination Policies. Marketing Communication – The promotion mix, Advertising & Publicity, 5M's of Advertising Management. Marketing Channels, Retailing, Marketing Communication, Advertising

UNIT IV

Marketing Research: Introduction, Type of Market Research, Scope, Objectives & Limitations Marketing Research Techniques, Survey Questionnaire design & drafting, Pricing Research, Media Research, Qualitative Research
Data Analysis: Use of various statistical tools – Descriptive & Inference Statistics, Statistical Hypothesis Testing, Multivariate Analysis - Discriminant Analysis, Cluster Analysis, Segmenting and Positioning, Factor Analysis

UNIT V

Internet Marketing: Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing

Business to Business Marketing: Fundamental of business markets. Organizational buying process. Business buyer needs. Market and sales potential. Product in business markets. Price in business markets. Place in business markets. Promotion in business markets. Relationships, networks, and customer relationship management. Business to Business marketing strategy

Home Assignments:

Written Analyses of Cases – Students are expected to report on their analysis and recommendations of what to do in specific business situations by applying concepts and principles learned in class (Case Studies to be shared by Faculty) e.g., "Marketing Myopia"

1. Field visit & live project covering steps involved in formulating Market Research Project
2. Measuring Internet Marketing Effectiveness: Metrics and Website Analytics

Text Books:

1. Marketing Management (Analysis, Planning, Implementation & Control) – Philip Kotler
2. Fundamentals of Marketing – William J. Stanton & Others
3. Marketing Management – V.S. Ramaswamy and S. Namakumari
4. Marketing Research – Rajendra Nargundkar
5. Market Research – G.C. Beri
6. Market Research, Concepts, & Cases – Cooper Schindl

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INTRODUCTION TO DATA SCIENCE
(OPEN ELECTIVE)

Course Code: GR22A3056 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Learn Numpy, Pandas for mathematical computation and Data Analysis
2. Analyze the importance of pre-processing techniques for Data Science
3. Learn and analyze various prediction and classification techniques on various datasets
4. Learn and analyze the applications of clustering techniques
5. Analyze Text data and Web scrapping data at morphological and syntactic and semantic levels using NLP techniques

UNIT I

Introduction to Data Science, Components of Data Science, Application of Data Science
NumPy: Array, Matrix and associated operations, Linear algebra and related operations **Pandas: Series, Data Frames, Panels, R**eading files, Exploratory data analysis, Data preparation, Indexing, Slicing, Merging and Joining data. Working with MySQL databases
Data Pre-processing Techniques: Data Imputation, Data Encoding, Standardization and Normalization, Dimensionality reduction, Feature Selection methods

UNIT II

Regression Analysis: Introduction to Regression, Simple linear regression, Multi-linear regression, Evaluation metrics for regression
Classification Methods: Introduction to Classification, Naïve Bayes classifier, Decision Tree classifier, Vector Machines, Logistic Regression, Ensemble methods, Random Forest, Bagging, Boosting, Evaluation metrics for classification

UNIT III

Clustering Methods: Introduction to Clustering, Similarity distance measures, K-means algorithm, Hierarchical clustering algorithm, DB Scan algorithm, Evaluation metrics for clustering.

UNIT IV

NLP Overview, Tokenization, Stemming, stop words removal, POS tagging, Lemmatization, Feature extraction using SKlearn, Text Classification, Text Clustering.

UNIT V

Learning Best Practices for Model Evaluation:
Pipelining, Hyperparameter Tuning, Debugging algorithms with learning and validation curves

Text Books:

1. Python Machine Learning, Second Edition by Sebastian Raschka Vahid Mirjalili Statistics and Machine Learning in Python Edouard Duchesnay,

Reference Books:

1. Data Science From Scratch: First Principles with Python, Second Edition (Greyscale Indian Edition) Paperback – 5 May 2019 by Joel Grus (Author)
2. Practical Data Science with Python: Learn tools and techniques from hands-on examples to extract

insights from data by Nathan George (Author)
3. HANDS ON INTRODUCTION TO DATA SCIENCE Hardcover – 2 April 2020 by Chirag Shah (Author)
4. Essential Math for Data Science: Take Control of Your Data with Fundamental Linear Algebra, Probability, and Statistics by Thomas Nield (Author)

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
USER-CENTRIC HUMAN COMPUTER INTERACTION
(OPEN ELECTIVE)

Course Code: GR22A3127 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Learn the concepts of interaction design and how it relates to human computer interaction and other fields.
2. Design how technologies can be to change people's attitudes and behavior.
3. Apply the difference between qualitative and quantitative data and analysis.
4. Extract the social Mechanisms that are used by people to communicate and collaborate.
5. Explore the user Experience design and analyze the factors involved in design

UNIT I

Introduction: Introduction to User Centric Computing(UCC) and history, Issues and challenges, Latest research trends, User-Centric Design and Software Engineering.

