Academic Regulations
Programme Structure
and
Detailed Syllabus

Bachelor of Technology (B.Tech)
in
Mechanical Engineering

(Four Year Regular Programme)

(Applicable for Batches admitted from 2024-25)

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY
(Autonomous)
Bachupally, Kukatpally, Hyderabad- 500 090

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY HYDERABAD

Academic Regulations for B.Tech (Regular) under GR24

(Applicable for Batches Admitted from 2024-25)

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	Computer Science and Business System	32	B.Tech Computer Science & Business System
7	Computer Science and Engineering (AIML)	66	B.Tech Computer Science and Engineering (Artificial Intelligence & Machine Learning)
8	Computer Science and Engineering (Data Science)	67	B.Tech Computer Science and Engineering (Data Science)

GR24 Regulations shall govern the above programmes offered by the Departments with effect from the students admitted to the programmes in 2024-25 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) All courses are to be registered by the student in a semester to earn credits which shall be assigned to each subject/ course in an L: T: P: C (lecture periods: tutorial periods: practical periods: credits) structure based on the following general pattern.
- One credit for one hour/week/semester for Theory/Lecture (L) courses and Tutorials (T).
- One credit for two hours/week/semester for Laboratory/Practical (P) courses.
- Mandatory Courses will not carry any credits.

i) 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 and Social 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 of Indian 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 ≥ 5).
c) A student must fulfill all the academic requirements for the award of the degree.

5. **Courses to be offered**

a) Open Electives: Students are to register an Open Elective (OE-I) during III year I semester, an Open Elective (OE-II) during III-year II semester, and a Open Elective (OE–III) in IV year I semester from the list of Open Electives given. OE-I and OE-II are to be selected from SWAYAM courses (MOOCs platform).

b) Professional Electives: The students have to choose six Professional Electives from the list of Professional Electives given in the course structure.

c) A course may be offered to the students, only if a minimum of 15 students opts for it.

d) More than one faculty member may offer the same subject.

e) A lab/practical may be included with the corresponding theory subject in the same semester) in any semester.

f) If more students opt for a particular course, then the priority shall be given to students firstly on 'first come first serve' basis and secondly based on CGPA (student who has higher CGPA is given more preference).

g) If more students opt for a particular course, then the concerned Head of the Department shall decide whether or not to offer such a course for two or more sections.

h) In case of options coming from students of other departments, priority shall be given to the student of the 'parent department'.

6. **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.

7. 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	Componentof 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 isfor 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 isfor 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 **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, 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.

- A student is deemed to have satisfied the academic requirements and earned the credits allotted to **Project Stage-I** if the student secures not less than 40% of marks (40 marks out of 100 marks) in the evaluation of the same.

- A student is deemed to have failed if the student does not submit a report on work carried out during Project Stage-I or does not make a presentation of the same before the evaluation committee as per schedule or secures less than minimum marks in the evaluation.
- A student who has failed may reappear once for evaluation when it is scheduled again; if the student fails in the evaluation of 'one such reappearance', the student has to reappear for the same in the subsequent semester, as and when it is offered.
- A student is deemed to have satisfied the academic requirements and earned the credits allotted to **Project Stage-II** if the student secures not less than 35% (14 marks out of 40 marks) in the Continuous Internal Evaluation (CIE), not less than 35% (21 marks out of 60 marks) in the Semester End Examinations (SEE), and a minimum of 40% (40 marks out of 100 marks) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of letter grades, this implies securing **'C'** grade or above in that subject/ course.
- The student is deemed to have failed if the student does not submit a report on work carried out during Project Stage-II or does not make a presentation of the same before the evaluation committee as per schedule or secures less than minimum marks in either CIE or SEE or CIE+SEE taken together.
- A student who has failed may reappear once for the evaluation when it is scheduled again; if the student fails again in the evaluation of "once such reappearance", the student has to reappear for the same in the subsequent semester as and when the evaluation is scheduled.

g) The evaluation of courses having ONLY **CIE** is as follows:

- **Elements of CE/EEE/ME/ECE/CSE as a Theory Course,** in I year I semester is evaluated for **50 marks**. The CIE for 50 marks shall be done through first and second mid-term examinations. The average marks of two mid-term examinations are taken as final marks in CIE. Student shall have to earn 40% i.e. 20 marks out of 50 marks in the average of two mid-term examinations. **There shall be no external evaluation.** The student is deemed to have failed, if he (i) is absent as per schedule, or (ii) secures less than 40% marks in this course.

  CIE is done for 50 marks as follows:
  - There shall be two mid-term examinations during the semester conducted for 40 marks consisting of two parts with a total duration of 2 hours: Part A for 20 marks and Part B for 20 marks.
  - Part A is an objective paper or a quiz and shall consist of multiple- choice questions, fill-in-the blanks, match the following, etc. for a total of 20 marks.

- Part B is a descriptive paper and shall contain 6 questions out of which, the student needs to answer 4 questions each carrying 5 marks.
- While the first mid-term examination shall be conducted for the first 50% syllabus, the second mid-term examination shall be conducted for the remaining 50% of the syllabus. The average of the two mid-term examinations shall be taken as final marks.
- Two assignments are evaluated for 5 marks each. The first assignment should be submitted before the conduct of the first mid-term examination, and the second assignment should be submitted before the conduct of the second mid-term examination. The assignments shall be given by the subject teachers. The average of the two assignments shall be taken as the final marks.
- The remaining 5 marks may be evaluated by conducting viva-voce in the subject or by evaluating the performance of the student in PPT/Poster/Case-Study presentation on a topic in the concerned subject before second mid-term examination**.**

- **Elements of CE/EEE/ME/ECE/CSE as a Lab Course,** in I year I semester is evaluated for **50 marks**.

  CIE is done for 50 marks as follows:
  - A write-up on day-to-day experiments in the laboratory (in terms of aim, components/procedure, expected outcome) shall be evaluated for 10 marks
  - 10 marks are awarded either for the performance in viva-voce (or) case study presentation (or) application development (or) poster presentation.
  - Internal practical examination shall be conducted by the concerned laboratory teacher for 15 marks.
  - The remaining 15 marks are awarded for laboratory project, which consists of the design (or) model presentation (or) prototype presentation at the end of the completion of laboratory course and before semester end practical examination.

- **Real-Time/Field-based Research Project C**ourse in II-year II Semester is evaluated for **50 marks.** The internal evaluation is for 50 marks 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**.

  A student is deemed to have satisfied the academic requirements and earned the credits allotted to "Real-Time/Field-Based Research Project" if the student secures not less than 40% marks (i.e. 20 marks out of 50 marks) in the evaluation of the same.

  A student is deemed to have failed in Real-Time/Field-Based Research Project, if he (i) does not submit a report on the same or (ii) does not make a presentation of the same before the evaluation committee as per schedule, or (iii) secures less than 40% marks in evaluation of the same.

A student who is failed in either Real-Time/Field-Based Research Project may reappear once for the evaluation when they are scheduled again; if the student fails again in the evaluation of 'one such reappearance', the student has to reappear for the same in the subsequent semester, as and when it is offered.

- **Mandatory Courses** are evaluated for **50 marks.** The CIE for 50 marks shall be done through first and second mid-term examinations. The average marks of two mid-term examinations are taken as final marks in CIE. Student shall have to earn 40% i.e. 20 marks out of 50 marks in the average of two mid-term examinations. There shall be **NO external evaluation**. The student is deemed to have failed, if he (i) is absent as per schedule, or (ii) secures less than 40% marks in this course.

  A mandatory course is not graded and does not carry credits. Only Pass/Fail shall be indicated in Grade Card

  The evaluation pattern for mandatory courses shall be done similar to **Elements of CE/EEE/ME/ECE/CSE as a Theory Course.**

8. **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.

9. **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.

10. **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.

11. **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.

12. **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.

13. **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 y ear second semester. **(ii)** Must have secured at least 50% credits up to First year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3	Second year first semester to Second year second semester	Regular course of study of Second year first semester.
4	Second year second semester to Third year first semester	**(i)** Regular course of study of Second year second semester **(ii)** Must have secured at least 60% credits up to Second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Third year first semester to Third year second semester	Regular course of study of Third year first semester.

6	Third year second semesterto Fourth year first semester	**(i)** Regular course of study of Third year second semester. **(ii)** Must have secured at least 60% credits upto Third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
7	Fourth year first semester toFourth year second semester	Regular course of study of Fourth year first semester.

14. 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) **S_k** the SGPA of **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 **i^{th}** course and **Gi** is the grade point scored by the student in the **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 **Sk**, where **k ≥ 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.

15. **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 ≥ 7.00 and CGPA <8.00
4	Second Class	CGPA ≥ 6.00 and CGPA <7.00
5	Pass Class	CGPA ≥ 5.00 and CGPA <6.00

Equivalence of grade to marks

Marks % = (CGPA -0.5)*10

16. **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).

17. **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.

18. **Transitory Regulations**

A. For students detained due to shortage of attendance:

1. A Student who has been detained in I year of GR22 Regulations due to lack of attendance, shall be permitted to join I year I Semester of GR24 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 GR22 regulations for want of attendance, shall be permitted to join the corresponding semester of GR24 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 GR24 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 GR22 Regulations who has been detained due to lack of credits, shall be promoted to the next semester of GR24 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 GR22 & GR24 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 GR24 Academic Regulations are applicable to a student from the year of readmission. See rule (C) for further Transitory Regulations.

C. For readmitted students in GR24 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 GR24 Regulations. **There is NO exemption of credits in any case**.

6. If a student is readmitted to GR24 Regulations and has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in GR24 Regulations will be substituted by another subject to be suggested by the college academic administration.

Note:

If a student readmitted to GR24 Regulations and has not studied any courses/topics in his/her earlier regulations of study which is prerequisite for further subjects in GR24 Regulations, then the college shall conduct remedial classes to cover those courses/topics for the benefit of the students.

19. **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.

20. 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 andthe 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 GR24

(Applicable for Batches Admitted from 2025-26)

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 toThird year first semester.	(i) Regular course of study of Second year second semester. (ii) Must have secured at least 50% credits up to Second year second semesterfrom 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 toFourth year first semester.	(i) Regular course of study of Third year second semester. (ii) Must have secured at least 60% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Fourth year first semester to Fourth year second semester.	Regular course of study of Fourth year first semester.

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 ≥ 7.00 and CGPA <8.00
4	Second Class	CGPA ≥ 6.00 and CGPA <7.00
5	Pass Class	CGPA ≥ 5.00 and CGPA <6.00

Academic Regulations for B.Tech with Minors Programme under GR24

(Applicable for Batches Admitted from 2024-25)

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"

GOKARAJURANGARAJUINSTITUTE OF ENGINEERINGANDTECHNOLOGY

(Autonomous)

Bachupally, Kukatpally, Hyderabad–500090,
India. (040)65864440

MECHANICAL ENGINEERING

B. Tech (ME) – GR24 Course Structure

I B. Tech I Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Int.	Ext	Total Marks
					L	T	P	Total			
1	Maths	BS	GR24A1001	Linear Algebra and Function Approximation	3	1	0	4	40	60	100
2	Chemistry	BS	GR24A1004	Engineering Chemistry	3	1	0	4	40	60	100
3	CSE	ES	GR24A1006	Programming forProblem Solving	2	0	0	2	40	60	100
4	ME	ES	GR24A1012	Elements of Mechanical Engineering	1	1	0	1	50	--	50
5	ME	ES	GR24A1016	Graphics for Engineers	1	0	4	3	40	60	100
6	Chemistry	BS	GR24A1019	Engineering ChemistryLab	0	0	3	1.5	40	60	100
7	CSE	ES	GR24A1021	Programming forProblem Solving Lab	0	0	3	1.5	40	60	100
8	ME	ES	GR24A1025	Engineering Workshop Lab	1	0	3	2.5	40	60	100
		TOTAL			**11**	**3**	**13**	**19.5**	**370**	**480**	**850**
9	Mgmt	MC	GR24A1028	Design Thinking	2	0	0	0	50	--	50

I B. Tech II Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Int.	Ext	Total Marks
					L	T	P	Total			
1	Maths	BS	GR24A1002	Differential Equations and Vector Calculus	3	1	0	4	40	60	100
2	Physics	BS	GR24A1003	Applied Physics	3	1	0	4	40	60	100
3	ME	ES	GR24A1015	Engineering Mechanics	3	1	0	4	40	60	100
4	English	BS	GR24A1005	English	2	0	0	2	40	60	100
5	CSE	ES	GR24A1017	Data Structures	2	0	0	2	40	60	100
6	CSE	ES	GR24A1027	Python Programming	1	0	0	1	50	--	50
7	Physics	BS	GR24A1018	Applied Physics Lab	0	0	3	1.5	40	60	100
8	English	BS	GR24A1020	English Language and Communicatio nSkills Lab	0	0	2	1	40	60	100
9	CSE	ES	GR24A1024	Data Structures Lab	0	0	2	1	40	60	100
		TOTAL			**14**	**3**	**7**	**20.5**	**370**	**480**	**850**

II B.Tech I Semester

S.No	BOS	Group	Course Code	Course Name	Credits				Int.	Ext.	Total Marks
					L	T	P	Total			
1	ME	PC	GR24A2039	Kinematics of Machinery	3	0	0	3	40	60	100
2	ME	PC	GR24A2040	Metallurgy and Material Science	3	0	0	3	40	60	100
3	EEE	ES	GR24A2013	Basic Electrical and Electronics Engineering	3	0	0	3	40	60	100
4	ME	PC	GR24A2041	Strength of Materials	3	0	0	3	40	60	100
5	ME	PC	GR24A2042	Thermodynamics	3	0	0	3	40	60	100
6	ME	PC	GR24A2048	Manufacturing Engineering	2	0	0	2	40	60	100
7	ME	PC	GR24A2044	Metallurgy and Material Science Lab	0	0	2	1	40	60	100
8	ME	PC	GR24A2043	Strength of Materials Lab	0	0	2	1	40	60	100
9	ME	PC	GR24A2050	Manufacturing Engineering Lab	0	0	2	1	40	60	100
Total					**17**	**0**	**6**	**20**	**360**	**540**	**900**
10	ME	MC	GR24A2002	Value Ethics and Gender Culture	2	0	0	0	50	--	50

II B.Tech II Semester

S. No	BOS	Group	Course Code	Course Name	Credits				Int.	Ext.	Total Marks
					L	T	P	Total			
1	ME	PC	GR24A2045	Thermal Engineering	3	0	0	3	40	60	100
2	ME	PC	GR24A2046	Fluid Mechanics and Fluid Machines	3	0	0	3	40	60	100
3	ME	PC	GR24A2047	Dynamics of Machinery	3	0	0	3	40	60	100
4	Maths	BS	GR24A2008	Computational Mathematics for Engineers	3	0	0	3	40	60	100
5	ME	PC	GR24A2052	Manufacturing Technologyand Metrology	3	0	0	3	40	60	100
6	ME	PC	GR24A2049	Thermal Engineering Lab	0	0	2	1	40	60	100
7	ME	PC	GR24A2051	Fluid Mechanics and Fluid Machines Lab	0	0	2	1	40	60	100
8	ME	PC	GR24A2053	Manufacturing Technology and Metrology Lab	0	0	2	1	40	60	100
9	ME	PW	GR24A2106	Real-time Research Project/ Societal Related Project	0	0	4	2	50	--	50
Total					**15**	**0**	**10**	**20**	**370**	**480**	**850**
10	Mgmt	MC	GR24A2001	Environmental Science	2	0	0	0	50	--	50

III Year I Semester

S.No.	BOS	Group	Course Code	Course Name	Credits				Int.	Ext.	Total Marks
					L	T	P	Total			
1	ME	PC	GR24A3049	Basic Machine Design	2	1	0	3	40	60	100
2	Mgmt	HS	GR24A3041	Economics and Accounting for Engineers	3	0	0	3	40	60	100
3	ME	PC	GR24A3050	CAD/CAM	3	0	0	3	40	60	100
4	ME	PC	GR24A3051	Applied Thermodynamics	3	0	0	3	40	60	100
5		PE-I		Professional Elective-I	3	0	0	3	40	60	100
6		OE-I		Open Elective-I	3	0	0	3	40	60	100
7	ECE	PC	GR24A3077	IOT Sensors Lab	0	0	2	1	40	60	100
8	ME	PC	GR24A3058	Computer Aided Design and Manufacturing Lab	0	0	2	1	40	60	100
				Total	**15**	**1**	**9**	**20**	**360**	**540**	**900**
9	Mgmt	MC	GR24A2003	Constitution of India	2	0	0	0	40	60	100

PROFESSIONAL ELECTIVE – I				
S. No.	BOS	Group	Course Code	Course
1	ME	PE	GR24A3052	Robotics
2	ME	PE	GR24A3053	Advanced Strength of Materials
3	ME	PE	GR24A3054	Mechanical Vibrations
4	ME	PE	GR24A3055	Industrial Internet of Things

III B.Tech II Semester

S.No.	BOS	Group	Course Code	Course Name	Credits				Int.	Ext.	Total Marks
					L	T	P	Total			
1	ME	PC	GR24A3059	Advanced Machine Design	3	0	0	3	40	60	100
2	ME	PC	GR24A3060	Heat Transfer	3	0	0	3	40	60	100
3	ME	PC	GR24A3061	Additive Manufacturing	3	0	0	3	40	60	100
4		PE-II		Professional Elective-II	3	0	0	3	40	60	100
5		OE-II		Open Elective-II	3	0	0	3	40	60	100
6	ME	PC	GR24A3067	Computer Aided Analysis and 3D Printing Lab	0	0	2	1	40	60	100
7	ME	PC	GR24A3068	Heat Transfer Lab	0	0	2	1	40	60	100
8	ME	PW	GR24A3027	Mini Project with Seminar	0	0	4	2	40	60	100
9	English	BS	GR24A3013	Advanced English Communication Skills Lab	1	0	0	1	40	60	100
				Total	**16**	**1**	**8**	**20**	**360**	**540**	**900**

PROFESSIONAL ELECTIVE – II				
S. No.	**BOS**	**Group**	**Course Code**	**Course**
1	ME	PE	GR24A3062	Mechanical Measurements
2	ME	PE	GR24A3063	Material Characterization and Testing
3	ME	PE	GR24A3064	Unconventional Machining Processes
4	ME	PE	GR24A3065	Intelligent Manufacturing Systems

IV B. Tech I Semester

S.No.	BOS	Group	Course Code	Course Name	Credits				Int.	Ext.	Total Marks
					L	T	P	Total			
1	ME	PC	GR24A4058	Finite Element Methods	3	0	0	3	40	60	100
2	ME	PC	GR24A4047	Instrumentation and Control Systems	3	0	0	3	40	60	100
3		PE-III		Professional Elective-III	3	0	0	3	40	60	100
4		PE-IV		Professional Elective-IV	3	0	0	3	40	60	100
5		OE-III		Open Elective-III	3	0	0	3	40	60	100
6	ME	PC	GR24A4056	Instrumentation and Control Systems Lab	0	0	2	1	40	60	100
7	ME	PC	GR24A4057	CFD Lab	0	0	2	1	40	60	100
8	ME	PW	GR24A4016	Project Work-Phase I	0	0	12	6	40	60	100
				Total	**15**	**0**	**16**	**23**	**320**	**480**	**800**

PROFESSIONAL ELECTIVE – III				
S. No.	**BOS**	**Group**	**Course Code**	**Course**
1	ME	PE	GR24A4048	Renewable Energy Resources
2	ME	PE	GR24A4049	Turbomachinery
3	ME	PE	GR24A4050	Computational Fluid Dynamics
4	EEE	PE	GR24A4051	Electrical and Hybrid Vehicles

PROFESSIONAL ELECTIVE – IV				
S. No.	**BOS**	**Group**	**Course Code**	**Course**
1	ME	PE	GR24A4052	Tribology
2	ME	PE	GR24A4053	Design for Manufacturing Assembly
3	ME	PE	GR24A4054	Soft Computing Techniques in Mechanical Engineering
4	ME	PE	GR24A4055	Artificial Intelligence in Mechanical Engineering