UNIT II

Engineering User-Centric Systems: Components of SDLC - Contextual Inquiry, - Design Guidelines, Prototyping.

UNIT III

User-Centric Computing: The UCC framework with illustrative case study, User-Centric models-descriptive, predictive models and taxonomy, Introduction to GOMS family of models

Computational user models (classical), Keystroke-Level Model(KLM), (CMN)GOMS Model, The Fitts' Law, The Hick-Hyman Law.

UNIT IV

Computational user models(contemperory): 2D and 3D pointing models, The steering Law and constrained navigation, Model for hierarchial menu selection, Mobile typing models(sibgle finger and two thumb typing), Model for touch performance(FFitts' law),

Formal system models: Introduction to formal models in UCD, Formal modelling of user-computer dialogue.

UNIT V

Empirical Research Methods: Introduction and research question formulation, Variables determination and experiment design, Data Analysis including model building

User-Centric Design Evaluation: Introduction to User-Centric design evaluation and expert evaluation technique, : User evaluation and model-based evaluation.

Text Books:

1. Samit Bhattacharya (July, 2019). Human-Computer Interaction: User-Centric Computing for Design, McGraw-Hill India, Print Edition: ISBN-13: 978-93-5316-804-9; ISBN-10: 93-5316-804-X, E-book Edition: ISBN-13: 978-93-5316-805-6; ISBN-10: 93-5316-805-8
2. Alan Dix, Janet E. Finlay, Gregory D. Abowd and Russel Beale. (2003). Human-Computer Interaction

(3rd Edition), Pearson.

Reference Books:

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen and Steven Jacobs. (2009). Designing the User Interfaces: Strategies for Effective Human-Computer Interaction (5th Edison), Pearson

Website Links:

https://paragnachaliya.in/wp-content/uploads/2017/08/HCI_Alan_Dix.pdf

GOKARAJU RANGARAJUINSTITUTE OF ENGINEERING AND TECHNOLOGY
DESIGN PATTERNS
(OPEN ELECTIVE)

Course Code: GR22A4063 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Ability to analyze and apply different design patterns for real life scenarios.
2. Ability to solve Object oriented design problems with a case study of designing a Document Editor.
3. Illustrates the skill apply creational design patterns.
4. Demonstrates the ability to apply different structural design patterns.
5. Analyze and Apply different behavioral design patterns.

UNIT I

Introduction: What Is a Design Pattern?, Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

UNIT II

A Case Study: Designing a Document Editor: Design Problems, Document Structure, Formatting,Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation, Summary.

UNIT III

Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns.
Structural Pattern Part-I: Adapter, Bridge, Composite.

UNIT IV

Structural Pattern Part-II: Decorator, Façade, Flyweight, Proxy.
Behavioral Patterns Part-I: Chain of Responsibility, Command, Interpreter, Iterator.

UNIT V

Behavioral Patterns Part-II: Mediator, Memento, Observer, State, Strategy, Template Method Visitor, Discussion of Behavioral Patterns. What to Expect from Design Patterns, A Brief History, The Pattern Community An Invitation, A Parting Thought.

Text Books:

1. Design Patterns by Erich Gamma, Pearson Education.

Reference Books:

1. Pattern's in JAVA Vol-I by Mark Grand,Wiley DreamTech.
2. Pattern's in JAVA Vol-II by Mark Grand,Wiley DreamTech.
3. JAVA Enterprise Design Patterns Vol-III by Mark Grand,Wiley DreamTech.

GOKARAJU RANGARAJUINSTITUTE OF ENGINEERING AND TECHNOLOGY
NON-CONVENTIONAL ENERGY SOURCES
(OPEN ELECTIVE)

Course Code:GR22A3019 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Illustrate the concepts of solar radiation at different instants.
2. Analyze the performance characteristics of PV modules.
3. Compare the performance of wind energy at various circumstances.
4. Make use of various sustainable energy resources for power generation.
5. Explain operation and performance of Wave energy, Fuel cells and Batteries.

UNIT I

Solar spectrum-Solar Radiation on Earth's surface- Solar radiation geometry-Solar radiation measurements-Solar radiation data-Solar radiation on horizontal and tilted surfaces. Solar Thermal Conversion-Flat plate collectors concentrated collectors- construction and thermal analysis- Solar Applications-Solar Ponds-Heliostat systems-water heater-air heater- solar still.

UNIT II

Photovoltaic Cells - Equivalent Circuit - V-I Characteristics- Photovoltaic Modules – Constructional details - Design considerations – Tracking - Maximum power point tracking – Algorithms - PV solar system design with energy backup - Solar Thermo electric conversion.

UNIT III

Fundamentals of wind energy-power available in wind-BetzLimit- Aerodynamics of wind turbine-Wind Turbines-Horizontal and vertical axis turbines – their configurations-Wind Energy conversion systems.

UNIT IV

Various fuels-Sources-Conversion Technologies-Wet Processes–Dry Processes-Biogas generation–Aerobic and an aerobic digestion- Factors affecting generation of bio gas – Classification of bio gas plants-Different Indian digesters-Digester design considerations- Gasification process-Gasifiers – Applications. Geo-thermal Energy-sources-Hydrothermal Convective-Geo-pressure resources-Petro-thermal systems (HDR)-Magma Resources-Prime Movers.

UNIT V

Principle of operation-Open and closed cycles, Energy from Tides-Principle of Tidal Power-Components of tidal Power Plants-Operation Methods-Estimation of Energy in Single and double basin systems-Energy and Power from Waves-Wave energy conversion devices-Fuel Cells-Design and Principle of operation-Types of Fuel Cells-Advantages and disadvantages- Types of Electrodes- Applications-Basics of Batteries –Constructional details of Lead acid batteries- Ni-Cd Batteries.

Text Books:

1. G.D. Rai, Non Conventional Energy Sources, Khanna publishers.
2. D.P.Kothari, Singal, Rakesh, Ranjan, Renewable Energy sources and Emerging Technologies, PHI, 2009.

Reference Books:

1. B.H.Khan, Non Conventional Energy Sources, PHI Publications.
2. John Twidell & Wier, Renewable Energy Resources, CRC Press, 2009.
3. T. Ackermann, "Wind Power in Power Systems", John Wiley and Sons Ltd., 2005.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
CONCEPTS OF CONTROL SYSTEMS
(OPEN ELECTIVE)

Course Code: GR22A3095 **L/T/P/C: 3/0/0/3**

Course Outcomes:
1. Infer the basic concept control systems.
2. Develop the mathematical model of the systems.
3. Analyze the time domain specifications and steady state error.
4. Outline the concept of stability of the system.
5. Solve the frequency response analysis.

UNIT I
BASIC CONCEPTS OF CONTROL SYSTEM
Terminology - plant, process, system, disturbances, controlled variable, manipulated variable etc., Block diagram of basic control system, application areas with examples. Classifications of control systems

UNIT II
MATHEMATICAL MODELLING OF SYSTEMS
Translational and rotational mechanical systems, electrical systems, Force voltage and force current analogy, Block diagram and signal flow graph representation of physical systems along with rules, properties, comparison and limitation, Mason's gain formula.

UNIT III
TIME RESPONSE ANALYSIS
Standard test signals along with examples of their usage, steady state errors for step, ramp and parabolic inputs, analysis of first and second order systems, Transient response specifications with numerical examples, Basic control actions and two position, proportional, P, PI, PID controllers, Limitations of time domain analysis.

UNIT IV
STABILITY
Concept of stability, types of stability, Routh's stability criterion, special cases with numerical examples, stability of closed loop system, concept of root locus, open loop and closed loop transfer poles, step by step procedure for root loci, numerical examples.

UNIT V
FREQUENCY RESPONSE ANALYSIS
Need of frequency response analysis, Sinusoidal response of linear system, methods used in frequency response, Bode Plot, Frequency domain specifications.

Text Books:
1. I J Nagrath, M.Gopal, Control System Engineering, New Age International Publishers, Fifth edition.
2. Norman S Nise, Control system engineering, John Wiley & Sons, Inc., Sixth edition

Reference Books:
1. Richard C. Dorf, Robert H Bishop, Modern control systems, Pearson Education International, Twelfth edition.
2. A Nagoor Kani, Control Systems, CBS Publishers.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ARTIFICIAL NEURAL NETWORKS AND FUZZY LOGIC
(OPEN ELECTIVE)

Course Code: GR22A4022 **L/T/P/C: 3/0/0/3**

Course Outcomes:
1. Outline importance of BNN, ANN and its learning techniques and architectures.
2. Summarize the algorithms for various applications using Back propagation networks.
3. Interpret the concept of Fuzzy and Crisp sets.
4. Model Fuzzy membership Function and rules for Applications.
5. Analyse the parameters of Genetic Algorithm.