IV B.Tech II Semester

S.No.	BOS	Group	Course Code	Course Name	Credits				Int.	Ext.	Total Marks
					L	T	P	Total			
1	ME	PC	GR24A4059	Industrial Engineering and Management	3	0	0	3	40	60	100
2	ME	PC	GR24A4060	Operations Research and Management	2	0	0	2	40	60	100
3		PE-V		Professional Elective-V	3	0	0	3	40	60	100
4		PE-VI		Professional Elective-VI	3	0	0	3	40	60	100
5	ME	PW	GR24A4026	Project Work-Phase II	0	0	12	6	40	60	100
				Total	**11**	**0**	**12**	**17**	**200**	**300**	**500**

PROFESSIONAL ELECTIVE – V				
S. No.	**BOS**	**Group**	**Course Code**	**Course**
1	ME	PE	GR24A4061	Refrigeration and Air Conditioning
2	ME	PE	GR24A4062	Power Plant Engineering
3	ME	PE	GR24A4063	Automobile Engineering
4	ME	PE	GR24A4064	Energy Conservation and Management

PROFESSIONAL ELECTIVE – VI				
S. No.	**BOS**	**Group**	**Course Code**	**Course**
1	ME	PE	GR24A4065	Production Planning and Control
2	ME	PE	GR24A4066	Mechatronics
3	ME	PE	GR24A4067	Microprocessors Applications in Manufacturing
4	ME	PE	GR24A4068	Micro and Nano Manufacturing

PROFESSIONAL ELECTIVES – 3 THREADS

THREAD 1:DESIGN	THREAD 2:THERMAL	THREAD3:MANUFACTURING
Robotics	Refrigeration and Air-Conditioning	Mechanical Measurements
Advanced Strength of Materials	Power Plant Engineering	Material Characterization and Testing
Mechanical Vibrations	Automobile Engineering	Un-Conventional Machining Processes
Industrial Internet of Things	Energy Conservation and Management	Intelligent Manufacturing Systems
Tribology	Renewable Energy Resources	Production Planning and Control
Design for Manufacturing Assembly	Turbomachinery	Mechatronics
Soft Computing Techniques in Mechanical Engineering	Computational Fluid Dynamics	Microprocessors Applications in Manufacturing
Artificial Intelligence in Mechanical Engineering	Electrical and Hybrid Vehicles	Micro and Nano Manufacturing

OPEN ELECTIVES FOR GR24 REGULATIONS

THREAD 1	THREAD 2	OFFERED BY
1. Human Resource Development and Organizational Behavior(GR24A3010) 2. Cyber Lawand Ethics(GR24A3024) 3. Economic Policies in India(GR24A4013) 4. Indian knowledge system(GR24A3023) 5. Personality Development through Life Enlightenment skills(GR24A4012)	1. Engineering Materials for Sustainability(GR24A3009)	**CE**
	2. Geographic Information Systems and Science(GR24A3022)	
	3. Plumbing (Water and Sanitation)(GR24A4011)	
	1. Non-Conventional Energy Sources(GR24A3035)	**EEE**
	2. Concepts of Control Systems(GR24A3046)	
	3. Artificial Neural Networks and Fuzzy Logic(GR24A4037)	
	1. Industrial Automation and Control(GR24A3056)	**ME**
	2. Operations Research(GR24A3034)	
	3. Composite Materials (GR24A3066)	
	1. Digital Electronics For Engineering(GR24A3076)	**ECE**
	2. Sensor Technology(GR24A3085)	
	3. Communication Technologies GR24A4078	
	1. Data Science for Engineers (GR24A3092)	**CSE**
	2. Data Analytics using open source tools (GR24A3103)	
	3. Augmented Reality and Virtual Reality GR24A4096)	
	1.Services Science and Service Operational Management(GR24A4115)	**CSBS**
	2. IT Project Management(GR24A4116)	
	3. Marketing Research and Marketing Management(GR24A4117)	
	1.Basics for java programming (GR24A3133)	**CSE (AIML)**
	2. Introduction to DBMS (GR24A3141)	
	3. Introduction to Data Mining (GR24A4124)	
	1. Introduction to Operating System (GR24A3143)	**CSE (DS)**
	2. Internet of Things (GR24A3145)	
	3. Scripting Languages (GR24A4134)	

I Year
I Semester

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

LINEAR ALGEBRA AND FUNCTION APROXIMATION

Course Code: GR24A1001 **L/T/P/C: 3/1/0/4**

I Year I Semester

Prerequisites: Elementary knowledge of vectors, matrices and pre-calculus.

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. Illustrate the concepts of function approximation with measurement of error.
5. Develop the skill of finding multivariable function optima.

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 orthonormalization 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 and the generalized inverse- Estimation of the least squares error.

UNIT IV

Function approximation tools in engineering: Mean value theorems- Lagrange's mean value theorem, Taylor's theorem (without proof), Approximation off a function by Taylor's series.

The principle of least squares- Function approximation using polynomial, exponential and power curves using matrix notation- Estimating the Mean squared error.

UNIT V

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.

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, R.K.Jain- 3rd edition- New Age publishers
3. 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: **L/T/P/C: 3/1/0/4**

I Year I Semester

Course Outcomes:

1. Assess the specification of water regarding its usage in domestic & Industrial scenarios.
2. Learn the working principles of various energy storage devices, and electrochemical reactions involved in corrosion.
3. Analyze the efficacy of polymers in diverse applications.
4. Distinguish various energy sources to prioritize eco-friendly fuels for environmentally sustainable development.
5. Interpret the role of engineering materials in various sectors.

UNIT I **(8 Lectures)**

Water and its Treatment: Introduction to the hardness of water – Estimation of hardness of water by complexometric method and related numerical problems. Potable water and its specifications - Steps involved in the treatment of potable water - Disinfection of potable water by chlorination and break-point chlorination. Boiler troubles: Sludges, Scales, and Caustic embrittlement. Internal treatment of Boiler feed water - Calgon conditioning - Phosphate conditioning, External treatment methods - Softening of water by ion-exchange processes. Desalination of water – Reverse osmosis

UNIT II **(8 Lectures)**

Battery Chemistry and Corrosion: Introduction - Classification of **Batteries**- primary, and secondary batteries with examples. Basic requirements for commercial batteries. Construction, working and applications of Zn-air and Lithium-ion battery, Applications of Li- ion battery to electric vehicles.

Fuel Cells - Definition, Construction, working principle and applications of Hydrogen- Oxygen fuel cell and Solid oxide fuel cell, Differences between battery and a fuel cell.

Corrosion: Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion, Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection – Sacrificial anode and impressed current methods.

UNIT III **(8 Lectures)**

Polymers: Definition – Classification of polymers with examples – Types of polymerization – addition (free radical addition) and condensation polymerization with examples – Nylon 6:6

Plastics: Plastics: Definition and characteristics- thermoplastic and thermosetting plastics, Preparation, Properties and engineering applications of PVC and Bakelite, Compounding and fabrication of plastics - compression moulding and injection moulding. Fiber-reinforced plastics (FRP).

Conducting Polymers: Characteristics and Classification with examples-mechanism of

conduction in trans-polyacetylene and applications of conducting polymers.
Biodegradable Polymers: Concept and advantages - Polylactic acid and poly vinyl alcohol and their applications.

UNIT IV (8 Lectures)

Energy Resources: Introduction, Calorific value of fuel – HCV, LCV- Dulong's formula. Classification- solid fuels: **Coal** – analysis of coal – proximate and ultimate analysis and their significance. Liquid fuels – **Petroleum** and its refining, cracking types – moving bed catalytic cracking. Knocking – octane and cetane rating, synthetic petrol - Fischer-Tropsch's process; Gaseous fuels – composition and uses of natural gas, LPG and CNG, Biodiesel – Transesterification, advantages.

UNIT V (10 Lectures)

Engineering Materials: Smart materials and their engineering applications: Shape memory materials- Poly L- Lactic acid. Thermoresponse materials- Polyacryl amides, Poly vinyl amides.
Biosensors: Definition, characteristics, classification-, construction & working, applications and advantages of biosensors. Biochips -Definition, advantages, and applications.
Semiconductors: Si and Ge - Preparation, Ultra-purification and Crystal Growth by Zone Refining and Czochralski Crystal Pulling methods, Doping – Epitaxy, Diffusion and Ion-implantation.

Text Books

1. Engineering Chemistry by P.C. Jain and M. Jain; Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
2. Engineering Chemistry, Rama Devi, Venkata Ramana Reddy and Rath, Cengage Learning, 2016.

Reference Books

1. A Textbook of Engineering Chemistry by Shashi Chawla, Dhanpat Rai Publishing Company (P) Ltd., New Delhi.
2. Engineering Chemistry by O.G.Palanna, Tata McGraw Hills Private Ltd.
3. Engineering Chemistry, Shikha Agarwal, Cambridge University Press, 2015.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PROGRAMMING FOR PROBLEM SOLVING

Course Code: GR24A1006 **L/T/P/C: 2/0/0/2**

I Year I Semester

Course Outcomes

1. Design algorithms and flowcharts for problem solving and illustrate the fundamentalsof C language.
2. 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. Demonstrate file handling mechanism, 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 andexplicit 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, voidpointer, null pointer, pointers to arrays and structures, function pointer.

Structures and Unions: Defining structures, declaring and initializing structures, arrays withinstructures, 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 access tofiles, error handling in files.

Preprocessor: Commonly used preprocessor commands like include, define, undef, if, ifdef,ifndef, elif, command line arguments, enumeration data type.

Teaching methodologies:

- Power Point Presentations
- Tutorial Sheets
- Assignments

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, Mc Graw Hill, 4th Edition

G**OKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY**

ELEMENTS OF MECHANICAL ENGINEERING

Course Code: GR24A1012 **L/T/P/C: 1/1/0/1**

I Year I Semester

Course Outcomes

1. Identify different sources of energy and their conversion process.
2. Explain the working principle of hydraulic turbines, pumps, IC engines and refrigeration.
3. Recognize various metal joining processes and power transmission elements.
4. Understand the properties of common engineering materials and their applications in engineering industry.
5. Discuss the working of conventional machine tools, machining processes, tools and accessories.

UNIT I

Basic concepts of Thermodynamics: Introduction, states, concept of work, heat, temperature; Zeroth, 1st, 2nd and 3rd laws of thermodynamics. Concept of internal energy, enthalpy and entropy

UNIT II

Boilers: Introduction to boilers, classification, Lancashire boiler, Babcock and Wilcox boiler. Introduction to boiler mountings and accessories (no sketches).

Turbines: Hydraulic Turbines, Steam turbines, gas turbines, Compressors and Pumps - Classification, Principles and operations, Advantages and Disadvantages

UNIT III

Internal Combustion Engines

Classification, I.C. Engines parts, 2 and 4 stroke petrol and 4-stroke diesel engines. P-V diagrams of Otto and Diesel cycles. Simple problems on indicated power, brake power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency and specific fuel consumption.

Refrigeration and Air conditioning

Refrigeration - Definitions - Refrigerating effect, Ton of Refrigeration, Ice making capacity, COP, relative COP, Unit of Refrigeration. Refrigerants, Properties of refrigerants, List of commonly used refrigerants. Principle and working of vapor compression refrigeration.

UNIT IV

Properties, Composition and Industrial Applications of engineering materials

Metals - Ferrous: cast iron, tool steels and stainless steels and nonferrous: aluminum, brass, bronze. Polymers Thermoplastics and thermosetting polymers. Ceramics - Glass, optical fiber glass, cermets. Composites - Fiber reinforced composites, Metal Matrix Composites Smart Materials Piezoelectric materials, shape memory alloys, semiconductors and insulators.

Joining Processes: Soldering, Brazing and Welding

Definitions. Classification and methods of soldering, brazing and welding. Brief description of arc welding, oxy-acetylene welding, TIG welding, and MIG welding.

Power Transmitting Devices: Belt Drives and Gear Drives Definitions advantages and disadvantages**.**

UNIT V

Lathe - Principle of working of a centre lathe. Parts of a lathe. Operations on lathe - Turning, Facing. Knurling. Thread Cutting. Drilling. Specification of Lathe

Milling Machine- Principle of milling, types of milling machines. Working of horizontal and vertical milling machines. Milling processes - plane milling, end milling.

Advanced Manufacturing Systems

Computer Numerical Control (CNC): Introduction, Computer Aided Product Life Cycle, components of CNC, 3D Printing, Applications

Robots: Robot anatomy, joints and links, common robot configurations. Applications of Robots in material handling, processing and assembly and inspection.

Textbooks:

1. Elements of Mechanical Engineering, K. R. Gopalakrishna, Subhas Publications, Bangalore, 2008.
2. Elements of Mechanical Engineering, Vol.-1 & 2, Hajra Choudhury, Media Promoters, New Delhi, 2001.

Reference Books:

1. Elements of Mechanical Engineering, R.K. Rajput, Firewall Media, 2005.
2. CAD/CAM/CIM, Dr. P Radhakrishnan, 3rd edition, New Age International Publishers, New Delhi 2016
3. Introduction to Robotics: Mechanics And Control, Craig, J. J., 2nd Ed.Addison-Wesley Publishing Company, Readong, MA, 1989.
4. Introduction to Engineering Materials", B.K. Agrawal,Tata McGraHill Publication, New Delhi. 2014
5. Thermal Science and Engineering", Dr. D.S. Kumar, S.K. Kataria & sons Publication, New Delhi. 2015

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

GRAPHICS FOR ENGINEERS

Course Code: GR24A1016 **L/T/P/C:**

1/0/4/3

I Year I Semester

Course Outcomes

1. Generate two dimensional drawings and apply AutoCAD commands.
2. Interpret projection methods and draw projections of line or point objects.
3. Imagine and generate multi-view projections of planes and solid objects in different positions
4. Construct and interpret sectional views and develop solid surfaces.
5. Create isometric drawings from given orthographic views and familiar with isometric to orthographic transformations.

UNIT I

Introduction to AutoCAD software: user interface, tool bar -draw, modify, dimension, layers, setting drawing area, status bar, print setup, generation of two-dimensional drawings.

Construction of Engineering Curves- Ellipse, Parabola and Hyperbola -general method only.

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 regular plane figures like triangle, square, pentagon, hexagon, and circle; projections of planes -inclined to one reference plane only.

Projections of solids - definition and types of right regular solids objects like prism, cylinder, pyramid, and cone; projections of solids -axis inclined to one reference plane only.

UNIT IV

Sections of solids- Section and sectional views of right regular solids like Prism, Cylinder, Pyramid and Cone – Auxiliary Views.

Development of surfaces- Development of surfaces of Right Regular Solids like Prism, Pyramid, Cylinder and Cone.

UNIT V

Isometric views– isomeric views of lines, planes (polygons) and solids (prism, cylinder, pyramid, and cone); generation of Isometric line diagrams. World Coordinate System, User Coordinate System.

Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

Text Books:

1. Engineering Drawing by N. D. Bhatt, Fiftieth Revised and Enlarged Edition:2011, Charotar Publishing House Pvt. Ltd.
2. Engineering Graphics by Basant Agrawal and C M Agrawal, fifth re-print 2011, Tata McGraw Hill Education Private Limited, New Delhi.

Reference Books:

1. Engineering Graphics with AutoCAD 2020 by James D. Bethune, Copyright © 2020 by Pearson Education, Inc. All rights reserved.
2 Engineering Graphics by M. B. Shah, B. C. Rana, S. N. Varma, Copyright © 2011 Dorling Kindersley (India) Pvt. Ltd, Licensees of Pearson Education in South Asia.
3. Engineering Drawing and Graphics by K Venu Gopal /New Age International Pvt. Ltd, Publishers, fifth edition, 2002.
4. Engineering Graphics by Koushik Kumar, Apurba Kumar Roy, Chikesh Ranjan, S Chand and Company limited, first edition 2019.
5. Engineering Drawing with Auto Cad by B. V. R. Gupta, M. Raja Roy, IK International Pub., 2009.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING CHEMISTRY LAB

Course Code: GR24A1019 **L/T/P/C: 0/0/3/1.5**

I Year I Semester

Course Outcomes:

1. Determination of parameters like hardness of water chloride content in water
2. Able to handle instruments like conductometer and potentiometer to find out the concentrations of acids and bases.
3. Estimate the amount of metal ion present in a given sample.
4. Prepare polymers like bakelite, nylon-6, and aspirin in the laboratory.
5. Find out the physical properties of fluids like adsorption, surface tension, and viscosity.

List of Experiments

1. Determination of Total Hardness of water by a complexometric method using EDTA.
2. Determination of Chloride content of water by Argentometry.
3. Redox titration: Estimation of Ferrous ion using standard $KMnO_4$ bY Permanganometry.
4. Estimation of HCl by Conductometric titrations.
5. Estimation of Ferrous ion by Potentiometry using dichromate.
6. Determination of rate of corrosion of mild steel in the presence and absence of inhibitor.
7. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
8. Determination of Viscosity of liquid by using Ostwald's Viscometer.
9. Determination of Surface tension of liquid by using Stalagmometer.
10. Determination of Partition Coefficient of Acetic acid between n-butanol and water.
11. Preparation of phenol-formaldehyde resin (Bakelite).
12. Synthesis of Aspirin.

Reference Books

1. Vogel's textbook of Practical Organic Chemistry, 5^{th} Edition.
2. A Textbook on Experiments and Calculations in Engineering Chemistry-S. S. Dara, S Chand & Company; 9^{th} edition.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PROGRAMMING FOR PROBLEM SOLVING LAB

Course Code: GR24A1021 **L/T/P/C: 0/0/3/1.5**

I Year I Semester

Course Outcomes:

1. Translate algorithms into a working program and analyze and debug the codes usingbasics 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

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

TASK 2

a. Write a C program to swap two numbers using the following:
   (i) Using third variable
   (ii) Without using third variable
   (iii) Using bitwise operators
b. 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

a. Write a C program to add two numbers without using arithmetic operators in C.
b. Write a C program to determine whether a number is a power of 2 or not using bitwise operator and ternary operator.
c. Write a C program to check whether a number is even or odd using bitwise operator and ternaryoperator.

TASK 4

a. Write a C program to find the roots of a quadratic equation using if-else.
b. Write a C program to input electricity unit charges and calculate total electricity bill according 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

c. Write a menu driven C program to implement a simple arithmetic calculator.
d. Write a C program to display number of days in month using switch case (The input is month number 1 -12).

TASK 5

a. Write a C program check whether a given number is Perfect number or not.
b. Write a C program check whether a given number is Palindrome number or not.
c. Write a C program check whether a given number is Armstrong number or not.
d. Write a C program check whether a given number is Strong number or not.