UNIT I
NEURAL NETWORKS I (Introduction & Architecture)
Neuron, Nerve structure and synapse, Biological Neural network, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques.

UNIT II
NEURAL NETWORKS II (Back Propagation Networks)
Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, application of Neural Networks in Load Forecasting.

UNIT III
FUZZY LOGIC I (Introduction)
Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

UNIT IV
FUZZY LOGIC II (Fuzzy Membership, Rules)
Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and
Fuzzy algorithms, Fuzzifications & Defuzzification's, Fuzzy Controller, application of Fuzzy logic control in washing machines.

UNIT V
GENETIC ALGORITHMS (GA)
Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, application of genetic algorithm in economic load dispatch.

Text Books
1. J M Zurada , "An Introduction to ANN",Jaico Publishing House.
2. Neural Networks, Fuzzy Logic, And Genetic Algorithms: Synthesis and Applications - by S. RAJASEKARAN, G. A. VIJAYALAKSHMI PAI, PHI publishers.

Reference Books:
1. Hung T. Nguyen, Nadipuram R. Prasad, Carol L. Walker and Elbert A. Walker, "A First Course in Fuzzy and Neural Control" Chapman & Hall, CRC.

2. Driankov, Dimitra, “An Introduction to Fuzzy Control”, Narosa Publication.Timothy J Ross, “Fuzzy Logic with Engg.Applications”, McGraw. Hill.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PRINCIPLES OF COMMUNICATIONS
(OPEN ELECTIVE)

Course Code: GR22A3040 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Apply concepts of modulation, frequency translation, gain and attenuation in communication systems.
2. Analyze the power spectrum characteristics of different modulation techniques.
3. Understand the role of multiplexing techniques in optimizing bandwidth utilization of Communication Systems.
4. Evaluate the suitability of specific digital modulation techniques for different communication applications.
5. Critically perform error analysis of each modulation scheme.

UNIT - I: Basics of Communication Systems

Definition and scope of communication systems, Types of communication systems: Analog and Digital, Block diagram of a communication system, Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

UNIT - II: Analog Modulation

Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM) and its variants, Power Spectrum of different modulations, Comparison of modulation techniques.

UNIT - III: Pulse Analog Modulation

Ideal sampling, Sampling theorem, aliasing, interpolation, natural and flat top sampling in time and frequency domains. Introduction to PAM, PWM, PPM modulation schemes. Frequency Division Multiplexing (FDM) and Time division multiplexing (TDM).

UNIT – IV: Digital Modulation

Basics of digital modulation, Advantages of digital modulation over analog modulation, Types of digital modulation: ASK, FSK, PSK, QAM, Comparison of digital modulation techniques

UNIT - V: Performance Analysis of Analog and Digital Modulation

Sources of Noise in Communication Systems, Super heterodyne Receiver, Figure of Merit, Noise Figure. Signal-to-Noise Ratio (SNR) and Eb/N0 ratio, Bit Error Rate (BER) and its significance, Error performance analysis for different modulation schemes, Channel capacity and bandwidth efficiency.

Text Books:

1. An Introduction to Analog and Digital Communications, 2nd Edition, Simon Haykin, Michael Moher, John Wiley, March 2006.
2. Communication Systems by Simon Haykin, Second Edition, Wiley Student Edition, 2007.
3. Digital Communications by John G. Proakis and Masoud Salehi, 5e, McGraw Hill Publications, 2014.

Reference Books:

1. Introduction to Data Communications and Networking, Wayne Tomasi, Pearson Education, 2005.
2. Digital & Analog Communication Systems By K.S. Shanmugam, John Wiley

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SENSOR TECHNOLOGY
(OPEN ELECTIVE)

Course Code: GR22A3113 **L/T/P/C: 3/0/0/3**

Course Outcomes:
1. Demonstrate the concept of resistive sensors which can be employed for real life applications
2. Realize the concept of reactive sensors and understand the implications while deploying them in practice.
3. Understand the working principle of special purpose sensors and the need for developing smart sensors.
4. Comprehend the design and development of various wearable sensors for use in healthcare applications.
5. Able to design and perform experiments on the sensors and develop the projects based on the customer needs.

UNIT-I
General concepts and terminology of Sensor systems, Transducers classification-sensors and actuators, General input-output configurations, Static and dynamic characteristics of measurement system.

UNIT-II
Resistive sensors- Potentiometers, strain gages (piezo-resistive effect), resistive temperature detectors (RTD), thermistors, light dependent resistor (LDR), resistive hygrometers, resistive gas sensors.

UNIT-III
Inductive sensors - variable reluctance sensors, Hall effect, Eddy current sensors, Linear variable differential transformers (LVDT), variable transformers, magneto-elastic, magneto-resistive, and magnetostrictive sensors. Capacitive sensors- variable capacitor, differential capacitor.

UNIT-IV
Accelerometers: Characteristics and working principle, Types- Capacitive, Piezoresistive, piezoelectric; Gyroscopes: Characteristics and working principle, Rotor Gyroscope; Diaphragm Pressure Sensor – resistive & capacitive type (micro press sensor).

UNIT-V
Overview of various smart sensors: Digital temperature sensor (DS1621, TMP36GZ), Humidity sensor (DHT11, DHT22), Gas sensor (MQ2,MQ8), Pressure sensors (BMP180), Accelerometers (ADXL335); Structural health monitoring sensors, Introduction to MEMS and Flexible sensors.

Text Books:
1. B. C. Nakra, K.K. Choudhury, “Instrumentation, Measurement and Analysis” -3rd Edition, Tata McGraw, 2009
2. Jacob Fraden, “HandBook of Modern Sensors: physics, Designs and Applications”, 3rd ed., Springer, 2010.

Reference Books:
1. A.K. Sawhney, “Electrical and Electronic Measurements and Instrumentation”, DhanpatRai.
2. Er. R.K. Rajput, “Electronic Measurements and Instrumentation”, S. Chand & Company Ltd. 3rd

Edition.
3. Bentley, John P., "Principles of Measurement Systems", 4th edition, Pearson/Prentice Hall, 2005
4. Jon. S. Wilson, "Sensor Technology HandBook", Elsevier Inc., 2005.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
COMMUNICATION TECHNOLOGIES
(OPEN ELECTIVE)

Course Code: GR22A4045 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Analyze the properties of basic Modulation techniques and apply them to Digital Communication
2. Apply error probability concepts to evaluate the performance of spread spectrum systems.
3. Understand the principle concepts of telecommunication systems and networking
4. Analyze link budgets for satellite communication, considering factors such as path loss, atmospheric effects, and antenna gain.
5. Evaluate the suitability of various technologies in cellular, mobile and wireless communication scenarios.

UNIT- I: Review of Digital Communication System

Review of fundamental concepts and parameters in Digital Communication. Digital modulation schemes, Power spectra of digital modulation signals.

UNIT- II: Spread-Spectrum Modulation

Introduction, Pseudo-Noise sequences, direct- sequence spread spectrum (DSSS) with coherent BPSK, processing gain, probability of error, frequency-hop spread spectrum (FHSS). Application of spread spectrum: CDMA.

UNIT- III: Telecommunication Systems: Telephones Telephone system, Paging systems, Internet Telephony. **Networking and Local Area Networks:** Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

UNIT- IV

Satellite Communication: Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.
Optical Communication: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT-V:

Cellular and Mobile Communications: Cellular telephone systems, AMPS, GSM, CDMA, and WCDMA.
Wireless Technologies: Wireless LAN, PANs and Bluetooth, ZigBee and Mesh Wireless Networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

Text Books:

1. Introduction to Data Communications and Networking, Wayne Tomasi, Pearson Education, 2005.
2. Simon Haykin and Michael Moher, “Modern Wireless Communications,” Pearson Education, 2005. 4. Marvin K. Simon, Sami M. Hinedi and W. C. Lindsay, “Digital Communication Techniques,” Eastern Economy Edition, 2010.

Reference Books:

1. Principles of communication systems By Taub Schilling, T.M.H
2. Andrew J Viterbi, “CDMA principles spread spectrum communications,” Adison Wesley, 1995.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INDUSTRIAL AUTOMATION AND CONTROL
(OPEN ELECTIVE)

Course Code: GR22A3030 **L/T/P/C:3/0/0/3**

Course Outcomes:
1. Explain the major automation theories, approaches and methodologies used in manufacturing.
2. Apply the knowledge for implementing the automated flow lines.
3. Employ the assembly systems and line balancing for automation
4. Implement the knowledge of material handling and storage systems in current industries.
5. Design adaptive control system for automated manufacturing.

UNIT I
Introduction: Introduction to automation, principles, reasons, types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding, tool changing and machine tool control transfer the automaton.