TASK 6

a. 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
```

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

TASK 7

a. Write a C programto find sum, average and minimum and maximum in a list of numbers.
b. Write a C program to implement Linear search.
c. Write a C program to implement Binary search.

TASK 8

a. Write a C program to implement matrix addition.
b. Write a C program to implement matrix multiplication.

TASK 9

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

TASK 10

a. Write a C program to implement factorial of a given integer using recursive and non-

recursive functions.

b. Write a C programto find the GCD (greatest common divisor) of two given integers using recursive and non-recursive functions.
c. Write a C program to print first 'n' terms of Fibonacci series using recursive and non-recursive functions.

TASK 11

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

TASK 12

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

TASK 13

a. 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 byrollno
   (iii)Print the names of the students having the highest test score
b. Write a C program that uses structures and functions to perform addition and product of two complex numbers? (use structures and functions)

TASK 14

a. Write a C program to merge two files into a third file.
b. 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.
c. Write a C program to append a file and display it.

TASK 15

a. Write a C program to find sum of 'n' numbers using command line arguments.
b. Write a C program to implement following pre-processor directives:
i. define ii. undef iii. ifdef iv. ifndef.
c. 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, PrenticeHall 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, McGraw Hill, 4th Edition.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING WORKSHOP LAB

Course Code: GR24A1025 **L/T/P/C: 1/0/ 3/2.5**

I B.Tech I Semester

Course Outcomes

1. Identify workshop tools and their operational capabilities.
2. Practice on manufacturing of components using workshop trades including Carpentry, Fitting, Tin Smithy, Welding, Foundry and Black Smithy.
3. Apply basic electrical engineering knowledge for House Wiring Practice.
4. Develop various trades applicable to industries.
5. Create hands on experience for common trades with taking safety precautions.

TRADES FOR EXERCISES: At least two tasks from each trade

1. **Carpentry:** Demonstration and practice of carpentry tools
   Task 1: Preparation of T- Lap Joint
   Task 2: Preparation of Dove Tail Joint.

2. **Fitting -** Demonstration and practice of fitting tools
   Task 3: Preparation of Straight Fit
   Task 4: Preparation of V-Fit

3. **Tin-Smithy -** Demonstration and practice of Tin Smithy tools
   Task 5: Preparation of Rectangular Tray
   Task 6: Preparation of Open Scoop

4. **Welding :** Demonstration and practice on Arc Welding tools
   Task 7: Preparation of Lap joint,
   Task 8: Preparation of Butt Joint

5. **House-wiring:** Demonstration and practice on House Wiring tools
   Task 9: Exercise on One way switch controlled two bulbs in series one bulb in Parallel.
   Task 10: Exercise on Stair Case connection.

6. **Foundry :** Demonstration and practice on Foundry tools
   Task 11: Preparation of Mould using Single Piece Pattern.
   Task 12: Preparation of Mould using Split Piece Pattern.

7. **Black Smithy:** Demonstration and practice on Black Smithy tools
   Task 13: Preparation of U-Hook
   Task 14: Preparation of S-Hook

8. Preparation of a prototype model of any trade under G-LOBE activity.

Text Books

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019.
2. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5thEdn. 2015.
3. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Elements of Workshop Technology, Vol. II by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 12th edition
3. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
4. Technology of machine tools, Steve F. Krar, Arthur R. Gill and Peter Smid, McGraw Hill Education (India) Pt. Ltd., 2013.
5. Engineering Practices Laboratory Manual, Ramesh Babu.V., VRB Publishers Private Limited, Chennai, Revised edition, 2013 – 2014.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DESIGN THINKING

Course Code: GR24A1028 **L/T/P/C: 2/0/0/0**

I Year I Semester

Course Outcomes:

1. Use design thinking and hypothesis-driven innovation processes to develop viable solutions to user challenges.
2. Use multiple brainstorming techniques to find innovative solutions.
3. Develop and test a business model or business case to support the viability of the solution.
4. Prototype a solution to a user challenge.
5. Investigate the cultural, emotional, technological, and business factors relevant to developing a new product or service design concept.

UNIT I

Revisiting Design Thinking :Creative thinking as basis of innovation; Empathy process for deep understanding of challenge with practical ingenuity; Making sense of observations and insights; Defining a point of view and context Design thinking skills for Problem Discovery, Definition, and Ideation – Identifying problems in daily lives and in the world at large, Understanding user and customer perspectives.

UNIT II

Ideation Process: Clear Articulation of problem statement with focus on latent needs; Brainstorming potential solutions; Ideation methods with case-study based approach to using Systematic Inventive Thinking (SIT) Methods such as Addition, Subtraction, Multiplication, Division and Task Unification Strategic Innovation for competition in future: Linear Innovation vs. non-linear innovation, Understanding and identifying weak signals, 3-box thinking, 3-Box framework and Box-3 ideation.

UNIT III

Designing Customer Experience: Understanding Innovation through Design Thinking; Enhancing Customer Experience; Service Design and Development Process and Case Studies; Service Experience Cycle and Case Studies.

UNIT IV

Sustainable Design Approaches: Concern for Environment and Sustainability in Design, Case Studies to understand good Design for Environment (DFE) Decisions; Design Considerations in the five stages of the Product Life Cycle.

UNIT V Integrative Engineering Design Solutions: Identifying and resolving issues with working in diverse teams, modularizing, prototype building by different engineering disciplines within the team, validated learning with accessible metrics, Capstone Project (Interdisciplinary) Applying Design Thinking Principles and Methods for Ideation and Prototyping, Testing Solution, Refining Solution, and Taking the Solution to the Users.

Text Books

1. 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization, Vijay Kumar, John Wiley & Sons, ISBN: 978-1118083468, 2012.
2. Living with Complexity, Donald A Norman, MIT Press, ISBN: 978-0262528948, 2016.
3. Design Thinking for Entrepreneurs and Small Businesses: Putting the Power of Design to Work, Beverly Rudkin Ingle, A Press, ISBN: 978-1430261810, 2013.

Reference Books

1. Emotionally Durable Design: Objects, Experiences and Empathy, Jonathan Chapman, 2nd Edition, Routledge, ISBN: 978-0415732161, 2015.
2. Innovation Design: How Any Organization Can Leverage Design Thinking to Produce Change, Drive New Ideas, and Deliver Meaningful Solutions, Thomas Lockwood, Edgar Papke, New Page Books, ISBN: 978-1632651167, 2017.
3. Design Thinking Business Analysis: Business Concept Mapping Applied, Thomas Frisendal, Springer, ISBN: 978-3642434822, 2012.
4. Chapter 1: A Simple Framework for Leading Innovation, The Three Box Solution, HBR Press, 2016.
5. Design a Better Business: New Tools, Skills and Mindset for Strategy and Innovation, Patrick Van Der Pijl, Justin Lokitz, Lisa Kay Solomon, Erik van der Pluijm, Maarten van Lieshout, Wiley, ISBN: 978-8126565085, 2016.

I Year
II Semester

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

Course Code: GR24A1002 **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 by suggested methods.
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 and mechanics.
4. Apply vector differential operators on scalar and vector fields and apply them to solve some field related problems.
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: LDE of the first order: Solution of Exact, Linear and Bernoulli equations, modeling Newton's law of cooling, growth and decay models.

UNIT II

ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER: LDE with constant coefficients: Complementary function, Particular integrals for *f(x)* of the form e^{ax}, x^n, $cosax$, $sinax$, $e^{ax}V(x)$ and $x\ V(x)$where $V(x)$=$cosax\ and\ sinax$, the method of variation of parameters, LDE with variable coefficients: Cauchy's homogeneous equation.

UNIT III

MULTIPLE INTEGRALS: Double integrals: Evaluation of Double Integrals, change of order of integration (only Cartesian form), change of variables (Cartesian and polar coordinates) Triple Integrals: Evaluation of triple integrals, change of variables (Cartesian to Spherical and Cylindrical polar coordinates) Applications: Area using the double integral –Volume of a solid using the double and triple integral.

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 publishing house, 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.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

APPLIED PHYSICS

Course Code: GR24A1003 **L/T/P/C: 3/1/0/4**

I Year II Semester

Course Outcomes:

1. Solve engineering problems involving quantum nature of radiation and matter waves.
2. Understand the characteristics of semiconductor devices and operation of optoelectronic devices.
3. Identify magnetic and superconducting materials based on their properties for various applications.
4. Analyze the properties of Laser and its propagation in different types of optical fibers.
5. Explore the features of nanomaterials.

UNIT I

Quantum Physics and Solids

Quantum Mechanics: Introduction, Black body radiation, Planck's law, Photoelectric effect-Einstein's Photoelectric equation(quantitative), Wave-Particle duality: de Broglie hypothesis, Davisson and Germer experiment, Heisenberg's uncertainty principle, Born's interpretation of the wave function, Schrodinger's time independent wave equation, Particle in one dimensional infinite potential box.

Solids: Classification of solids into metals, semiconductors, and insulators.

UNIT II

Semiconductors and devices: Intrinsic and extrinsic semiconductors(qualitative) - Hall Effect and its applications, direct and indirect band gap semiconductors, Construction and principle of operation of p-n junction diode, I-V characteristics of p-n junction diode and Zener diode.

Radiative transition: Absorption, Spontaneous and Stimulated emissions, Principle, Construction, Working, Characteristics and Applications: LED and Solar cell.

UNIT III

Magnetic materials and Superconductivity

Magnetic Materials: Introduction, permeability, field intensity, magnetic field induction, magnetisation, magnetic susceptibility, origin of magnetic moment: Bohr magneton, classification of magnetic materials: Ferro, Para, Dia, Antiferro and Ferri, Hysteresis curve based on domain theory of ferromagnetism, Soft and hard magnetic materials, Applications of magnetic materials.

Superconductivity: Superconductivity phenomenon, Meissner effect, Type I and Type II superconductors, applications of superconductors.

UNIT IV

Lasers and Fiber Optics

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, Advantages of optical fibers over conventional cables, Types of optical fibers, Acceptance angle-Numerical aperture, Losses associated with optical fibers, Applications of optical fibers.

UNIT V

Nanotechnology: 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.

Text books

1. Engineering Physics, B.K. Pandey, S. Chaturvedi – Cengage Learing.
2. Applied Physics, T. Bhīma Sankaram, BSP Publishers.
3. Engineering Physics, P.K Palanisamy, Scitech Publishers.
4. A textbook of Engineering Physics, Dr. M. N. Avadhanulu, Dr. P.G. Kshirsagar - S. Chand.

Reference Books

1. Fundamentals of Semiconductor Devices, Second Edition, Anderson and Anderson, McGraw Hill.
2. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw- Hill Inc. (1995)
3. Semiconductor Physics and Devices, 4e, Neamen and Biswas, McGraw Hill.
4. Online Course: “Optoelectronic Materials and Devices” by Monica Katiyar and Deepak Guptha on NPTEL.
5. Halliday and Resnick, Physics – Wiley.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING MECHANICS

Course Code: GR24A1015 **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, Determine the forces in the members of the trusses
3. Find the location of centroid and calculate moment of inertia of a given section and bodies
4. Solve Kinematic Problems of uniform motion and uniform accelerated motion
5. Solve Dynamic problems using Newton's Second Law, work energy and Impulse Momentum Equations.

UNIT I

Introduction to Engineering Mechanics - Force Systems: Basic concepts, Particle equilibrium in 2-D ; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, – 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.

Analysis of Trusses: Introduction, Classification of trusses, Assumptions made in the analysis of perfect truss, Methods of Analysis of Trusses- Method of Joints and Method of Sections.

UNIT III

Centroid and Center of gravity- Centroid of Areas and Volumes from first principle, centroid of composite sections; Centre of Gravity and its implications.

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; 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 Rectangular box, Cylinder, Cone and Sphere.

UNIT IV

Kinematics of Particles: Rectilinear motion (Uniform motion and uniform accelerated motion), Plane curvilinear motion (rectangular, path, and polar coordinates), Projectile motion, Relative and constrained motion.

UNIT V

Dynamics of Particles ; Newton's 2nd law of motion to solve particle kinetics (rectangular, path, and polar coordinates). energy, power Work-energy method, potential energy, kinetic energy. Impulse-momentum method (linear, angular), Impact (Direct and oblique).

Text Books

1. Singer's Engineering Mechanics: Statics and Dynamics, 2011 Edition by K. Vijay Kumar Reddy, J. Suresh Kumar , B.S. Publications.
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 International Edition, 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.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGLISH

Course Code: GR24A1005 **L/T/P/C: 2/0/0/2**

I Year II 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. Convey complex ideas clearly and accurately in academic and professional settings

UNIT I

Chapter entitled '***Toasted English*' by R.K.Narayan** from ***"English: Language, Context and Culture"*** published by Orient BlackSwan, Hyderabad.

Vocabulary: The Concept of Word Formation -The Use of Prefixes and Suffixes - Acquaintance with Prefixes and Suffixes from Foreign Languages to form Derivatives - Synonyms and Antonyms

Grammar: Identifying Common Errors in Writing with Reference to Articles and Prepositions.

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 – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT II

Chapter entitled **'Appro JRD' by Sudha Murthy** from ***"English: Language, Context and Culture"published*** by Orient BlackSwan, Hyderabad.

Vocabulary: Words Often Misspelt - Homophones, Homonyms and Homographs

Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement andSubject-verb Agreement.

Reading: Sub-Skills of Reading – Skimming and Scanning – Exercises for Practice

Writing: and Style of Writing- Defining /Describing People, Objects, Places and Events – Classifying- Providing Examples or Evidence.

UNIT III

Chapter entitled **'Lessons from Online Learning' by F.Haider Alvi, Deborah Hurst et al** from ***"English: Language, Context and Culture"*** published by Orient BlackSwan, Hyderabad.

Vocabulary: Words Often Confused - Words from Foreign Languages and their Use in English.

Grammar: Identifying Common Errors in Writing with Reference to Misplaced ModifiersB and Tenses.

Reading: Sub-Skills of Reading – Intensive Reading and Extensive Reading – Exercises for

Practice.

Writing: Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Email Etiquette, Job Application with CV/Resume.

UNIT IV

Chapter entitled **'Art and Literature' by Abdul Kalam** from ***"English: Language, Context and Culture"*** published by Orient BlackSwan, Hyderabad.

Vocabulary: Standard Abbreviations in English

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Survey, Question, Read, Recite and Review (SQ3R Method) - Exercises for Practice

Writing: Writing Practices- Essay Writing-Writing Introduction and Conclusion -Précis Writing.

UNIT V

Chapter entitled **'Go, Kiss the World' by Subroto Bagchi** from ***"English: Language, Context andCulture"*** published by Orient BlackSwan, Hyderabad.

Vocabulary: Technical Vocabulary and their Usage

Grammar: Common Errors in English (*Covering all the other aspects of grammar which were notcovered in the previous units*)

Reading: Reading Comprehension-Exercises for Practice

Writing: Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Note: Listening and Speaking Skills which are given under Unit-6 in AICTE Model Curriculum are coveredin the syllabus of ELCS Lab Course.

- **Note: 1**. As the syllabus of English given in AICTE *Model Curriculum-2018 for B.Tech First Year is* ***Open-ended***, besides following the prescribed textbook, it is required to prepare teaching/learning materials **by the teachers collectively** in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning in the class.
- **Note**: **2**.Based on the recommendations of NEP2020, teachers are requested to be flexible to adopt Blended Learning in dealing with the course contents .They are advised to teach 40 percent of each topic from the syllabus in blended mode.

Text Books

1. "English: Language, Context and Culture" by Orient BlackSwan Pvt. Ltd, Hyderabad. 2022. Print.Reference Books
1. Effective Academic Writing by Liss and Davis (OUP)
2. Richards, Jack C. (2022) Interchange Series. Introduction, 1,2,3. Cambridge University Press
3. Wood, F.T. (2007). Remedial English Grammar. Macmillan.
4. Chaudhuri, Santanu Sinha. (2018). Learn English: A Fun Book of Functional Language, Grammar and Vocabulary. (2nd ed.,). Sage Publications India Pvt. Ltd.
5. (2019). Technical Communication. Wiley India Pvt. Ltd.
6. Vishwamohan, Aysha. (2013). English for Technical Communication for Engineering Students.Mc Graw-Hill Education India Pvt. Ltd.

7. Swan, Michael. (2016). Practical English Usage. Oxford University Press. Fourth Edition.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DATA STRUCTURES

Course Code: GR24A1017 **L/T/P/C: 2/0/0/2**

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 operationson stack and queue and their applications.
3. Develop algorithms for various operations on linked lists and convert themto 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 and implementation 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 v/s arrays, representation ofa 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).

Teaching methodologies:

- Power Point Presentations
- Tutorial Sheets
- Assignments

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

PYTHON PROGRAMMING

Course Code: GR24A1027 **L/T/P/C: 1/0/0/1**

I Year II Semester

Course Outcomes:

1. Demonstrate the fundamental concepts and flow control in Python.
2. Implement different sequence types and file handling operations.
3. Design python programs using functions and exception handling mechanisms.
4. Develop programs with object oriented programming features and modules.
5. Design GUI based applications using Tkint.

UNIT I

Introduction: features of Python-Interactive execution, comments, types, variables, operators, expressions, Statements-assignment, input, print.

Control flow: if, if-else, if-elif-else Statements, Nested Decision Structures, Loops- while loop, for loop, Nested Loops, break, continue, pass statement.

UNIT II

Sequences: Strings, Lists and Tuples-basic operations and functions, iterating over sequences, Sets and Dictionaries- operations and functions, Python program examples.

Files-operations-opening, reading, writing, closing, file positions.

UNIT III

Exceptions: raising and handling exceptions, try/except statements, finally clause, standard exceptions, custom exceptions.

Functions: definition, call, scope and lifetime of variables, keyword arguments, default parameter values, variable length arguments, recursive functions, Lambda function.

UNIT IV

Modules: Modules, Standard Modules, Importing Modules, Namespaces and Packages.

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: Introduction, Tkinter, Widgets (Buttons, Canvas, Frame, Label, Menu, Entry, Text, Scrollbar, Combobox, Listbox), event driven programming-events, callbacks, binding, layout management- geometry managers: pack and grid, creating GUI based applications in Python.

Teaching methodologies:

- Power Point Presentations
- Tutorial Sheets
- Assignments

Text Books

1. Exploring Python, Timothy A. Budd, McGraw Hill Publications.
2. Introduction to Programming using Python, Y.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. Internet of Things - A hands on approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.
3. Fundamentals of Python, K. A. Lambert, B.L. Juneja, Cengage Learning. 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

APPLIED PHYSICS LAB

Course Code: GR24A1018 **L/T/P/C: 0/0/3/1.5**

I Year II Semester

Course Outcomes:

1. Compare the behavior of Solar cells and LED.
2. Analyze the behavior of magnetic fields and their applications.
3. Infer the work function of a material through photoelectric effect.
4. Discuss the characteristics of Lasers and infer the losses in optical fibers.
5. Estimate the frequency of tuning fork through the phenomena of resonance.

List of Experiments:

1. Energy gap of P-N junction diode: To determine the energy gap of a semiconductor diode.
2. Solar Cell: To study the V-I Characteristics of solar cell.
3. Light emitting diode: To study V-I characteristics of light emitting diode.
4. Stewart – Gee's experiment: Determination of magnetic field along the axis of a current carrying coil.
5. Hall effect: To determine Hall co-efficient of a given semiconductor.
6. Photoelectric effect: To determine work function of a given material and Planck's constant.
7. LASER: To study the V-I characteristics of LASER sources.
8. Optical fiber: To determine the bending losses of Optical fibers.
9. Optical fiber: To determine the Numerical Aperture of Optical fibers.
10. Melde's experiment: To determine the frequency of a tuning fork using Melde's arrangement.

Note: Any 8 experiments are to be performed.

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

Course Code: GR24A1020 **L/T/P/C: 0/0/2/1**

I Year II 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 knowledge collaboratively 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:

a. Computer Assisted Language Learning (CALL) Lab
b. 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– Weak Forms and Strong Forms in Context– Word Stress and Rhythm.

Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.

ICS Lab:

Understand: Features of Good Conversation – Non-verbal Communication.

Practice: Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions- Telephone Etiquette, Rapid Round –Memory Games.

Exercise III

CALL Lab:

Understand: Intonation--Errors in Pronunciation-the Influence of Mother Tongue (MTI).

Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronounciation.

ICS Lab:
Understand: Public Speaking – Exposure to Structured Talks.
Practice: 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

DATA STRUCTURES LAB

Course Code: GR24A1024 **L/T/P/C: 1/0/4/3**

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, deleteand 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.

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.

II Year
I Semester

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

KINEMATICS OF MACHINERY

Course Code: GR24A2039 **L/T/P/C: 3/0/0/3**

II Year I Semester

Course Outcomes

1. Understand the various elements in mechanism and the inversions of commonly used mechanisms such as four bar, slider crank and double slider crank mechanisms.
2. Draw the velocity and acceleration polygons for a given configuration of a mechanism.
3. Understand the conditions for straight line motion mechanisms, steering mechanism and the usage of Hooke's joint.
4. Draw the displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
5. Calculate the number of teeth and velocity ratio required for a given combination of gears.

UNIT I

Mechanisms: Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematics pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully and incompletely constrained.

Mechanism and Machines – Mobility of Mechanisms: Grubler's criterion, classification of machines – kinematics chain – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains, Mechanical Advantage.

UNIT II

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

Plane motion of body: Instantaneous center of rotation- centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method. Kliens construction - Coriolis acceleration - determination of Coriolis component of acceleration

Analysis of Mechanisms: Analysis of slider crank chain for displacement- velocity and acceleration of slider – Acceleration diagram for a given mechanism.

UNIT III

Straight-line motion mechanisms: Exact and approximate copied and generated types – Peaucellier - Hart - Scott Russel – Grasshopper – Watt -Tchebicheff's and Robert Mechanism - Pantographs

Steering gears: Conditions for correct steering – Davis Steering gear, Ackerman's steering gear.

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

UNIT IV

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

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

UNIT V

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

Forms of teeth, cycloidal and involutes profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference – expressions for arc of contact and path of contact of Pinion & Gear and Pinion & Rack Arrangements– Introduction to Helical – Bevel and worm gearing

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

Text Books

1. Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.
2. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

Reference Books

1. Sadhu Sigh, "Theory of Machines", Third Edition, Pearson Education, 2012.
2. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
3. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
4. Rao. J.S. and Dukkipati. R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
5. ASHOK G. AMBEKAR, "Mechanism and Machine Theory", PHI Learning, 2007.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

METALLURGY AND MATERIAL SCIENCE

Course Code: GR24A2040 **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 iron-iron carbon 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, effect of grains on the properties of metal, determination of grain size, Point and line defects, strengthening mechanisms, Tensile test, torsion test, Impact test, Fatigue test, Young's modulus, Hardness measurements by Rockwell, Brinell, Vickers method.

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 microstructures, properties of Austenite, Ferrite, Martensite.

UNIT III

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

UNIT IV

Ferrous & Non ferrous metals: Steels, Types of steels, Properties and applications of Plain carbon steels, Alloy Steels, High and low alloy 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, super alloys- Inconel and nimonic, Titanium and its alloys.

UNIT V

Composites and Modern Ceramics: Composite materials: Classification of composites, various methods of manufacturing composites, particle–reinforced materials, fibre-reinforced materials, metal–matrix composites, ceramics and its properties, Properties and applications of glass, cermets, WC, TiC, TaC, SiC, Si3N4, CBN.

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.
3. S.H. Avener, Introduction to Physical Metallurgy, 2nd ed., Tata McGraw-Hill Education, 2011.
4. G.E. Dieter, Mechanical Metallurgy, 2nd ed., McGraw-Hill, 1976.
5. J. Roesler, H. Harders, M. Baeker, Mechanical Behaviour of Engineering Materials: Metals, Ceramics, Polymers, and Composites, Springer-Verlag, 2007.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Course Code: GR24A2013 **L/T/P/C: 3/0/0/3**

II Year I Semester

Course Outcomes:

1. Analyze and solve DC and AC Circuits.
2. Choose appropriate LT switchgear used for electrical installations.
3. Summarize the working principles of Electrical Machines and Transformers.
4. Categorize various types of diodes.
5. Interpret the different modes of Operations of a transistor.

UNIT I

D.C. Circuits: Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, analysis of simple circuits with dc excitation.

A.C. Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single- phase ac circuits, Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT II

Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

UNIT III

Electrical Machines: Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency, Three-phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equations and Speed control of DC motors, Construction and working principle of Three-phase Induction motor, Torques equations and Speed control of Three-phase induction motor. Construction and working principle of synchronous generators.

UNIT IV

P-N Junction and Zener Diode: Principle of Operation Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Zener diode characteristics and applications.

Rectifiers and Filters: P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters.

UNIT V

Bipolar Junction Transistor (BJT): Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE, CB and CC configurations.

Field Effect Transistor (FET): Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

Text Books

1. "Basic Electrical and electronics Engineering", –M S Sukija TK Nagasarkar Oxford University
2. "Basic Electrical and electronics Engineering",-D P Kothari. I J Nagarath, McGraw Hill Education

Reference Books

1. "Electronic Devices and Circuits", – R. L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. "Electronic Devices and Circuits", – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.
3. "Network Theory", by Sudhakar, Shyam Mohan Palli, TMH.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

STRENGTH OF MATERIALS

Course Code: GR24A2041 **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. Calculate the slope and deflections in beamssubjected to transverse loads.
4. Analyze the stresses due to maximum shear Force and maximum bending momentacting on the beams.
5. Solve the torsion problems in bars and Analyze various situations involving structural members subjected with stresses on oblique planes.

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, 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

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 (Cantilever beams and Simply Supported beams)

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UNIT IV

Bending stresses: Theory of simple bending, assumptions, derivation of flexural formula, Bending of common cross sections (rectangular, I,T,L) with respective centroidal & parallel axes, bending stress distribution diagrams, moment of resistanceand section modulus.

Shear stresses: Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for I, T and L symmetrical sections, maximum and average shear stresses, shear connection between flange & web.

UNIT V

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.

Principal stresses and strains: Normal and shear stresses on any oblique plane - Concept of principal planes, derivation for principal stresses and maximum shearstress, position of principal planes & planes of maximum shear, graphical solution using Mohr's circle of stresses.

Text Books

1. R.K Bansal, A Text book of Strength of Materials (in S.I units), Laxmi Publications, 6th Edition, 2022
2. R.S. Khurmi, N. Khurmi, A Text book of Strength of Materials, S Chand and Company Limited, 26th Edition, 2019

Reference Books

1. S S Bhavikatti, Strength of Materials, Vikas Publications, 5th Edition, 2021.
2. Dr Sadhu Singh, Strength of Materials, Khanna Book Publishing Company, 1st Edition, 2016.
3. S S Rattan, Strength of Materials, McGraw-Hill Education (India) Pvt Limited, 3rd Edition, 2017.
4. Egor P. Popov, Mechanics of Materials, Pearson, 2nd Edition, 2015.
5. Stephan Timoshenko, Strength of Materials, CBS Publications and Distributors, 3rd Edition, 2002.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMODYNAMICS

Course Code: GR24A2042 **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 flowenergy equation.
3. Analyze the problems on heat engines, refrigeration and entropy by applyingsecond 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 2/e - P K Nag /TMH, III Edition, 2010
2. Fundamentals of Thermodynamics – Sonntag, Borgnakke and van wylen / Johniley & sons (ASIA) Pvt Ltd.4th Edition, 2014

Reference Books

1. Engineering Thermodynamics – Jones & Dugan, TMH, 3rd edition, 2016
2. Thermodynamics – An Engineering Approach – Yunus Cengel & Boles /TMH, 2018
3. Thermodynamics – J.P.Holman / McGraw Hill, 4th edition , 2012
4. An introduction to Thermodynamics / YVC Rao / New Age International, 6th edition, 2011
5. Thermal Engineering by Dr R K Rajput, Laksmi Publications, 11th edition , 2019

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MANUFACTURING ENGINEERING

Course Code: GR24A2048 L/T/P/C: 2/0/0/2

II B.Tech I Semester

Course Outcomes

1. Impart knowledge on role and value of production and identify basic productionprocesses.
2. Introduction to methods of joining that shows a comprehensive understanding oftools, materials, equipment, and processes.
3. Apply critical thinking skills for development and evaluating sheet metal formingprocesses.
4. Identify and use the materials, tools, machines, and techniques used in variousforming 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- Gating System–Moulding machines–Types of moulding machines – Types of Melting furnaces–Working principle of Special casting processes–Shell Mould casting, investment casting – Ceramic mould– Lost Wax process – Pressure die casting – Centrifugal casting – CO2 process– Sand Casting defects – Inspection of Castings.

UNIT II

Joining Processes: Types of joining methods-Classification of welding process- Fusion welding processes- Types of Gas welding–Equipments used–Flame characteristics–Filler and Flux materials-Arc welding equipments –Types of 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 welding processes-Thermit welding–Ultrasonic welding-Electron beam welding- LASER beam welding-Plasma arc welding–Friction welding– Diffusion welding–Explosive 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- Blanking and Piercing operations– Stretch forming operations —

Formability of sheet metal – Testing 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, 2008
2. S.Gowri, P.Hariharan, and A.Suresh Babu, "Manufacturing Technology 1", Pearson Education , 2008.

Reference books

1. P.N. Rao,"ManufacturingTechnology",Tata McGraw-Hill Publishing Limited, II Edition, 2017.
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, IVEdition, 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,2020.

Teaching Methodology:

- Power point Presentations
- Working models
- White board & marker

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

METALLURGY AND MATERIAL SCIENCE LAB

Course Code: GR24A2044 **L/T/P/C: 0/0/2/1**

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

Teaching Methodology: Experimental Test rigs & Microscopes

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

STRENGTH OF MATERIALS LAB

CourseCode: GR24A2043 **L/T/P/C: 0/0/2/1**

II Year I Semester

Course Outcomes

1. Determine the Young's modulus for ductile materials and analyze the compressionstrength of both ductile and brittle materials.
2. Analyze the various points on stress strain diagram and calculate the modulus ofelasticity 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 variousmaterials.

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 simply supported 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 Torsiontesting 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

MANUFACTURING ENGINEERING LAB

Course Code: GR24A2050 L/T/P/C: 0/0/2/1

II Year I 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-1Exercise

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

VALUE ETHICS AND GENDER CULTURE

Course Code: GR24A2002 **L/T/P/C: 2/0/0/0**

Course Outcomes:

1. To enable the student to understand the core values that shapes the ethical behaviour. And Student will be able to realize the significance of ethical human conduct and self-development
2. Students will be able to inculcate positive thinking, dignity of labour and religious tolerance.
3. The students will learn the rights and responsibilities as an employee and a team member.
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 Empowering students to understand and respond to gender violence.

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

Text Books

1. Professional Ethics Includes Human Values (2nd Edition) By R Subramanian, Oxford University Press, 2017.
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, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu and published by Telugu Akademi, Hyderabad,Telangana State in the year 2015.

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

II Year
II Semester

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMAL ENGINEERIG

Course Code: 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, Eighth Edition, 2014
2. Thermal Engineering / Rajput / Lakshmi Publications, Eleventh Edition,2020

Reference Books

1. I C Engines – Mathur & Sharma – DhanpathRai& Sons. 2016
2. Engineering fundamentals of IC Engines – Pulkrabek / Pearson /PHI,2nd edition, 2003
3. Thermal Engineering / Rudramoorthy– TMH, 2017
4. Thermodynamics & Heat Engines / B. Yadav/ Central Book, 7th revised edition, 2001
5. Applied Thermodynamics by Dr.R.Yadav, CP Publications, 6th revised edition,2006

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

FLUID MECHANICS AND FLUID MACHINES

Course Code: 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 through circular 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, 4th edition,2014
2. Fluid Mechanics and Hydraulic Machines by R K Rajput.Laxmi Publications(P)Ltd., 2019, 10th edition

Reference Books

1. A Textbook of Fluid Mechanics and Hydraulic Machines by Dr R.K. Bansal, Laxmi Publications(P) Ltd.,2019, 9th edition.
2. Introduction to Fluid Mechanics and Fluid Machines By S K Som, Gautam Biswas,Mc Graw Hill , 2012, 5th edition
3. Fluid Mechanics by F M White, Tata Mcgraw Hill Publications, 6th edition , 2016
4. Fluid Mechanics & Hydraulic Machines: Problems & Solutions byK.Subrmanya/TMH private limited, 16th edition, 2011,
5. Hydraulic Machines by Banga & Sharma, Khanna Publishers, 3rd edition , 2008.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DYNAMICS OF MACHINERY

Course Code: 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. Rattan, S.S, "Theory of Machines", 4th Edition, Tata McGraw-Hill, 2014.
2. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

Reference Books

1. Sadhu Sigh, "Theory of Machines", Third Edition, Pearson Education, 2012.
2. R. S. Khurmi, J. K. Gupta, "Theory of Machines", S Chand publishers, 2015
3. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
4. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
5. Rao. J.S. and Dukkipati. R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

COMPUTATIONAL MATHEMATICS FOR ENGINEERS

Course Code:GR24A2008 **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 techniques for univariate and bivariate data using Gaussian and cubic spline methods
3. Apply numerical techniques to find eigen values and corresponding eigenvectors of a matrix
4. Apply numerical techniques in differentiation and integration.
5. Apply finite difference method to solve IVP in ODE and PDE.

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 solve a linear algebraic system

UNIT II
INTERPOLATION AND CUBIC SPLINE

Interpolation with non-uniform data: Newton divided differences formula, Hermite interpolation, Interpolation with uniform data- Newton and Gauss formulas-Newton's bivariate interpolation for uniform data, Fitting natural cubic spline to data

UNIT III
EIGENVALUES AND EIGENVECTORS

Jacobi iteration method for finding eigenvalues and eigenvectors of a symmetric matrix- Power method and inverse power method for finding the largest and smallest eigenvalues and eigenvectors of a matrix

UNIT IV
NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION

Numerical differentiation using the Newton's forward, backward and central difference formulas. Numerical integration by Trapezoidal rule, Simpson's 1/3rd and $3/8^{th}$ rules, Gauss- Legendre one point, two point and three point rules.

UNIT V
NUMERICAL SOLUTION OF INITIAL AND BOUNDARY VALUE PROBLEMS IN ODE AND PDE

Euler ,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- Solution of Laplace's equation by Jacobi and Successive over relaxation (SOR) methods

TEXTBOOKS

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

REFERENCES

1. GRIET reference manual
2. S.S.Sastry- Introductory methods of numerical analysis- Prentice Hall (India)- Fourth edition- 2010

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MANUFACTURING TECHNOLOGY AND METROLOGY

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

II Year II Semester

Course Outcomes

1. Explain the importance of tool geometry in manufacturing the component.
2. Perform various operations on Lathe machines and reciprocating metal cutting machines
3. Execute different milling operations on various milling, Drilling, Boring and surface finishing machine tools.
4. Identify techniques to minimize errors in measurement.
5. Understand methods and devices for measurement of length, angle, gear& thread parameters, surface roughness and geometric features of parts.

UNIT I

Theory of Metal Cutting: Elementary treatment of metal cutting theory, Elements of cutting process, Classification of Material removal processes, Machine Tools, cutting tools (Single and multi-point) and Nomenclature of Single point cutting tool. Mechanics of metal cutting:

Metal Cutting: Chip formation and types of chips, Orthogonal & oblique Cutting, Tool Wear and Tool Life, Surface Finish, cutting fluids, machinability– MRR, Types of Cutting Tool Materials.

UNIT II

Lathe Machines: working principle and specifications of lathe, Constructional Features of a Centre Lathe, work holding and tool holding devices, Operations Performed on Centre Lathe. **Capstan and Turret Lathes**: construction and differences. Introduction of automatic lathes and CNC Lathes

Reciprocating Machine Tools: Introduction of Shaper, Slotter and Planer machines. Principles of working, Principal parts, specifications, classification, operations performed.

UNIT III

Milling machine: working principle, specifications, classifications of milling machines, Principal features of horizontal, vertical and universal milling machines, milling cutters,Various milling operations

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.

Fundamentals of grinding: Theory of grinding– classification of grinding machines, cylindrical and surface grinding machine, Tool and cutter grinding machine, Different types of abrasives and bonds, specification of a grinding wheel and selection of a grinding wheel Introduction to Lapping, honing and broaching machines

UNIT IV

Limits, fits and tolerances- Unilateral and bilateral tolerance system, hole and shaft basis system. Interchangeability and selective assembly.

Limit Gauges: Taylor's principle, Design of GO and NO-GO gaugesMeasurement of angles, Bevel protractor, Sine bar.

Measurement of flat surfaces, straight edges, surface plates, optical flat, interferometer and auto collimator.

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

UNIT V

Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf.

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

Gear measurement: Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch pressure angle and tooth thickness. Machine Tool Alignment Tests on lathe, milling and drilling machines.Coordinate Measuring Machines: Types and Applications of CMM.

Text books:

1. Production Technology by R.K. Jain and S.C. Gupta.
2. Workshop Technology – B.S.RaghuVamshi – Vol II.
3. I.C. Gupta, "A Textbook of Engineering Metrology", Dhanpat Rai & sons,4th edition 1997.
4. R.K. Jain, "Engineering Metrology", Khanna Publishers, Edition 22nd, 2022.

References:

1. Machine Tools :C.Elanchezhian and M. Vijayan / Anuradha Agencies Publishers.
2. Production Technology by H.M.T. (Hindustan Machine Tools).
3. Raghavendra., Krishnamurthy., Krishnamurthy. (2013). Engineering Metrology and Measurements. India: OUP India.
4. Rajput, R. K. (2009). Engineering Metrology & Instrumentation. India: S. K. Kataria & Sons.
5. Busch, T. (1989). Fundamentals of Dimensional Metrology. United States: Delmar.

Teaching Methodology:

- Power point Presentations
- Working models
- white board & marker

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMAL ENGINEERING LAB

Course Code: **L/T/P/C: 0/0/2/1**

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 assemblingand 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 petrolengine.
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 Electricalloading.
Task-4: Heat balance test on 4 stroke single cylinder diesel engine with Electricalloading. **Task-5:** Performance test on 4- stroke single cylinder diesel engine with Mechanicalloading. **Task-6:** Heat balance test on 4-stroke single cylinder diesel engine with Mechanicalloading. **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

FLUID MECHANICS AND FLUID MACHINES LAB

Course Code: GR22A2051 L/T/P/C: 0/0/2/1

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 analyse 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. Analyse 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 Orificemeter.

Task-3: Determination of Darcy's Friction factor in various diameters of pipes

Task-4:Determination of Minor Losses (Different Valve connections, SuddenExpansion, 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 ConstantSpeed and Constant Head