UNIT II
Automated flow lines: Methods of 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 IV
Automated material handling and storage systems: Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems. Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT V
Adaptive control systems: Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations. Consideration of various parameters such as cutting force, temperatures, vibration and acoustic emission in the adaptive controls systems.

Text Books:
1. Mikell P.Groover, Automation, Production Systems, and Computer- integrated Manufacturing, prentice Hall, 2014
2. Serope Kalpakjian and Steven R. Schmid, Manufacturing– Engineering and Technology, 7th edition, Pearson, 2013

Reference Books:
1. Automation, Production Systems, and Computer-Integrated Manufacturing. (2016). India: Pearson India.
2. Bolz, R. W. (2012). Manufacturing Automation Management: A Productivity Handbook. United States: Springer US.

3. Boucher, T. O. (2012). Computer Automation in Manufacturing: An Introduction. Switzerland: Springer US.
4. Altintas, Y. (2012). Manufacturing Automation: Metal Cutting Mechanics, Machine Tool Vibrations, and CNC Design. United States: Cambridge University Press.
5. Morriss, S. B. (1995). Automated manufacturing systems. United Kingdom: Glencoe.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
COMPOSITE MATERIALS
(OPEN ELECTIVE)

Course Code: GR22A3105 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Identify the types of composite materials and their characteristic features
2. Explain the methods employed in composite fabrication.
3. Differentiate the strengthening mechanisms of composite and its corresponding effect on performance
4. Analyze the various criterions for isotropic, anisotropic and composite materials, prediction of laminates failure.
5. Examine experimental techniques utilized for failure mode of composites.

UNIT I

Definition and applications of composite materials, Fibers- glass, carbon, ceramic and aramid fibers; Matrices- polymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina- assumptions, macroscopic viewpoint, generalized Hooke's law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.

UNIT II

Manufacturing of composite materials, bag moulding, compression moulding, pultrusion, filament welding, other manufacturing processes

UNIT III

Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, cross ply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria.

UNIT IV

Von Mises Yield criterion for isotropic materials, generalized Hill's criterion for anisotropic materials, Tsai- Hill's criterion for composites, prediction of laminate failure, thermal analysis of composite laminates.

UNIT V

Analysis of laminated plates- equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Text Books:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill,1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill,1998.

Reference Books:

1. Clyne, T. W. and Withers, P. J., "Introduction to Metal Matrix Composites", Cambridge University Press, 1993.
2. Strong, A.B., "Fundamentals of Composite Manufacturing", SME, 1989.
3. Sharma, S.C., "Composite materials", Narosa Publications, 2000.
4. Broutman, L.J. and Krock,R.M., " Modern Composite Materials", Addison-Wesley, 1967.
5. Introduction to Composite Materials Design by Ever J. Barbero 3rd Edition 2017

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
OPERATIONS RESEARCH
(OPEN ELECTIVE)

Course Code: GR22A3018 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Apply the various linear programming techniques for optimal allocation of limited resources such as machine, material and money
2. Solve transportation problems to minimize cost and understand the principles of assignment of jobs and recruitment policies.
3. Solve sequencing problems and to distinguish various inventory models and develop proper inventory policies
4. Apply game theory to analyze various business competitions and analyze the various waiting line oriented situations.
5. Develop optimum replacement policy and Dynamic Programming Techniques.

UNIT I

Introduction: Development – Definition– Characteristics and Phases of operations Research– Types of models – operation Research models– applications.

Allocation: Linear Programming Problem Formulation – Graphical solution – Simplex method – Artificial variables techniques -Two–phase method, Big-M method – Duality Principle.

UNIT II

Transportation models: Formulation – Methods for finding feasible solutions; North west corner rule, Least cost entry method, Vogel's approximation method. Optimal solution; MODI method. Unbalanced transportation problem and Degeneracy.

Assignment models - Formulation – Optimal solution - Variants of Assignment 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.

Inventory: Introduction – Single item – Deterministic models – Purchase inventory modelwith one price break and multiple price breaks – shortages are not allowed – Stochastic models – demand may be a discrete variable or continuous variable – Instantaneous production. Instantaneous demand and continuous demand and no set up cost.

UNIT IV

Theory of games: Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – dominance principle– m X 2 and 2 X n games -graphical method.

Waiting lines: Introduction – Single Channel – Poisson arrivals – exponential service times – with infinite population and finite population models– Multichannel – Poisson arrivals – exponential service times with infinite population single channel Poisson arrivals.

UNIT V

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.

Dynamic programming: Introduction – Bellman's Principle of optimality – Applications of dynamic

programming- capital budgeting problem – shortest path problem – linear programming problem.