Task-7: Determination of overall efficiency of Francis Turbine at Constant Speed andConstant Head

Task-8: Determination of overall efficiency of Kaplan Turbine at Constant Speed andConstant 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

MANUFACTURING TECHNOLOGY AND METROLOGY LAB

Course Code: **L/T/P/C: 0/0/2/1**

II Year II Semester

Course Outcomes:

1. Apply tool geometry in manufacturing the component
2. Operate machine tool equipment commonly found in industry like lathes, milling machines, drill presses and cutting machines
3. Execute the finishing process on various machines.
4. Deploy different measuring instruments towards quality control.
5. Operate effective methods of measuring straightness, flatness, roundness, profile, screw threads and gear teeth.

List of Experiments:

1. Step Turning and Taper Turning operation on lathe Machine
2. Thread cutting and Knurling operations on Lathe Machine
3. Drilling, boring, operations on lathe machine
4. Drilling and internal thread cutting using Tapping
5. Edge preparation using Shaping machine and Keyway cutting operation on Slotting machine
6. Face milling operation using Milling machine
7. Grinding of tool angles using Cylindrical /Surface Grinding Machine
8. Measurement of lengths, heights, by vernier calipers, vernier height gauge.
9. Measurement of diameters by internal, external micrometers and dial bore indicator
10. Using gear tooth Vernier calipers and checking the chordal addendum and chordal height of spur gear
11. Angle measurement by Bevel protractor, Sine bars and Thread measurement by three wire method.
12. Surface roughness measurement by Surface roughness tester.
13. Measurement of screw thread by using Profile Projector and Tool makers
14. Microscope

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.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS)

ENVIRONMENTAL SCIENCE

Course Code: **L/T/P/C: 2/0/0/0**

II Year, I/II Semester

Course Pre-Requisites: Basic knowledge of environmental issues

Course Outcomes:

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

REFERENCES:

1. Introduction to Environmental Science, Y. Anjaneyulu, BS Publications, 2004.

Environmental Studies, Anubha Kaushik & C. P. Kaushik, 4th Edition, New Age International Publishers.

III Year
I Semester

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

BASIC MACHINE DESIGN

Course Code: GR24A3049 **L/T/P/C: 2/1 /0 /3**

III Year I Semester

Course Outcomes:

1) Determine tolerances, limits, 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–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 –Rivet Materials -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, 6thEdition, Pearson Education India,2006.
4) Machine Design by R. L.Norton, 5thEdition, Pearson Education India,2018.
5) Machine Design by R.S.Khurmi and JKGupta, S.Chand and Company,2022

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
(Autonomous)
ECONOMICS AND ACCOUNTING FOR ENGINEERS

Course Code: GR24A3041 **L/T/P/C: 3/0/0/3**
III Year II Semester

COURSE OUTCOMES

1. The students will be able to understand the managerial economics, analyze demand behavior and interpret the concepts of national income indicators.
2. The student will be able to plan the production levels in tune with maximum utilization of organizational resources to determine optimal input combinations for production processes.
3. To recognize the type of markets based on competition levels, the characteristics and determine pricing strategies for products and services.
4. Understand the importance of capital budgeting in the context of strategic financial management and identify, evaluate investment opportunities using appropriate capital budgeting techniques.
5. Learners understand the fundamental principles, concepts & conventions of accounting, including the recording of business transactions using journals, ledgers, preparation of trail balance and more emphasis on preparation of final accounts.

UNIT I

INTRODUCTION & DEMAND ANALYSIS: DEFINITION AND SCOPE

Introduction to micro, macroeconomics, Nature, and Scope of Managerial Economics. National Income and its Components - GNP, NNP, GDP, NDP, ***Introduction to demand:*** 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, Law of supply.

UNIT II

PRODUCTION & COST ANALYSIS: PRODUCTION FUNCTION

Law of variable proportions, 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 of Pricing, Methods of Pricing. *Business:* Features and evaluation of different forms of Business Organisation: Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises.

UNIT IV

INTRODUCTION TO FINANCIAL ACCOUNTING: ACCOUNTING CONCEPTS AND CONVENTIONS

Double-Entry Bookkeeping. ***Accounting Cycle:*** Journal, Ledger, Trial Balance, Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

UNIT V

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)

TEXTBOOKS

1. Managerial Economics – International Edition, 2019, by Christopher Thomas (Author), S. Charles Maurice (Author), McGraw-Hill Education
2. Managerial Economics & Business Strategy, Michael R. Baye, Jeffrey T. Princ, McGraw-Hill Education, 2021 (10th Edition)
3. Managerial Economics, Mark Hirschey, Cengage Learning, 2016 (13th Edition)
4. Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2016.
5. Managerial Accounting, Carl S. Warren, James M. Reeve, Jonathan Ducha, Cengage Learning, 2021
6. Managerial Accounting: Tools for Business Decision Making (9th Edition), Jerry J. Weygandt, Paul D. Kimmel, Donald E. Kieso, Wiley, 2021
7. Managerial Economics Aryasri: Managerial Economics and Financial Analysis, TMH, 2009.

REFERENCES

1. Managerial Economics 4th Edition, W. Cris Lewis, Sudhir K. Jain, H. Craig Petersen, Pearson, 2009
2. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi.2009
3. Financial Accounting, 6/e, Dr S N Maheshwari, CA Sharad K Maheshwari & Dr Suneel K Maheshwari, Vikas Publishing, 2018

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
CAD/CAM

Course Code: GR24A3050 **L/T/P/C: 3/0/0/3**
III 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 to increase the production rate and quality of the product.

UNIT I

Introduction to CAD/CAM: Definition, Fundamentals of CAD, Product life 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, Homogeneous 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: line, circle, conics, synthetic entities: Hermite cubic curve, Bezier curve, B- Spline and NURBS.

UNIT III

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

Solid Modeling–Analytical and synthetic solid entities. Boundary representation (B-rep), Constructive Solid Geometry (CSG) representation 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-Automated Programmed Tools (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 ,FourthEdition, NewAge Publisher, 2018
3) CAD/CAM/CIM byDr. K.CJain, 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
APPLIED THERMODYNAMICS

Course Code: GR24A3051 **L/T/P/C:3/0/0/3**

III Year I Semester

Course Outcomes
After successful completion of this course, the students will be able to:
CO1 : Analyze and evaluate the performance of the Rankine cycle and fuel combustion systems, including calorific value determination and flue gas analysis, to estimate thermal efficiency and optimize air–fuel ratios.
CO2 : Apply thermodynamic principles to assess boiler performance, chimney draught requirements, and steam nozzle flow, including the determination of conditions for maximum discharge and efficiency.
CO3 : Interpret and construct velocity diagrams for impulse and reaction turbines, calculate efficiency parameters, and determine operating conditions for maximum performance.
CO4 : Evaluate condenser performance parameters, identify causes and effects of air leakage, and compare open and closed gas turbine cycles with performance-improving methods such as regeneration, reheating, and intercooling.
CO5 : Explain the working principles of various jet propulsion and rocket systems, perform thrust and propulsion efficiency calculations, and assess the impact of propellant type on performance metrics such as specific impulse.

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 chimney for 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:GR24A3052 **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.

Components of the Industrial Robotics: Laws of 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 end effectors.

UNIT II

Microcontroller/ MCU: Microcontroller Vs Microprocessor, Basics of microcontroller, Arduino microcontroller, Arduino IDE & overview, Why Arduino, Arduino installation, Interfacing LED, Introduction to MCU, Communication protocols – I2C & SPI, how to read schematics, Basics of Arduino programming

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: Drive systems, Hydraulic, Pneumatic Electrical DC and AC servo motors and stepped motors comparison of Electric, Hydraulic and Pneumatic types of locomotion devices. **Sensors:** Range, Proximity, touch, Force and torque sensors, Robot vision, Image representation, Image recognition approaches.

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, 2009.
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: GR24A3053 **L/T/P/C: 3/0/0/3**

III year I sem

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

1) Determine stress and strain transformations and derive constitutive equations in Elasticity
2) Calculate fixing moments and support reactions in fixed and continuous beams
3) Evaluate stresses and strain in thin and thick cylinders
4) Determine the stresses in columns and struts
5) Analyze stresses in curved bars and rotating discs

UNIT- I

Fixed Beams: Fixing moments for a fixed beam: using moment area method and Macaulay's method, effect of sinking support and rotation of support.

UNIT II

Continuous Beams: Analysis of continuous beams using Clapeyron's three-moment theorem, reactions at the supports, propped cantilevers

UNIT III

Thin and Thick Cylinders: Derivation of Lame's equations, calculation of radial longitudinal and hoop stresses and strains due to internal pressure in thick cylinders, compound cylinders, hub shrunk on solid shafts

UNIT IV

Introduction to Columns and Struts: Failure of a Column or Strut. Types of end conditions of columns. Euler's column theory. Assumptions in Euler's column theory. Euler's formula. Slenderness ratio. Limitations of Euler's fomulae, Equivalent length of a column. Rankine's formula for columns. Johnson's Formula for columns, Long columns subjected to Eccentric Loading.

UNIT- V

Stresses in Curved Bars: Determination of radius of neutral axis in circular, rectangular and trapezoidal sections, stresses in crane hook. Stresses due to Rotation: Stresses in wheel rim, rotating disc of uniform thickness and disc of uniform strength, permissible speed of a solid disc.

Text Books:

1. L S Srinath, Advanced Mechanics of Solids, 3rd Edition, McGraw-Hill, 2009. (Unit-I)
2. S S Rattan, Strength of Materials, 2nd Edition, Tata McGraw Hill Education, 2011. (Unit- II to V)

Reference Books:

1. Gere, Timoshenko, Mechanics of Materials, 2nd Edition, CBS Publishers, 2004.
2. R C Hibbeler, Mechanics of Materials, 9th Edition, Pearson publishers, 2018.
3. B C Punmia, A Jain and Arun Kumar Jain, Mechanics of materials, Laxmi Publications Pvt Ltd, 2001.
4. S P Timoshenko and J N Goodier, Theory of Elasticity, 3rd Edition, Tata McGraw-Hill Edition, 2010.
5. A Hall, A Holowenko and H Laughlin, Schaum's Outline of Machine Design, 1st Edition, 2007.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MECHANICAL VIBRATIONS
(PROFESSIONAL ELECTIVE- I)

Course Code: GR24A3054 **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
4. L. Meirovich, Elements of Vibration Analysis, 1st Edition, Tata McGraw Hill, 1986
5. Singiresu S. Rao, Mechanical Vibrations, 6th Edition, Pearson Education, 2018

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

Industrial Internet of Things
(PROFESSIONAL ELECTIVE –I)

Course Code:GR24A3055 **L/T/P/C: 3/0/0/3**
III Year I Semester

Course Outcomes:

1. Gain a clear understanding of Industry 4.0 principles and the role of IIoT in transforming mechanical and manufacturing industries.
2. Demonstrate knowledge of IIoT system architecture and the ability to identify and select appropriate sensors, actuators, and embedded components for industrial applications.
3. Explain and apply various industrial communication protocols and networking standards essential for IIoT connectivity and interoperability.
4. Perform data acquisition and develop monitoring dashboards; utilize data analytics techniques for predictive maintenance and process optimization in industrial settings.
5. Analyze and articulate IIoT business frameworks and reference architectures, enabling design and deployment of scalable and flexible industrial IoT solutions.

Unit I

Introduction to Sensing, Actuation, and Communication: Introduces the fundamentals of sensing and actuation in industrial contexts. Communication basics in two parts, including industrial communication protocols and networking principles essential for IIoT systems.

Unit II

Smart Factories: Evolution to Industry 4.0, focusing on globalization, emerging challenges, and the fourth industrial revolution. LEAN production systems, smart and connected business models, and the concept and features of smart factories.

Unit III

Advanced Industry 4.0 Technologies: Detailed study of Cyber-Physical Systems (CPS) and next- generation sensor technologies used in IIoT. Collaborative platforms, product lifecycle management, and emerging technologies such as augmented reality (AR), virtual reality (VR), artificial intelligence (AI), big data, and advanced analytics.

Unit IV

Cybersecurity and Industrial Processes: Fundamentals of cybersecurity challenges in Industry 4.0 environments. The basics of industrial IoT, including industrial processes, industrial sensing and actuation, and industrial internet system architectures.

Unit V

IIoT Business Models and Reference Architectures: Introduction to Industrial IoT concepts, exploring various IIoT business models in two parts. A comprehensive study of IIoT reference architectures, covering system components, communication protocols, and data management frameworks necessary for industrial deployments.

Text Books:

1. Sabina Jeschke, Christian Brecher Houbing Song , Danda B. Rawat Editors Industrial Internet of Things Cyber Manufacturing Systems
2. Inside the Internet of Things (IoT), Deloitte University Press

Reference Books:

1. Internet of Things- From Research and Innovation to Market Deployment; By Ovidiu & Peter; River Publishers Series
2. Five thoughts from the Father of the Internet of Things; by Phil Wainewright - Kevin Ashton 7. How Protocol Conversion Addresses IIoT Challenges: White Paper By RedLion.
3. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights ,2014

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
IOT SENSORS LAB

Course Code: GR24A3077 **L/T/P/C:0/0/2/1**

III Year I Semester

Course Outcomes: On completion of the course, the student will be able to
1. Understand the different blocks involved in an IOT ecosystem and
2. Understand interfacing techniques to connect different sensors to a microcontroller.
3. Understand how a gateway module works as a bridge between two networks.
4. Understand different communication protocols used in IOT such as HTTP and web sockets.
5. Understand the programming of mobile applications to push and pull data from the cloud. and apply the concepts to implement a complete IOT ecosystem with different data flow scenarios

Task-1: Microcontroller – sensor/ actuator Interfacing

Programming a Generic Sensor Board to interface the following sensors/actuators.
1. Blinking of LED
2. Buzzer Tone
3. Relay control for switching applications.
4. Ultrasonic sensor module
5. Soil Moisture Sensor Module
6. MEMS Sensor Module (INMP 441)
7. PIR Sensor Module
8. Gesture Sensor Module
9. Bluetooth Module
10. Environment Monitoring Module (BMP 280)
11. Heart Rate Monitoring Module
12. Multi-Axis Accelerometer Sensor Module
13. Magnetic switch
14. OLED Display interface
15. IR sensor Interface

Task-2: Mobile App development

Mobile app development using MIT's App Inventor and Kodular platforms to
1. Develop apps with simple UI
2. Mobile apps to push pull data from the cloud database.
3. Mobile apps to push actuator commands to the cloud database.

Task-3: IOT projects

Integrating different blocks to do the following IOT projects.
1. Home Security System with IOT interface
2. Smart Garden with IOT interface
3. IR Remote based motor Control with IOT Interface
4. IoT based Remote Range Meter
5. Fall Detection using IOT
6. Gesture Recognition using IOT
7. Heart Rate Monitoring using IOT
8. Wake Sound Detection and Alarm Notification using IOT
9. IoT based Real Time Appliance Control
10. Environment Monitoring using IOT

Text/ Reference Books:

1. Building Arduino Projects for the Internet of Things by Adeel Javed, Apress, 2016

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
Computer Aided Design and Manufacturing Lab

Course Code: GR24A3058 **L/T/P/C:**

III Year I Semester

Course Outcomes

1. Prepare 2D Drawings using sketcher workbench of any parametric CAD software.
2. Generate 3D Solid models from 2D sketches using Part workbench of any parametric CAD software.
3. Generate part drawings for given part models
4. Generate sectional drawings for given part models
5. Create part programs using CAM packages for milling and turning Machine

Task 1 Practice Exercise related to Sketch and Basic Feature Options.
Task 2 Practice Exercise related to Advanced Feature Options.
Task 3 Modelling of various parts using special features in 3D software
Task 4 Working with sectional views in 3D figure
Task 5 Creating Parts and assembly related to Footstep Bearing.
Task 6 Creating Parts and assembly related to Pipe vice
Task 7 Creating Parts and assembly related to Plummer Block
Task 8 Creating Parts and assembly related to Universal Joint
Task 9 Model 1 G codes M codes generation for turning
Task 10 Model 2 G codes M codes generation for turning
Task 11 Model 3 G codes M codes generation for milling
Task 12 Model 4 G codes M codes generation for milling

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
(Autonomous)

Constitution of India

Code: GR24A2003 **L/T/P/C: 2/0/0/0**

Course Outcomes:

1. Students will be able to know the importance of Constitution and Government
2. Students will be able to become Good Citizens and know their fundamental rights, duties and principles.
3. Students will learn about the role of PM, President, Council of Ministers etc and it will help students learn about Local Administration.
4. The students understand the importance of Election Commission and the Students will become aware of how a Country and State are run in Democracy.
5. They will 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 lakshminarainagarwal publication

III YEAR
II SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ADVANCED MACHINE DESIGN

Course Code: GR24A3059 **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 Crankshafts: 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, 5thEdition, 2020
2) Machine Design by Dr N.C.Pandya and Dr. C.S.Shah- Charotar Publishers, 2022

References Books:

1) Machine Design byAllen SHall, Alfred R Holowenko, Herman G.Laughlin, Schaum'sOutlines, McGraw Hill Edition, 2017
2) Shigleys's Mechanical Engineering Design by Richard G Budinas, J.Keith Nisbett, McGrawHill Publisher, Eleventh Edition, 2020
3) Design of Machine Elements by M.F.Spotts, 6thEdition, Pearson Education India, 2006.
4) Machine Design byR. L. Norton, 5thEdition, Pearson Education India, 2018.
5) Machine Design by R.S.Khurmi and JKGupta, S.Chand and Company, 2022

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

Note: Design data book is allowed for exam

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
HEAT TRANSFER

Course Code: GR24A3060 **L/T/P/C: 3/ 0/ 0/ 3**
III Year II Semester

Course Outcomes (COs)

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

CO1: To **formulate and simplify the general heat conduction equation** in Cartesian, cylindrical, and spherical coordinates, applying appropriate initial and boundary conditions for steady, unsteady, and periodic heat transfer.

CO2: To **analyze one-dimensional steady and unsteady conduction problems** in slabs, cylinders, and spheres, including systems with fins, variable conductivity, and heat generation, using Biot and Fourier numbers.

CO3: To **evaluate convective heat transfer coefficients** in forced and free convection using dimensional analysis, boundary layer theory, and empirical correlations for external and internal flows.

CO4: To **apply boiling, condensation, and heat exchanger design principles** (LMTD and NTU methods) to calculate heat transfer rates and predict effectiveness under various operating conditions.

CO5: To **apply radiation heat transfer laws and network models to practical applications such as electronics cooling, energy storage, solar thermal collectors, and nuclear/space systems**, evaluating performance and energy efficiency.

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 UN STEADY 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 AND APPLICATIONS
Radiation Fundamentals:Emission characteristics and laws of black body radiation – Total and monochromatic quantities – Laws of Planck, Wien, Kirchhoff, Lambert, Stefan–Boltzmann.
Radiative Heat Exchange: Heat exchange between two black bodies – Concept of shape factor – Emissivity – Heat exchange between grey bodies – Radiation shields – Electrical analogy for radiation networks – Irradiation and radiosity.
Applications of Radiation Heat Transfer: **Electronics Cooling**: Role of radiation in thermal management of microchips, circuit boards, and data centers.**Energy Storage Systems**: Thermal radiation effects in phase-change material (PCM) storage and molten salt tanks.**Solar Thermal Collectors**: Selective coatings, radiative losses, and efficiency improvement in flat plate and concentrating collectors.**Nuclear & Space Systems**: Radiative cooling in nuclear reactors, spacecraft thermal control using radiation shields and heat pipes.

TEXT BOOKS:
1. Fundamentals of Engg. Heat and Mass Transfer – R.C.Sachdeva / New Age International
2. Heat and Mass transfer – D.S. Kumar / S.K.Kataria & Sons
3. *Heat and Mass Transfer***, Nag, P.K.,** 4th Edition, McGraw-Hill Education.

REFERENCE BOOKS
1. Heat and Mass transfer – Cengel / Mc Graw Hill
2. Heat and Mass transfer – R.K.Rajput / S.Chand& Company Ltd
3. Heat and Mass Transfer – Kodandaraman
4. **Holman, J.P.,** *Heat Transfer*, 10th Edition, McGraw-Hill.
5. **Kakac, S., and Yener, Y.,** *Heat Conduction and Radiation Applications*, CRC Press.
6. **Siegel, R., and Howell, J.R.,** *Thermal Radiation Heat Transfer*, 5th Edition, Taylor & Francis.
7. Selected **recent IEEE/ASME journal papers** on electronics cooling, solar thermal, and nuclear thermal systems.

Data Book: Heat and Mass Transfer – Kodandaraman

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ADDITIVE MANUFACTURING

Course Code: GR24A3061 **L/T/P/C: 3/0/0/3**
III 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
1. 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
Mechanical Measurements
(PROFESSIONAL ELECTIVE - II)

Course Code: GR24A3062 **L/T/P/C: 3/0/0/3**
III Year II Semester

Prerequisite: A strong foundation in mathematics and physics.

Course Outcomes:

1. Apply the basic concepts of mechanical measurements wherever applicable.
2. Measure linear and angular dimensions using appropriate instruments.
3. To demonstrate the measuring techniques of gears and screw threads.
4. Explain the various methods for surface roughness measurements.
5. Illustrate the effective methods of advanced mechanical measurements.

Unit I
Mechanical Measurements - Need of mechanical measurement, Basic definitions: Hysteresis, Linearity, Resolution of measuring instruments, Threshold, Drift, Zero stability, loading effect and system response. Measurement methods, Generalized Measurement system, Static performance characteristics, Errors and their classification.

Unit II
Linear and angle measurements - Linear Measuring Instruments, Vernier calliper, Micrometer, vernier height gauge, Limit gauges, concepts of interchange ability, Angular measuring instruments, Bevel protractor, angle gauges, sine bar, Angle alignment telescope, Autocollimator.

Unit III
Measurement of Gears and screw threads: Gear tooth terminology, Sources of errors in manufacturing of gears, Measurement of tooth thickness: Gear tooth vernier, Measurement of tooth profile: Tool maker's microscope, Involute tester, Alignment of gears. Screw Thread Measurement: Errors in threads, screw thread gauges, measurement of external and internal threads, thread calliper gauges.

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
Advanced Mechanical Measurements - Basic concept of lasers Advantages of lasers, laser Interferometers, concept of CMM and its working, Types of CMM, Machine Vision Systems, Laser vision, In-process gauging, 3D metrology, metrology softwares, Nano technology instrumentation, stage position metrology

Text books:

1. G. Beckwith, R. D. Marangoni and J. H. Lienhard, Mechanical Measurements, Addison Wesley, 1993.
2. R.K. Jain , "Engineering Metrology", Khanna Publishers, Edition 22nd,2022.

References:

1. Raghavendra, Krishnamurthy, Engineering Metrology and Measurements. India: OUP India, 2013.
2. Rajput, R. K.Engineering Metrology & Instrumentation. India: S. K. Kataria & Sons, 2009
3. W. Dally, W. F. Riley and K. G. McConnell, Instrumentation for Engineering Measurements, 2nd Edition, John Wiley & Sons, 1993.
4. O. Doebelin, Measurement Systems-Applications and Design, 4th Edition, Tata McGraw-Hill, 1990.
5. The Metrology Hand book- Jay. L.Bucher (ed), American Society for Quality, 2004

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

Course Code: GR24A3063 **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:GR24A3064 **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 and evaluate the mechanism of material removal rate in the ultrasonic machining process.
2. Analyze the theories of jet machining processes for higher reliability, better repeatability and higher accuracy.
3. Assess the utilization of energy for various thermo electrical processes.
4. Apply knowledge of electrochemical processes to select suitable machining methods for precision engineering and industrial applications.
5. Apply knowledge of chemical machining, electro stream drilling, and shaped tube electrolytic machining for precision manufacturing applications.

UNIT I
Introduction: Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials Applications. **Mechanical processes**: Ultrasonic machining – Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.

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

UNIT-III
Thermo electric processes- General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and Wire electric discharge machining, laser beam machining, 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. Generation control and theory of electron beam for machining, comparison of thermal and non-thermal processes. Thermal features, cutting speed and accuracy of cut of LBM. Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.

UNIT IV
Electro chemical: 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.

UNIT V
Chemical processes: 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:GR24A3065 **L/T/P/C: 3/0/0/3**
III Year II Semester

Course Outcomes

By the end of this course, students will:

1. Understand the role and need for intelligent systems in modern manufacturing.
2. Describe the basics of knowledge-based systems and their application in decision-making.
3. Apply basic AI concepts such as neural networks and learning methods in manufacturing examples.
4. Explain the fundamentals of automated process planning.
5. Appreciate the role of GT and its intelligent extensions in improving manufacturing efficiency.

UNIT I: Introduction to Intelligent Manufacturing Systems: Concept and need for Intelligent Manufacturing. Structure and components of IMS. Functional areas: Overview of CAD, CAPP, CAM, CAQC, ASRS in an Intelligent Manufacturing environment. Advantages of intelligent approaches over conventional CIM. Introduction to manufacturing communication systems (MAP/TOP, OSI basics, data handling)

UNIT II: Knowledge-Based Systems in Manufacturing: Concept of Knowledge-Based Systems (KBS) Basic Components: Knowledge base, inference engine, user interface. Simple knowledge representation methods (rules, logic, decision trees). Role of expert systems in manufacturing decision-making. Applications of KBS (maintenance, scheduling, process selection)

UNIT III: Artificial Intelligence & Machine Learning Applications: Introduction to Artificial Intelligence in manufacturing. Conceptual learning and problem solving. Basic Neural Network model (biological vs artificial neuron, simple network types). Applications of AI/ML in manufacturing: fault detection, predictive maintenance, quality analysis

UNIT IV: Automated Process Planning & Decision Support: Importance of process planning in manufacturing. Automated process planning approaches: Variant and Generative methods (overview). Role of Expert Systems in process planning. Feature Recognition (basic examples in machining/CAD models). Equipment Selection problem (introductory overview using a knowledge-based approach)

UNIT V: Group Technology (GT) and Intelligent GT: Concept and advantages of GT in manufacturing systems. GT Implementation methods: Visual inspection, coding methods, and simple clustering idea. GT in automated manufacturing (cellular manufacturing, FMS context). Introduction to Intelligent Group Technology (knowledge-based GT concepts)

Text Books:

1. Mikell P. Groover, *Automation, Production Systems & Computer-Integrated Manufacturing*
2. Rao, Tewari & Kundra, *Computer Aided Manufacturing*

References

1. Elmaraghy H.A., *Flexible and Intelligent Manufacturing Systems*
2. Rich & Knight, *Artificial Intelligence* (introductory reference for manufacturing AI)

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
Computer Aided Analysis and 3D Printing Lab

Course Code:GR24A3067 **L/T/P/C: 0/0/2/1**
III Year II 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. Create and convert CAD models into various file formats which are compatible with other software.
5. Model complex parts using Advance feature options and printing them using 3D Printer.

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: 3D Printing of Model 1
Task 10: 3D Printing of Model 2
Task 11: 3D Printing of Model 3
Task 12: 3D Printing of Model 4

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
HEAT TRANSFER LAB

Course Code: GR24A3068 **L/T/P/C:** 0/0/2/1
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
4. Assess the performance parameters of the pin fin
5. Apply the knowledge of physics of radiation on black and gray bodies, evaluation of Stefan Boltzmann constant.

LIST OF EXPERIMENTS:
1. Heat transfer through given metal rod.
2. Heat transfer through Composite wall
3. Heat transfer through lagged pipe.
4. Heat Transfer through a Concentric Sphere
5. Heat transfer in natural convection (Horizontal Position)
6. Heat transfer in natural convection (Vertical Position)
7. Heat transfer in forced convection apparatus.
8. Heat transfer in pin-fin
9. Measurement of Surface Emissivity
10. Determine the Stefan Boltzmann constant Stefan Apparatus.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MINI PROJECT WITH SEMINAR

Course Code:GR24A3027 **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.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ADVANCED ENGLISH COMMUNICATION SKILLS LAB

Course Code: GR24A3013 **L/T/P/C: 0/0/2/1**

Course Outcomes:

Students will be able to

1. Demonstrate effective listening and reading strategies to comprehend, analyze, and evaluate texts.
2. Produce well-structured written documents for academic, professional, and digital platforms.
3. Deliver effective oral presentations using appropriate language, structure, and non-verbal cues.
4. Participate confidently in group discussions using logical reasoning, fluency, and teamwork.
5. Apply interview strategies to perform successfully in face-to-face and virtual interviews.

1. Syllabus:

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

1. **Activities on Listening and Reading Comprehension:** Active Listening – Development of Listening Skills Through Audio clips - Benefits of Reading – Methods and Techniques of Reading – Basic Steps to Effective Reading – Common Obstacles – Discourse Markers or Linkers - Sub- skills of reading - Reading for facts, negative facts and Specific Details- Guessing Meanings from Context, Inferring Meaning - Critical Reading –– Reading Comprehension – Exercises for Practice.

2. **Activities on Writing Skills**: Vocabulary for Competitive Examinations - Planning for Writing – Improving Writing Skills - Structure and presentation of different types of writing – Free Writing and Structured Writing - Letter Writing –Writing a Letter of Application –Resume vs. Curriculum Vitae – Writing a Résumé **–** Styles of Résumé - e-Correspondence – Emails – Blog Writing - (N)etiquette– Report Writing – Importance of Reports – Types and Formats of Reports– Technical Report Writing– Exercises for Practice.

3. **Activities on Presentation Skills -** Starting a conversation – responding appropriately and relevantly – using the right language and body language – Role Play in different situations including Seeking Clarification, Making a Request, Asking for and Refusing Permission, Participating in a Small Talk – Oral presentations (individual and group) through JAM sessions- PPTs – Importance of Presentation Skills – Planning, Preparing, Rehearsing and Making a Presentation – Dealing with Glossophobia or Stage Fear – Understanding Nuances of Delivery - Presentations through Posters/Projects/Reports – Checklist for Making a Presentation and Rubrics of Evaluation.
4. **Activities on Group Discussion (GD):** Types of GD and GD as a part of a Selection Procedure - Dynamics of Group Discussion- Myths of GD - Intervention, Summarizing -

Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas – Do's and Don'ts - GD Strategies – Exercises for Practice.

5. **Interview Skills**: Concept and Process - Interview Preparation Techniques - Types of Interview Questions – Pre-interview Planning, Opening Strategies, Answering Strategies - Interview Through Tele-conference & Video-conference - Mock Interviews.

2. Minimum Requirement:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- Spacious room with appropriate acoustics
- Round Tables with movable chairs
- Audio-visual aids
- LCD Projector
- Public Address system
- One PC with latest configuration for the teacher
- T. V, a digital stereo & Camcorder
- Headphones of High quality

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

- **TOEFL & GRE** (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)
- **Oxford Advanced Learner's Dictionary**, 10th Edition
- **Cambridge Advanced Learner's Dictionary**
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**
- **Lingua TOEFL CBT Insider**, by Dreamtech

4. Books Recommended:

1. Rizvi, M. Ashraf (2018). *Effective Technical Communication*. (2nd ed.). McGraw Hill Education (India) Pvt. Ltd.
2. Suresh Kumar, E. (2015). *Engineering English.* Orient BlackSwan Pvt. Ltd.
3. Bailey, Stephen. (2018). Academic *Writing: A Handbook for International Students.* (5th Edition). Routledge.
4. Koneru, Aruna. (2016). *Professional Communication*. McGraw Hill Education (India) Pvt. Ltd.
5. Raman, Meenakshi & Sharma, Sangeeta. (2022). *Technical Communication, Principles and Practice*. (4TH Edition) Oxford University Press.
6. Anderson, Paul V. (2007). *Technical Communication***.** Cengage Learning Pvt. Ltd. New Delhi.
7. McCarthy, Michael; O'Dell, Felicity & Redman, Stuart. (2017). *English Vocabulary in Use*
   Series. Cambridge University Press
8. Sen, Leela. (2009). *Communication Skills*. PHI Learning Pvt Ltd., New Delhi.
9. Elbow, Peter. (1998). *Writing with Power*. Oxford University Press.
10. Goleman, Daniel. (2013). *Emotional Intelligence*: *Why it can matter more than IQ.* Bloomsbury Publishing.

IV YEAR
I SEMESTER

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

Finite Element Methods

Course Code:GR24A4058 **L/T/P/C: 3/0/0/3**
IV Year I Semester

Prerequisite: Higher Engineering Mathematics, heat transfer and Fluid Mechanics.

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 (modeling, analysis, and interpretation of results) to realistic engineering problems to develop the ability to generate the governing FE equations for systems governed by partial differential equations
3. Describe the principle of mathematical modeling of engineering problems
4. Interpret the complete idea on applications of finite element method
5. Explain the limitations of the FE method and understand the possible error sources in its use.

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 mechanics, longitudinal vibration and mode shapes, transverse deflections and natural frequencies.

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.

Textbooks:

1. Computational Fluid Dynamics the Basics with Applications, John D Anderson, Jr., McGraw Hill Book Company.2013 edition
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method, H K Versteeg, W Malalasekera, Pearson Education Ltd., 2016 edition.
3. Finite element Analysis by Reddy, J.N, McGraw Hill Book Company.2013 edition

Reference Books:

1. Introduction to Computational Fluid Dynamics, Anil W Date, Cambridge University Press, 2018 edition
2. Numerical Heat Transfer and Fluid Flow, Suhas V Patankar, Hemisphere Publishing Co. 2016 Edition
3. Computational Fluid Dynamics: A Practical Approach, JiyuanTu, Guan HengYeoh, Chaoqun Liu, Elsevier.2013 Edition

4. Principles of Computational Fluid dynamics, Pieter Wesseling, Springer International Edition, 2019 edition
5. Fundamentals of Computational Fluid Dynamics, Tapan K. Sengupta, Universities Press, 2000 Edition
6. Introduction to Fluid Mechanics, Edward J Shaughnessy, Jr., Ira M Katz, Oxford University press.2015 edition

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INSTRUMENTATION AND CONTROL SYSTEMS

Course Code: GR24A4047 **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 Controlsystems/ 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
RENEWABLE ENERGY RESOURCES
(PROFESSIONAL ELECTIVE- III)

Course Code:GR24A4048 **L/T/P/C: 3/0/0/3**
IV Year I 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 -III)

Course Code: GR24A4049 **L/T/P/C: 3/0/0/3**
IV Year I 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 draft tube , performance and regulation of hydraulic machines

TextBooks:
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

ReferenceBooks:
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 – III)

Course Code:GR24A4050 **L/T/P/C: 3/0/0/3**
IV Year I 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- III)

Course Code:GR24A4051 **L/T/P/C:3/0/0/3**
IV Year I 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 139
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
TRIBOLOGY
(PROFESSIONAL ELECTIVE-IV)

Course Code:GR24A4052 **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 FOR MANUFACTURING ASSEMBLY
(PROFESSIONAL ELECTIVE – IV)

Course Code:GR24A4053 **L/T/P/C:3/0/0/3**

IV Year I Semester

Course Outcomes:

1. Understand the principles of design for manufacturing processes, manual and automated assembly, economical production and material selection.
2. Apply design rules for ease of forming, machining, casting and assembly
3. Analyse components using design features to facilitate forming and machining.
4. Analyze casting designs, apply parting line and core minimization principles, and evaluate uneconomical designs to propose cost-effective modifications.
5. Apply design guidelines, analyze assemblies, and evaluate product designs for efficient manual, automated, and robot-assisted manufacturing using CAD tools.

UNIT I

Introduction: Design Philosophy - steps in design process - General design rules for manufacturabilty - Basic principles of designing for economical production-creativity in design Materials: Selection of materials for design - Developments in materials technology - Criteria for materials selection - Material selection inter relationship with process selection

UNIT II

Design for Form: Working principle, Material, Manufacture, Design - Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

UNIT III

Design for Machining: Design features to facilitate machining - drills - milling cutters - keyways – Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability

UNIT IV

Design for Casting: Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design.

UNIT V

Design for Assembly: Design guidelines for manual assembly, large assemblies, analysis of an assembly, rules for product design for automation, design for robot assembly, Design for manufacture and Computer aided design

Text books:

1. A K Chitale and R C Gupta, Product Design and Manufacturing, Prentice Hall of India, New Delhi, 2003.
2. Geoffrey Boothroyd, Dewhurst P and Knight W, Product design for manufacture and assembly, CRC press, 2002.

Reference books:

1. James G. Bralla, Design for Manufacturabillity handbook, McGraw hill, 1999.
2. George E. Dieter, Engineering Design - A material processing approach, 5/e, McGraw Hill International, 2003.
3. ASM Handbook, Design for manufacture, 2000.
4. M F Ashby and K Johnson, Materials and Design - the art and science of material selection in product design, Butterworth-Heinemann, 2003.
5. K G Swift and J D Booker, Process selection: from design to manufacture, London: Arnold, 1997.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

SOFT COMPUTING TECHNIQUES IN MECHANICAL ENGINEERING
(PROFESSIONAL ELECTIVE -IV)

Course Code: GR24A4054 **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) P. M. Dixit, U. S. Dixit, Modeling of metal forming and machining processes: by finite element and soft computing methods, 1st Ed, Springer-Verlag, 2008.
2) K. Deb, Optimization for Engineering Design: Algorithms and Examples, Prentice Hall, 2006.
3) R. A. Aliev, R. R. Aliev, Soft Computing and its Applications, World Scientific Publishing Co. Pte. Ltd., 2001.
4) Amar Patnaik, Vikas Kukshal, Pankaj Agarwal, Ankush Sharma, Mahavir Choudhary, Application of Soft Computing Techniques in Mechanical Engineering, 1st Edition, First Published in 2022, Boca Raton, CRC Press.
5) Pratihar, Dilip Kumar. Soft computing, Alpha Science International Limited, 2007.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ARTIFICIAL INTELLIGENCE IN MECHANICAL ENGINEERING (PROFESSIONAL ELECTIVE- IV)

Course Code:GR24A4055 **L/T/P/C:3/0/0/3**
IV 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

(OPEN ELECTIVE – III)
OPERATIONS RESEARCH

Course Code:GR24A3066 **L/T/P/C: 3/0/03**
IV Year I Semester

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

CO1: To formulate and solve linear programming problems using simplex and duality approaches for resource allocation.
CO2: To apply non-linear optimization techniques (single and multi-variable unconstrained methods) to practical engineering and management problems.
CO3: To analyze and solve transportation and assignment models for effective decision-making in logistics and resource allocation.
CO4: To evaluate inventory control systems and queuing models to optimize stock management and service efficiency.
CO5: To apply replacement and dynamic programming models for long-term decision-making in capital budgeting, maintenance, and system optimization.

UNIT I: Introduction & Linear Programming
Introduction: Development, Definition, Characteristics and Phases of Operations Research, Types of models: Operations Research models – Applications: Linear Programming Problem (LPP) formulation, Graphical solution method, Simplex method – Artificial variables techniques (Two–phase method, Big-M method), Duality principle

UNIT II: Non-Linear Programming
Introduction – Difference between linear and nonlinear programming, applications in engineering & management; **Single-variable unconstrained optimization**: Uni-modal functions, Elimination methods – Bisection/interval halving, Fibonacci method, Golden Section method; **Multi-variable unconstrained optimization**: Gradient of a function, optimality condition, Gradient methods – Steepest Descent Method, Conjugate Gradient Method (Fletcher–Reeves)

UNIT III: Transportation & Assignment Models
Transportation models: Formulation, Methods for finding feasible solution and optimal solution, Unbalanced transportation problems, degeneracy; **Assignment models**: Formulation, Optimal solution, Variants of Assignment Problem (e.g., unbalanced, maximization, traveling salesman problem)

UNIT IV: Inventory & Queuing Models
Inventory models: Single-item deterministic models, Purchase inventory models with one price break and multiple price breaks, Shortages not allowed, Stochastic models – demand as discrete or continuous variable, Instantaneous production, instantaneous demand and continuous demand (no setup cost)
Queuing models: Introduction, Single-channel system: Poisson arrivals, exponential service times, infinite/finite population, Multi-channel systems: Poisson arrivals, exponential service times with infinite population

UNIT V: Replacement & Dynamic Programming
Replacement models: Replacement of items that deteriorate with time (with and without time value of money), Replacement of items that fail completely, Group replacement policy

Dynamic programming: Introduction – Bellman's Principle of Optimality Applications: capital budgeting, shortest path problem, linear programming problem

Text books:

1. Operations Research/ Prem Kumar Gupta, Dr. D.S. Hira
2. Operations Research / S. D.Sharma-Kedarnath
3. Operation Research /J.K.Sharma/MacMilan.

References:

1. Operations Research / R.Pannerselvam,PHI Publications.
2. Introduction to O.R /Taha/PHI
3. Operations Research / Wagner/ PHI Publications.
4. Introduction to O.R/Hiller and Libermann (TMH).
5. Operations Research /A.M.Natarajan, P.Balasubramani,A. Tamilarasi/Pearson Education.
6. Operations Research: Methods and Problems / Maurice Saseini, ArhurYaspan and Lawrence Friedman
7. O.R/Wayne L.Winston/Thomson Brooks/cole

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

Instrumentation and Control Systems Lab