Text Books:

1. Operations Research - Prem Kumar Gupta and D S Hira/ S Chand Publishing/ 2015
2. Operations Research / S. D.Sharma / KedarNath RamNath Publication/2020

Reference Books:

1. Operations Research / R.Panneerselvam, 3rd Edition/PHI Publications/ 2023
2. Operations Research An Introduction - Hamdy A Taha/8 th Edition/ Prentice Hall/2006
3. Principles of Operations Research: With Applications to Managerial Decisions - Harvey M. Wagner/Prentice-Hall Operations Research/2020
4. Operations Research - Kanthi Swarup, P.K. Gupta, Man Mohan Sultan Chand & Sons/ 2019
5. Operations Research / A.M.Natarajan, P.Balasubramani,A. Tamilarasi / Pearson Education/2006

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING MATERIALS FOR SUSTAINABILITY
(OPEN ELECTIVE)

Course Code: GR22A3009 **L/T/P/C: 3/0/0/3**

Course Outcomes:
1. Describe the different types of environmental factors effecting materials
2. Report the work in sustainability for research and education
3. Illustrating the broad perspective in thinking for sustainable practices
4. Perform cost/benefit analysis and life-cycle analysis of green buildings.
5. Identify and compare cost and performance of building materials

UNIT I

Sustainability – Introduction, Need and concept of sustainability, Social- environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols – Clean Development Mechanism (CDM), Environmental legislations in India – Water Act, Air Act

UNIT II

Air Pollution, effects of Air Pollution; Water pollution-sources, Sustainable wastewater treatment, Solid waste-sources, impacts of solid waste, zero waste concept, 3R concept, Global environmental issues-Resource degradation, climatic change, Global warming, Ozone layer depletion, Regional and Local Environmental issues. Carbon credits and carbon trading, carbon foot print.

UNIT III

Green Building Materials, Basic concepts of sustainable habitat, green buildings, green materials for building construction, material selection for sustainable design, green building certification, Methods for increasing energy efficiency of buildings. Sustainably managed Materials, Depletingnatural resources of building materials; renewable and recyclable resources; energy efficient materials; non-renewable Energy of Materials

UNIT IV

Green cement, Biodegradable materials, Smart materials, Manufactured Materials, Volatile Organic Compounds like acetone, formaldehyde, BTEX substances, Natural Non-Petroleum Based Materials, Recycled materials, Renewable and Indigenous Building Materials, Engineering evaluation of these materials

UNIT V

Green Building Planning and Specifications**,** Environment friendly and cost effective Building Technologies, Integrated Life cycle design of Materials and Structures, Green Strategies for Building Systems, Alternative Construction Methods, Energy Conservation Measures in Buildings, Waste &Water management and Recycling in Sustainable Facilities, Heating,

Ventilation and Air Conditioning, Passive Solar & Daylight, Plumbing and its Effect on Energy Consumption

Text Books:

1. Alternative Building Materials and Technologies (2007) – K S Jagadeesh, B V Venkata Rama Reddy & K S Nanjunda Rao – New Age International Publishers
2. Integrated Life Cycle Design of Structures (2002)– AskoSarja – SPON Press
3. Non-conventional Energy Resources (2012) – D S Chauhan and S K Srivastava – New Age International Publishers

Reference Books:

1. Green Buildings (2007) McGraw hill publication by Gevorkian
2. Emerald Architecture (2008) case studies in green buildings, The Magazine of Sustainable Design
3. Understanding Green Building Guideline (2010): For Students and Young Professionals, Traci Rose Rider, W. W. Norton & Company Publisher.
4. Understanding Green Building Materials (2011) Traci Rose Rider, W. W. Norton & Company Publisher.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
GEOGRAPHIC INFORMATION SYSTEMS AND SCIENCE
(OPEN ELECTIVE)

Course Code:GR22A3086 **L/T/P/C: 3/0/0/3**

Course Outcomes:
1. Interpret the fundamental concepts of Geographic Information Science and Technology along with different data structures.
2. Demonstrate Map creation and design principles, including thematic map display, employment of map projections and cartographic design.
3. Analyze the types of digital maps for different themes.
4. Apply the spatial analysis to remote sensing data to generate thematic maps.
5. Solve the real life problems associated with geospatial and remote sensing.