Course Code:GR24A4056 **L/T/P/C:3/0/0/3**
IV Year I Semester

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

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.

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 measurement
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
COMPUTATIONAL FLUID DYNAMICS LABORATORY

Course Code: GR24A4057 **L/T/P/C: 0/0/2/1**

IV Year I Semester
Pre-requisite: Heat Transfer and Fluid Mechanics

Course Objective: To apply the principles of Heat Transfer and Fluid Mechanics to solve simple heat transfer and fluid flow problems using commercial CFD software

Course Outcomes: At the end of the course, the student should be able to

- Solve the simple heat transfer and fluid flow problems.
- Experience in computing aerodynamic problems and understanding flow physics over the objects
- Understand and to appreciate the need for validation of numerical solution
- Analyze the errors and cause of errors in computational analysis
- Hands on experience on various solving technique with boundary conditions

Task 1. Simulation of Couette flow when the upper plate is moving with a velocity of 40 m/s. Take the distance between the plates as 4 cm. Properties of fluid are; ν = 0.000217 m^2/s, ρ= 800 kg/m^3. Make simulations for a pressure gradient of 0-30000 $N/m^2/m$ and 20000 $N/m^2/m$ and report the variation of velocity contours for each case.

Task 2. Simulation of a channel flow (Tube flow) for a tube of diameter, 5 cm and take the fluid as water at 30^0C at the entry of the tube of length 0.7 m. A heat flux of 30000 W/m^2 is imposed along the wall.

Task 3: Obtain the contours of velocity and temperature along the length of the tube and also obtain the centre line temperature and velocity of fluid.

Task 4: Simulation of a channel flow (Tube flow) for a tube of diameter, 5 cm and take the fluid as water at 30^0C at the entry of the tube of length 0.7 m. A constant wall temperature of 300^0C is imposed along the wall. Obtain the contours of velocity and temperature along the length of the tube and also obtain the centre line temperature and velocity of fluid.

Task 5: Unsteady simulation of compressible flow of air through 2D a convergent – divergent nozzle, with inlet and outlet of 0.2 m size and both are joined by a throat section where the flow area is reduced by 10% and is of sinusoidal shape. Air enters the nozzle at a pressure of 0.9 atm and leaves at 0.73 atm. Obtain the contours of velocity, pressure and Mach number.

Task 6: Simulation of flow over a circular cylinder of size 5 cm for different Reynold's number values of air and plotting the contours of velocity and vorticity.

Task 7: Simulation of temperature contours for a square plate of size 0.2 m and subjected to different types of boundary conditions

Task 8: Simulation of temperature contours for a pin fin subjected to natural and forced convective conditions

Task 9: Simulation of Natural convection with and without radiation inside an enclosure

Task 10: Simulation of Lid driven cavity problem

Task 11: Structural analysis for beams and trusses

The experiments are to be conducted using ANSYS – CFX or equivalent software.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PROJECT WORK - PHASE I

Course Code: GR24A4016 **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
INDUSTRIAL ENGINEERING AND MANAGEMENT

Course Code: GR24A4059 **L/T/P/C: 3/0/0/3**

IV 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, 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, continuous production and 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.

UNIT - III WORK STUDY AND WORK MEASUREMENTS: Work study and its objectives; Method Study and its objectives, Charts to record moments in shop operation – process charts, flow process charts, travel chart and multiple activity charts. Definition, work measurement and its objectives, Work sampling: need, confidence levels, random observation, Time Study and its objectives, steps in time study, allowances and standard time determination. Breaking jobs into elements, recording information. Rating of employees performance, scale of rating.

UNIT – IV HUMAN RESOURCE MANAGEMENT: Concepts of Managements: importance, functions of 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, single and double sampling, Control charts – X and R – CURRENT TRENDS IN INDUSTRIAL ENGINEERING AND MANUFACTURING: Agile manufacturing, Lean and Six Sigma, Value Engineering, Just in time, Total quality management, 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
OPEN ELECTIVE III
OPERATIONS RESEARCH AND MANAGEMENT

Course Code: GR24A4060 **L/T/P/C: 2/0/0/2**
IV Year II Semester

Course Outcomes (COs)
After completing this course, students will be able to:

CO1: To formulate and solve linear programming and allocation problems using classical optimization methods.
CO2: To analyze and optimize resource allocation in transportation and assignment scenarios.
CO3: To apply sequencing models and project management techniques (PERT & CPM) for effective scheduling.
CO4: To evaluate competitive strategies using game theory and make rational choices using decision analysis tools like decision trees.
CO5: To model real-life systems with queuing and replacement to aid decision-making in engineering and management

UNIT I: Introduction & Linear Programming
Introduction: Development, Definition, Characteristics and Phases of Operations Research, Types of models: Operations Research models – **Applications:** Linear Programming Problem (LPP) formulation, Graphical solution method, Simplex method – Artificial variables techniques (Two–phase method, Big-M method), Duality principle

UNIT II: Transportation & Assignment Models
Transportation: TP - Examples, Definitions – decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods – NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution. **Assignment problem:** Examples, Definitions – decision variables, constraints, formulation, Balanced & unbalanced, Variants of Assignment Problem

UNIT III: Sequencing & Project Management
Sequencing: Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines.
PERT & CPM Project definition, Project scheduling techniques – Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time-cost trade-off.

UNIT IV: Game & Decision Theory
Game Theory: 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.
Decision Theory: Decision-making under certainty, risk, and uncertainty – Decision trees and Expected Value criterion.

UNIT V: Queuing & Replacement Models
Queuing Theory: Definitions – queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queuing system, queue types (channel vs. phase). Kendall's notation, Little's law, steady state behaviour, Poisson's Process & queue, Models with examples - M/M/1 and its performance measures;

M/M/m and its performance measures; brief description about some special models.
Replacement Models: Replacement of items that deteriorate with time (with and without time value of money), Replacement of items that fail completely, Group replacement polic.

Text books:

1. Operations Research/ Prem Kumar Gupta, Dr.D.S. Hira
2. Operations Research / S. D.Sharma-Kedarnath
3. Operation Research /J.K.Sharma/MacMilan.

References:

1. Operations Research / R.Pannerselvam, PHI Publications.
2. Introduction to O.R /Taha/PHI
3. Operations Research / Wagner/ PHI Publications.
4. Introduction to O.R/Hiller and Libermann (TMH).
5. Operations Research /A.M.Natarajan, P.Balasubramani,A. Tamilarasi/Pearson Education.
6. Operations Research: Methods and Problems / Maurice Saseini, ArhurYaspan and Lawrence Friedman
7. O.R/Wayne L.Winston/Thomson Brooks/cole

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

REFRIGERATION AND AIR CONDITIONING
(PROFESSIONAL ELECTIVE- V)

Course Code: GR24A4061 **L/T/P/C: 3/0/0/3**
IV Year II 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- V)

Course Code: GR24A4062 **L/T/P/C: 3/0/0/3**
IV Year II 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

Overview of Modern Coal-Based Thermal Power Plants and their Key Components: 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 Plant: 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

Nuclear Power Station: Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants

Types of Reactors: 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

Hydro Electric Power Plant: Hydroelectric power plants, classification, typical layout and components, construction and working

Power from Non-Conventional Sources: Principles of wind, tidal, solar Photo Voltaic and solar thermal, geothermal, biogas and fuel cell power systems.

UNIT V

Power Plant Economics and Environmental Considerations: 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.
3.
4. **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-V)

Course Code: GR24A4063 **L/T/P/C:3/0/0/3**
IV Year II 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, cooling system oil filters, oil pumps – crank case ventilation – engine service, reboring, 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. 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:

6. Automotive Mechanics-Vol.1 & Vol.2, by Kirpalsing, Standard Publishers, New Delhi 2008.
7. 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
5. Automobile Engineering, (3rd edition), by William crouse, TMH Distributors, New Delhi, 2017

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

Course Code:GR24A4064 **L/T/P/C:3/0/0/3**
IV Year II 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.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
PRODUCTION PLANNING AND CONTROL
(PROFESSIONAL ELECTIVE- VI)

Course Code:GR24A4065 **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

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

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 & SCHEDULING

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: 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 byChase ,PHI, 2006
4. Management Science- A R Aryasri-4e-TMH, 2008
5. Operations management – Heizer – Pearson, 2015

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MECHATRONICS
(PROFESSIONAL ELECTIVE- VI)

Course Code:GR24A4066 **L/T/P/C: 3/0/0/3**
IV Year II Semester

Course Outcomes:
1. Be proficient in concepts of Mechatronics.
2. Select appropriate sensors to control the behaviour of a process or product.
3. Make use of appropriate actuators for the mechatronic systems.
4. Develop and design a PLC system for automation.
5. Implement micro mechatronics systems for real time applications.

UNIT I
Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design of mechanical systems: Mechatronic approach, Integrated Product Design, stages of design process – Traditional and Mechatronics design concepts, control system and its types, Man-Machine Interface.

UNIT II
Sensors and transducers: Classification of Sensors and Transducers: Static and dynamic Characteristics of Sensor, 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, Embedded Systems: Hardware Structure, Software Design and Communication, Automatic Control and Real Time Control Systems.

UNIT-IV
Introduction to Programmable logic controller, Basic structure, Input and output processing, Programming, Mnemonics, Timers, counters and internal relays, Data handling, Selection of PLC.

UNIT V
Micro-mechatronic systems, microsensors, microactuators, Micro-fabrication techniques LIGA Process, 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: GR24A4067 **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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MICRO AND NANO MANUFACTURING

Course Code: GR24A4068 **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. 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: GR24A4026 **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.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

OPEN ELECTIVES

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
HUMAN RESOURCE DEVELOPMENT AND ORGANIZATIONAL BEHAVIOUR
(OPEN ELECTIVE)

Course Code: GR24A3010 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:

1. Acquaint with the determinants of intra -individual, inter-personnel and inter-group behaviour in organizational setting.
2. 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. 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. Impart and apprise the capable of applying the principles and techniques as professionals for developing human resources in an organization.
5. 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 :

Organisational Behaviour- Concept and Emergence of OB Concept; Nature and Theoretical frameworks; Models of Organisational Behaviour, Challenges and Opportunities for Organisational 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 Organisations: Selected cases covering HRD practices in government organisations, manufacturing and service industries and MNCs.

TEXT BOOKS:

1. Robbins, Stephen P. and Timothy A. Judge, Organisational 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: GR24A3024 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:

1. Identify and analyze statutory, regulatory, constitutional, and organizational laws that affect the information technology professional.
2. Locate and apply case law and common law to current legal dilemmas in the technology field.
3. Apply diverse viewpoints to ethical dilemmas in the information technology field and recommend appropriate actions.
4. Understand cybercrime and ethical practices and the student will be able to know and learn web technologies and related issues.
5. 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).

REFERENCE BOOKS:

1. Sudhir Naib, The Information Technology Act, 2005: A Handbook.
2. S. R. Bhansali, Information Technology Act, 2000
3. University Book House Pvt. Ltd. Jaipur (2003).
4. 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: GR24A4013 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
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-I: 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-II: Factors and measure:
Meaning of Economic development, National income, Per capital income, Quality of life, Capital Formation – Savings, Investment.

UNIT-III: 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-IV: Private and Public Sector, Public Sector:
Role and growth, Achievements of the public sector, Private Sector – Importance Problems, New foreign Trade Policy.

UNIT-V: 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
INDIAN KNOWLEDGE SYSTEM
(OPEN ELECTIVE)

Course Code: GR24A3023 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Understand nature, scope and related fields of Indian knowledge system.
2. Demonstrate the scientific literature available in ancient Indian traditions
3. Understanding the application of Bharatiya Jnana Parampara
4. Understand Indian approach towards Wellbeing
5. Appreciate vast contribution of ancient Indian researchers, engineers, scientists and architects to the modern world

UNIT-I: Introduction to Indian Knowledge Systems:
Meaning, Nature, Scope and Salient Aspects of Bharatiya Jnana Parampara - Introduction to Vedas, Upanishads, Vidya, Kala, Jnana, Shastra - Practices and Continuity of Tradition

UNIT-II: Overview of History of Indian Education and Scientific Literature:
Gurukul System - Role of Sanskrit in Natural Language Processing - Scientific Literature – Vedic. Literature - Available Scientific Treatises - Interlinkings

UNIT-III: Introduction to Scientific Theories from Pure Sciences from Ancient Indian Knowledge Systems:
Overview of theories from available ancient Indian Literature about Physics, Chemistry and Mathematics - Interlinking's and applications

UNIT-IV: Introduction to Ancient Indian Wellness Systems:
Concept of Wellness – Yoga System - Ayurveda System - Ancient Indian Aesthetics Achievements of the public sector, Private Sector – Importance Problems, New foreign Trade Policy.

UNIT-V: Development of Engineering, Science, Technology & Fine Arts in India:
Various Industries - Silk, Cotton and Ship Building - Evolution of Indian Fine Arts – Cave and Temp Architecture, Vastu - Vidya, Sculpture, Forts and Stepwells, Observatories and Paintings - Music and Natyakala - Cultural Traditions & Folk Arts.

Pedagogy for Teachers: Apart from Classroom Instruction, the following Methods are Suggested.
1. Project based activities and learning.
2. Presentation and case studies.
3. Film screening and book reviews.
4. Visit to historical places, archives centre, research centre or library nearby.

Note: Activities mentioned above are only suggestive. Teacher-educators should encourage students to be innovative.

TEXT BOOKS:
1. B. Mahadevan, Bhat Vinayak and Nagendra Pavan R.N., (2022) 'Introduction to Indian

Knowledge Systems: Concepts and Applications' PHI learning PVT, New Delhi ISBN [9789391818203]
2. Dharmapal (1971) 'Indian Science and Technology in the Eighteenth Century'. Other India Press, Goa.
3. Kapil Kapoor, Singh Avdhesh Kumar, (2005) 'Indian Knowledge Systems' D.K. Printworld (P) Ltd. ISBN 10: 8124603367 / ISBN 13: 9788124603369
4. Chakradeo, Ujwala, Temples of Bharat, Aayu Publications, New Delhi, 2024.
5. D.N. Bose, S.N. Sen and B. V. Subbarayappa, A Concise History of Science in India, Indian National Science Academy, New Delhi, 2009.
6. Datta B. and A. N. Singh, History of Hindu Mathematics: Parts I and II, Asia Publishing House, Bombay, 1962.
7. Kapoor, K. (2021), Indian Knowledge System: Nature, Philosophy, Character in Indian Knowledge System, vol. 1, Pub. Indian Institute of Advanced Studies, Shimla
8. Mahadevan, B., Bhat, V.R., Pavana, N. (2022), Philosophical Systems, in Introduction to Indian Knowledge System, Pub. PHI Learning, New Delhi.
9. Mahadevan, B., Bhat, V.R., Pavana, N. (2022), Knowledge: Framework and Classification, in Introduction to Indian Knowledge System, Pub. PHI Learning, New Delhi.

VIDEO RESOURCES:

1. Introductory lectures by Prof. Gauri Mahulikar
2. Introductory lectures by Prof. Kapil Kapoor

WEBSITES:

- https://iksin dia.org/index.php
- Official Website of IKS- Indian Knowledge System
- https://www.youtube.com/watch?v=uKcf-hSlcUE
- Address by Prof Kapil Kapoor | Indian Institute of Advanced Study (FDP 2021)
- https://www.youtube.com/watch?v=MDJTXNiH2_A
- Mukul Kanitkar on Bharatiya Knowledge System
- https://www.youtube.com/watch?v=uARMhv97pjk
- https://www.youtube.com/watch?v=oTwgf56GbsA
- Scientific History of India | Mukul Kanitkar Lecture in DTU
- https://youtu.be/gNJNmPJqXJc?si=WFBbuUT65mLZzpOW
- Ancient India's Scientific Achievements & Contribution in Mathematics, Astronomy, Science & Medicine

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
A PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS (OPEN ELECTIVE)

Course Code: GR24A4012 **L/T/P/C: 3/0/0/3**

Course Outcomes:

1. Study of Shrimad- Bhagwad-Gita wiil help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neethishatakam will help in developing versatile personality of students
4. To develop self-developing attitude towards work without self-aggrandizement and to develop suffering free meditative mind
5. To develop tranquil attitude in all favorable and unfavorable situations and to develop high spiritual intelligence

UNIT-I: Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)

UNIT-II: Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT-III: Approach to day to day work and duties

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT-IV: Statements of basic knowledge

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

UNIT-V:

- Classification, Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

TEXT BOOKS/ REFERENCE BOOKS:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
ENGINEERING MATERIALS FOR SUSTAINABILITY
(OPEN ELECTIVE)

Course Code: GR24A3009 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
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 by utilizing the engineering knowledge and principles gained from this course
4. Perform cost/benefit analysis and life-cycle analysis of green buildings.
5. Identify the balance affordability, functionality, and environmental responsibility to create sustainable and effective building designs.

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: Environmental management standards:
ISO 14000 series, Life Cycle Analysis (LCA) – Scope and Goal, Bio-mimicking, Environment Impact Assessment (EIA) – Procedures of EIA in India

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, Depleting natural resources of building materials; renewable and recyclable resources; energy efficient materials; Embodied Energy of Materials

UNIT-IV:
Green cement, Biodegradable materials, Smart materials, Manufactured Materials, Volatile Organic Compounds (VOC's), 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 – By K S Jagadeesh, B V Venkata Rama

Reddy & K S Nanjunda Rao – New Age International Publishers, 2007
2. Integrated Life Cycle Design of Structures – By AskoSarja – SPON Press, 2011
3. Non-conventional Energy Resources – By D S Chauhan and S K Srivastava – New Age International Publishers, 2021

REFERENCE BOOKS:

1. Emerald Architecture: case studies in green buildings, The Magazine of Sustainable Design, 2008
2. Understanding Green Building Guidelines: For Students and Young Professionals, Traci Rose Rider, W. W. Norton & Company Publisher.2009
3. Understanding Green Building Materials, Traci Rose Rider, W. W. Norton & Company Publisher.2011
4. Green Buildings (McGraw hill publication): by Gevorkian, 2006

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
GEOGRAPHIC INFORMATION SYSTEMS AND SCIENCE
(OPEN ELECTIVE)

Course Code: GR24A3022 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:

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.

4.

REFERENCE BOOKS:

1. Remote Sensing and Geographical Information systems by M. Anji Reddy JNTU Hyderabad.4th Edition 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, Prentice Hall 4. GIS by Kang – tsung chang, TMH Publications & Co., 2nd edition, 2013.
4. Basics of Remote 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
PLUMBING -WATER AND SANITATION
(OPEN ELECTIVE)

Course Code: GR24A4011 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Coordinate plumbing works from inception to completion with Owners, Architects, other consultants, and contractors.
2. Select proper plumbing materials and systems.
3. Read and interpret plumbing drawings.
4. Supervise code based plumbing installations. Understand methods to conserve water and energy, Protect health and safety of end users.
5. Enjoy better job opportunities and career options

UNIT-I: Introduction to Plumbing and Sanitation Importance of Codes, Architectural and Structural Coordination Codes and Standards: Scope, purpose; codes and standards in the building industry, UIPC-I (Uniform Illustrated Plumbing Code-India), NBC (National Building Code) and other codes, Local Municipal Laws, approvals, general regulations, standards, water supply, sewerage system, drainage system, workmanship, water conservation, protection of pipes and structures, waterproofing. 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.
Architectural and Structural coordination: Provisions for plumbing systems, coordination during the planning stage, various agencies involved and their roles, space planning for plumbing systems, water tanks, pump room, centralized hot water systems, toilet locations.