UNIT I
Fundamentals of GIS – Information Systems, Modelling Real World Features Data, Data Formats, Applications of GIS, – Spatial and Non-spatial, Components, Data Collection and Input, Data Conversion, Database Management – Database Structures, Files; Standard Data Formats, Compression Techniques, Hardware – Computing, printing and scanning systems; Software – Standard Packages like Arc view, ArcGIS (commercial) & Auto-CAD Map, Map Info etc. QGIS open software- Salient features.

UNIT II
Topology – Types of Errors, Editing and Error Rectification, Types of Topology, Modeling topological Relationships, Tolerances.

UNIT III
Map – mapping concepts, analysis with paper-based maps, limitations, Computer Automated Cartography– History and Developments, GIS- Definition, advantages of digital maps.

UNIT IV
Spatial Analysis and Modelling – Proximity Analysis, Overlay Analysis, Buffer Analysis, Network Analysis, Spatial Auto Correlation, Gravity Modelling, DTM/DEM, Integration with Remote Sensing data

UNIT V
GIS Project Planning and Implementation – Under Standing the Requirements, Phases of Planning, Specifications, Data Procurement, Tendering, Human Resources, Back Up, Monitoring Progress

Text Books:
1. Concepts & Techniques of GIS by C. P. Lo Albert, K. W. Yonng, Prentice Hall (India) Publications, 2nd edition, 2016.
2. Fundamental of GIS by Mechanical designs John Wiley &Sons, 4th edition, 2008.
3. Principals of Geographic Information Systems – Peter Beur and Rachael A.Mc Donnell, Oxford Publishers 2016.

Reference Books:
1. Remote Sensing and Geographical Information systems by M. Anji Reddy JNTU Hyderabad.4thedition, 2014, B. S. Publications.
2. Introduction to Geographic Information Systems by Kang-tsung Chang, Tata McGraw-Hill Publishing Company Limited- 2008.

3. Remote sensing of the environment –An earth resource perspective by John R Jensen, PrenticeHall 4. GIS by Kang – tsung chang, TMH Publications & Co., 2nd edition, 2013.
4. Basics ofRemote sensing & GIS by S.Kumar, Laxmi Publications, 1st edition,2016.
5. Remote Sensing and its applications by LRA Narayana, UniversityPress 1999.
6. Remote sensing and image interpretation by Thomas Lillesand, 7th Edition, John Wiley&sons,6th edition 2011.
7. Fundamentals of Geographic Information systems by Michael N. Demers, 4th Edition, Wiley Publishers, 2012.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENVIRONMENTAL IMPACT ASSESSMENT
(OPEN ELECTIVE)

Course Code:GR22A4011 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Identify, predict and evaluate the environmental effects of proposed actions and projects.
2. Explain the appropriate methodologies for environmental impact prediction and assessment.
3. Analyze the importance of Public Participation, Fault Tree Analysis and Consequence analysis in EIA.
4. Understand the activities in environmental auditing.
5. Plan EIA for developmental projects.

UNIT I

Introduction: Concepts of EIA methodologies – Sustainable development- Need for Environmental Impact Assessment (EIA) - Environmental Impact Statement (EIS) – Evolution of EIA: Screening and scoping; Rapid EIA and Comprehensive EIA

UNIT II

Introduction to EIA, Criteria for the selection of EIA Methodology, General Framework for Environmental Impact Assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of Risk, Matrix Method; Checklist method.

UNIT III

Prediction and Assessment: Public participation Fault tree analysis, Consequence Analysis; Socioeconomic aspects, measures of the effectiveness of pollution control activities;

UNIT IV

Environmental Legislation: Introduction to Environmental Management Systems; Environmental Statement - procedures; Environmental Audit: Cost-Benefit Analysis;

UNIT V

Life Cycle Assessment, Resource Balance, Energy Balance & Management Review - Operational Control - Case Studies on EIA with reference to Indian Scenario.

Text Books:

1. Y Anjaneyulu, and Valli Manikkam, Environmental Impact Assessment Methodologies, BSP Books PVT Ltd., 2nd edition, 2011.
2. R.R. Barthwal, Environmental Impact Assessment, New Age International Private Limited, 2nd edition, 2012.
3. Canter R.L., Environmental Impact Assessment, Mc Graw Hill International Edition, 2nd edition,1997.

Reference Books:

1. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
2. Judith Petts, Handbook of Environmental Impact Assessment Vol. I &II, Blackwell Science,1999.
3. Cutter, S.L., "Environmental Risk and Hazards", Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.

4. Anji Reddy Mareddy, Environmental Impact Assessment: Theory and Practice, Butterworth-Heinemann publisher, 1st Edition, 2017.
5. MoEF & CC, Govt. of India: EIA notification and subsequent amendments