UNIT-II: Plumbing Terminology:
Definitions, use/purpose of the following. ***Plumbing Fixtures:*** accessible, readily accessible, aerated fittings, bathroom group, carrier, flood level rim, floor sink, flush meter valve, flush tanks, lavatories, macerating toilet, plumbing appliances, plumber. ***Traps:*** indirect waste, vent, blow off, developed length, dirty arm, indirect waste, receptors, slip joints, trap, and vent. ***Drainage:*** adapter fitting, adjusted roof area, air break, air gap, area drain, base, bell and spigot joint, building drain, branch, (DFU) Drainage Fixture Units, grease interceptor, joints, roof drain, smoke test, stack. ***Water supply:*** angle valve, anti-scald valve, backflow, bypass, check valve, cross connection, gate valve, gray water, joints.

UNIT-III: Plumbing Fixtures and Fittings:
Definitions of plumbing fixtures, fittings, appliances and appurtenances; maximum flow rates, water closets, urinals, flushing devices, washbasins, bath/shower, toilets for differently abled, kitchen sinks, water coolers, drinking fountain, clothes washer, dish washer, mop sink, overflows, strainers, prohibited fixtures, floor drains, floor, location of valves, hot water temperature controls, installation standard dimensions in plan and elevation.

UNIT-IV:

Traps, Interceptors, Indirect Waste and Vents Traps required, trap arms, developed length, trap seals, venting to traps, trap primers, prohibited traps, building traps. Discharge for indirect waste piping, nature of contents or systems, proper methods to install indirect waste piping, air gap and air break, sink traps, dish washers. Vent requirement, purpose of venting, trap seal protection, materials, vent connections, **Sanitary Drainage and Storm Drain** Preamble, one pipe and two pipe systems, different pipe materials and jointing methods, special joints, hangers and supports, protection of pipes and structures, alternative materials, workmanship, prohibited fittings and practices.

Water Supply, Gray and Reclaimed Water: Preamble, one pipe and two pipe systems, different pipe materials and jointing methods, special joints, hangers and supports, protection of pipes and structures, alternative materials, workman ship, prohibited fittings and practices, change in direction of flow, T and Y fittings, Storm drain required, prohibited connections, subsoil drains, sub-drains, gutters, channels or scuppers, roof drains, catchment, collect/capture storm water, discharging storm water, Rain Water Harvesting (RWH) definition, need, catchment, conduits, settlement tanks, treatment, possible uses, recharging pits, NBC requirements.

UNIT-V:

Water Supply, Gray and Reclaimed Water (Preamble, sources of water, potable and non- potable water, reclaimed water, calculating daily water requirement and storage, hot and cold water distribution system. pipe materials and jointing methods, alternative materials, hangers and supports, workmanship, prohibited fittings and practices, protection of pipes and Plumbing (Water and Sanitation) structures, pressure controls, unions, thermal expansion, types of valves, Definition of gray water, approvals, specifications and drawings, safety, total gray water discharge, holding tanks, valves and piping.

Introduction to water treatment plant (WTP) and STP: Introduction to Net Zero concept, need to reduce and reuse, rating of Water Efficient Plumbing fixtures and fittings, 24x7 water supply, metering and sub-metering, typical daily water and wastewater calculations for a project.

TEXT BOOKS:

1. Elements of Water Pollution Control Engineering, O.P. Gupta, Khanna Book Publishing, New Delhi. Edition ·1, 2019.
2. Plumbing Engineering" Author: R. G. Saran Publisher: S. K. Kataria & Sons Latest Edition: 2022 (Revised Edition)
3. "Water Supply and Sanitary Engineering" Authors: G. S. Birdie and J. S. Birdie Publisher: Dhanpat Rai Publishing Company Latest Edition: 2022 (33rd Revised Edition)
4. "Plumbing: Design and Installation" Author: L. G. Wade Publisher: Cengage Learning Latest Edition: 2019 (4th Edition)

REFERENCE BOOKS:

1. "Plumbing Engineering Design Handbook" (Volumes I & II) Publisher: American Society of Plumbing Engineers 2022 Edition (Volume 1: Fundamentals; Volume 2: Systems)
2. Water Efficiency and Sanitation Standard published by IPA Indian Plumbing Association (IPA) and IAPMO International Association of Plumbing and Mechanical Officials (India) Water Pollution, Berry, CBS Publishers, 2023 edition.
3. 'A Guide to Good Plumbing Practices', a book published by IPA, 2016 edition.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
NON-CONVENTIONALENERGYSOURCES
(OPEN ELECTIVE)

Course Code: GR24A3035 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Recall the concepts of Solar Energy and Solar collectors.
2. Illustrate the PVSolar system with energy backup.
3. Analyze the basic physics of wind power generation.
4. Determine the energy generation from biomass, biogas, and geothermal energy.
5. Discuss Tidal power systems and fuel cells.

UNIT-I: Solar Radiation:
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: Photo Voltaic System:
Photo voltaic 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: Wind Energy:
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: Biogas and Geothermal Energy:
Various fuels-Sources- Conversion technologies–Dry Processes-Biogas generation–Aerobic and anaerobic digestion- Factors affecting the generation of biogas –Classification of biogas plants-Different Indian digesters- Digester design considerations- Gasification process-Gasifiers-Applications. Geothermal Energy-sources-Hydro thermal convective-Geo-pressure resources-Petro-thermal systems(HDR)-Magma Resources-Prime Movers

UNIT-V: Tidal Energy:
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 andPrincipleofoperation-TypesofFuelCells-Advantagesanddisadvantages-TypesofElectrodes-Applications-Basics of Batteries –Constructional details of Lead acid batteries- Ni-Cd Batteries.

TEXT BOOKS:
1. John Twidell & Wier, Renewable Energy Resources,CRCPress,2009.
2. D.P.Kothari, Singal, Rakesh, Ranjan, Renewable Energy Sources and Emerging Technologies,

PHI, 2009.

REFERENCE BOOKS:

1. G.D.Rai–Non-Conventional Energy sources, Khanna publishers.
2. B.H.Khan,"Non-ConventionalEnergyResources",2ndedition,TataMcGraw-Hill,New Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

CONCEPTSOF CONTROLSYSTEMS
(OPEN ELECTIVE)

Course Code: GR24A3046 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

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. IJNagrath, M.Gopal, Control System Engineering,New Age International Publishers, Fifth edition.
2. NormanSNise, Control system engineering, JohnWiley& Sons,Inc.,Sixth edition

REFERENCE BOOKS:

1. RichardC.Dorf, Robert HBishop, Modern control systems, Pearson Education International, Twelfth edition.
2. ANagoorKani, Control Systems, CBS Publishers. Jon. S. Wilson; "Sensor Technology Hand

Book", Elsevier Inc., 2005.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ARTIFICIALNEURAL NETWORKS AND FUZZY LOGIC
(OPEN ELECTIVE)

Course Code: GR24A4037 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

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 Crispsets.
4. Model Fuzzy membership Function and rules for Applications.
5. Analyze the parameters of Genetic Algorithm.

UNIT-I: NEURALNETWORKS 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.

to Information Theory, Shanon Capacity, Multimedia Data, Data Processing, Boolean Logics, Information Content, Entropy, Source Coding, Channel Coding, Modulation Schemes, Internet.

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: FUZZYLOGIC I (Introduction):

Basic concepts of fuzzy logic, Fuzzy sets and Crispsets, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

UNIT-IV: FUZZYLOGIC 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: GENETICALGORITHMS(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. JMZurada,"An Introduction to ANN",JaicoPublishing House.
2. Neural Networks, Fuzzy Logic, And Genetic Algorithms: Synthesis and Applications -byS. Rajasekaran, G. A. Vijayalakshmi Pai, PHI publishers.

REFERENCE BOOKS:

1. HungT.Nguyen,Nadipuram R.Prasad,CarolL. Walker andElbertA.Walker,"AFirstCourse in Fuzzy and Neural Control" Chapman & Hall, CRC.
2. Driankov,Dimitra,"AnIntroductiontoFuzzyControl",NarosaPublication.
3. TimothyJRoss, "Fuzzy Logic with Engg. Applications",McGraw.Hill.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INDUSTRIAL AUTOMATION AND CONTROL
(OPEN ELECTIVE)

Course Code: GR24A3056 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
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, 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.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

OPERATIONS RESEARCH
(OPEN ELECTIVE)

Course Code: GR24A3034 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

1. Formulate and solve linear programming problems using simplex and duality approaches for resource allocation.
2. Apply non-linear optimization techniques (single and multi-variable unconstrained methods) to practical engineering and management problems.
3. Analyze and solve transportation and assignment models for effective decision-making in logistics and resource allocation.
4. Evaluate inventory control systems and queuing models to optimize stock management and service efficiency.
5. Apply replacement and dynamic programming models for long-term decision-making in capital budgeting, maintenance, and system optimization.

UNIT-I: Introduction & Linear Programming:

Introduction: Development, Definition, Characteristics and Phases of Operations Research, Types of models: Operations Research models – Applications: Linear Programming Problem (LPP) formulation, Graphical solution method, Simplex method – Artificial variables techniques (Two–phase method, Big-M method), Duality principle

UNIT-II: Non-Linear Programming:

Introduction – Difference between linear and nonlinear programming, applications in engineering & management; **Single-variable unconstrained optimization**: Uni-modal functions, Elimination methods – Bisection/interval halving, Fibonacci method, Golden Section method; **Multi-variable unconstrained optimization**: Gradient of a function, optimality condition, Gradient methods – Steepest Descent Method, Conjugate Gradient Method (Fletcher–Reeves)

UNIT-III: Transportation & Assignment Models:

Transportation models: Formulation, Methods for finding feasible solution and optimal solution, Unbalanced transportation problems, degeneracy; **Assignment models**: Formulation, Optimal solution, Variants of Assignment Problem (e.g., unbalanced, maximization, traveling salesman problem)

UNIT-IV: Inventory & Queuing Models:

Inventory models: Single-item deterministic models, Purchase inventory models with one price break and multiple price breaks, Shortages not allowed, Stochastic models – demand as discrete or continuous variable, Instantaneous production, instantaneous demand and continuous demand (no setup cost)

Queuing models: Introduction, Single-channel system: Poisson arrivals, exponential service times, infinite/finite population, Multi-channel systems: Poisson arrivals, exponential service times with infinite population

UNIT-V: Replacement & Dynamic Programming:

Replacement models: Replacement of items that deteriorate with time (with and without time value of money), Replacement of items that fail completely, Group replacement policy
Dynamic programming: Introduction – Bellman's Principle of Optimality Applications: capital budgeting, shortest path problem, linear programming problem

TEXT BOOKS:

1. Operations Research/ Prem Kumar Gupta, Dr. D.S. Hira
2. Operations Research / S. D.Sharma-Kedarnath
3. Operation Research /J.K.Sharma/MacMilan.

REFERENCE BOOKS:

1. A.K. Operations Research / R.Pannerselvam,PHI Publications.
2. Introduction to O.R /Taha/PHI
3. Operations Research / Wagner/ PHI Publications.
4. Introduction to O.R/Hiller and Libermann (TMH).
5. Operations Research /A.M.Natarajan, P.Balasubramani,A. Tamilarasi/Pearson Education.
6. Operations Research: Methods and Problems / Maurice Saseini, ArhurYaspan and Lawrence Friedman
7. O.R/Wayne L.Winston/Thomson Brooks/cole

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

COMPOSITE MATERIALS
(OPEN ELECTIVE)

Course Code: GR24A3066 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

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
DIGITAL ELECTRONICS FOR ENGINEERING
(OPEN ELECTIVE)

Course Code: GR24A3076 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
1. Get basic knowledge on logic gates, Universal gates and their switching logics.
2. Realize Boolean expressions using NAND/NOR gates and reduce them using K map.
3. Know all types of combinational and sequential circuits.
4. Acquire knowledge on realization of logic families using diodes and transistor, and also on different types of integrated circuits.
5. Understand the characteristics and applications of operational amplifiers in different modes of operation.

UNIT-I: Number Systems:
Number systems, Complements of Numbers, Codes- Weighted and Nonweighted codes and its properties. Boolean Algebra: Basic Theorems and Properties, Switching Functions- Canonical and Standard Form, Algebraic Simplification, Digital Logic Gates, EX-OR gates, Universal Gates, Multilevel NAND/NOR realizations.

UNIT-II: Minimization of Boolean functions:
Karnaugh Map Method - Up to four Variables, Don't Care Map Entries, Tabular Method, Combinational Logic Circuits: Adders, Subtractors, Comparators, Multiplexers, Demultiplexers, Encoders, Decoders and Code converters, Hazards and Hazard Free Relations.

UNIT-III: Sequential Circuits Fundamentals:
Basic Architectural Distinctions between Combinational and Sequential circuits, SR Latch, Flip Flops: SR, JK, JK Master Slave, D and T Type Flip Flops, Excitation Table of all Flip Flops, Fundamentals of shift registers, ripple and decade counters.

UNIT-IV: Realization of Logic Gates Using Diodes & Transistors:
AND, OR and NOT Gates using Diodes and Transistors, DCTL, RTL, DTL, TTL, CML and CMOS Logic Families and its Comparison, standard TTL NAND Gate Analysis & characteristics, TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tristate outputs, CMOS transmission gate.

UNIT-V: Integrated Circuits:
Classification, chip size and circuit complexity, basic information of op-amp, ideal and practical Op-amp, internal circuits, Op-amp characteristics, DC and AC Characteristics, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential.

TEXT BOOKS:
1. Switching and Finite Automata Theory - ZviKohavi& Niraj K. Jha, 3rd Edition, Cambridge, 2010.
2. Modern Digital Electronics – R. P. Jain, 3rd Edition, 2007- Tata McGraw-Hill
3. Linear Integrated Circuits, D. Roy Chowdhury, New Age International(p) Ltd.

4. Op-Amps & Linear ICs, Ramakanth A. Gayakwad, PHI

REFERENCE BOOKS:

1. Digital Design- Morris Mano, PHI, 4th Edition,2006
2. Operational Amplifiers & Linear Integrated Circuits, R.F. Coughlin & Fredrick F. Driscoll, PHI
3. Operational Amplifiers & Linear Integrated Circuits: Theory & Applications, Denton J. Daibey, TMH.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SENSOR TECHNOLOGY
(OPEN ELECTIVE)

Course Code: GR24A3085 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to
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 or 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: Introduction to Sensor Systems:
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 magneto strictive sensors. Capacitive sensors- variable capacitor, differential capacitor.

UNIT-IV: Accelerometers:
Characteristics and working principle of accelerometer sensors, 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, "Hand Book of Modern Sensors: Physics, Designs and Applications", 3rd Edition.,

REFERENCE BOOKS:

1. Er. R.K. Rajput, "Electronic Measurements and Instrumentation", S. Chand & Company Ltd. 3rd Edition.
2. A.K.Sawhney, "Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai.
3. Bentley, John P., "Principles of Measurement Systems", 4th Edition, Pearson/Prentice Hall, 2005
4. Jon. S. Wilson; "Sensor Technology Hand Book", Elsevier Inc., 2005.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
COMMUNICATION TECHNOLOGIES
(OPEN ELECTIVE)

Course Code: GR24A4078 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to
1. Understand the information theory and its coding styles.
2. Acquire knowledge on wireless communications and services.
3. Understand the various mobile networks and generations
4. Acquire knowledge on optical communications.
5. Know about network security through encryption and decryption.

UNIT-I: Information Theory:
Introduction to Information Theory, Shanon Capacity, Multimedia Data, Data Processing, Boolean Logics, Information Content, Entropy, Source Coding, Channel Coding, Modulation Schemes, Internet.

UNIT-II: Wireless Communication Technologies:
Introduction to Wireless Communication Technologies, WLAN, Wifi, Bluetooth, Other Wireless PAN And WAN Technologies, Satellite Communications, Broadcast Services.

UNIT-III: Cellular Mobile Networks:
Introduction to Cellular Mobile Networks, GSM(2G), UMTS (3G), LTE(4G), 5G Mobile Networks, Mobile Network Planning Aspects.

UNIT-IV: Optical Communication:
Introduction to Optical Communications, Optical Fiber, FTTC, FTTH, FTTBS, Free Space Optical Link, Channel Model with Different Factors, Deep Space Optical Communications.

UNIT-V: Network Security and Management:
Introduction to Network Security and Management, Symmetrical Encryption, Asymmetrical Encryption, Authentication, Hash-Value, Integrity Check, Telecommunications Management Network, SNMP, Functionalities of Network Management, Trends and Future Development.

TEXT BOOKS:
1. Shun-Ping Chen, “Fundamentals of Information and Communication Technologies” 2020
2. B.P. Lathi, “Communication systems”- BS Publications, 2006..

REFERENCE BOOKS:
1. Simon Haykin, John Wiley “Digital Communications” 2005.
2. Herbert Taub, Donald L Schilling Gautham Saha “Principles of Communication systems” 3rd edition McGraw-Hill 2008.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
DATA SCIENCE FOR ENGINEERS
(OPEN ELECTIVE)

Course Code: GR24A3092 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:
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.
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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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DATA ANALYTICS USING OPEN SOURCE TOOLS
(OPEN ELECTIVE)

Course Code: GR24A3103 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

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, The Care and Feeding of Your Data Zoo.

TEXT BOOKS:

1. Philipp K. Janert, Data Analysis with Open Source Tools, O'Reilly Media, Inc, November2010:

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 RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
AUGMENTED REALITY AND VIRTUAL REALITY
(OPEN ELECTIVE)

Course Code: GR24A4096 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to
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 Health and 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 RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SERVICES SCIENCE AND SERVICE OPERATIONAL MANAGEMENT
(OPEN ELECTIVE)

Course Code: GR24A4115 **L/T/P/C: 3/0/0/3**

Course Pre-Requisite(s): Fundamentals of Management, Operations Research
Course Outcomes: After completing this course, students will be able to:
1. Understand concepts of services and its 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:
Simple 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 RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
IT PROJECT MANAGEMENT
(OPEN ELECTIVE)

Course Code: GR24A4116 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to
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:
Reporting **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. Pichler, Agile Product Management with Scrum
2. Roman Ken Schwaber, Agile Project Management with Scrum (Microsoft Professional

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
MARKETING RESEARCH AND MARKETING MANAGEMENT
(OPEN ELECTIVE)

Course Code: GR24A4117 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

1. Understand the significance of marketing management concepts, marketing environment, consumer behaviour elements and strategies related to STP.
2. Understand various product management strategies and importance of branding, 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. 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 about 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, 5 M'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. Relationship, 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 Schindler.

REFERENCE BOOKS:

1. Marketing Management – Rajan Saxena.
2. Marketing Management – S.A. Sherlekar.
3. Service Marketing – S.M. Zha.
4. Journals – The IUP Journal of Marketing Management, Harvard Business Review.
5. Research for Marketing Decisions by Paul Green, Donald, Tull.
6. Business Statistics, A First Course, David M Levine at al, Pearson Publication.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

BASICS OF JAVA PROGRAMMING
(OPEN ELECTIVE)

Course Code: GR24A3133 **L/T/P/C: 3/0/0/3**

Course Outcomes: After completing this course, students will be able to:

1. Apply OOP principles by writing Java programs using data types, operators, and control structures.
2. Analyze Java programs by implementing classes, constructors, arrays, and inheritance, and differentiate overloading and overriding.
3. Demonstrate modular design with packages, interfaces, and abstract classes, and evaluate exception handling.
4. Implement multithreading and synchronization and utilize collections for efficient data management.
5. Design modern Java applications using JavaFX, Spring Boot, and Hibernate/JPA

UNIT-I:

Object Oriented Thinking: Introduction, Need of object-oriented programming, principles of object-oriented languages, Applications of OOP, history of JAVA, Java Virtual Machine, Java features, Program structures, Installation of JDK.

Variables, Primitive data types, Identifiers- Naming Conventions, Keywords, Literals, Operators- Binary, Unary and Ternary, Expressions, Primitive Type conversion and casting, flow of control- branching, conditional, loops.

UNIT-II:

CLASSES, INHERITANCE, POLYMORPHISM:

Classes and Objects: Classes, Objects, creating objects, methods, constructors- constructor overloading, cleaning up unused objects- Garbage collector, class variable and methods- static keyword, this keyword, arrays, Command line arguments, Nested Classes

Strings: String, String Buffer, String Tokenizer

Inheritance and Polymorphism: Types of Inheritance, deriving classes using extends keyword, super keyword, Polymorphism – Method Overloading, Method Overriding, final keyword, abstract classes.

UNIT-III:

INTERFACES, PACKAGES, EXCEPTIONS

Interfaces: Interface, Extending interface, interface Vs Abstract classes.

Packages: Creating Packages, using Packages, Access protection, java I/O package. Exceptions Introduction, Exception handling Techniques: try…catch, throw, throws, finally block, user defined Exception.

UNIT-IV:

MULTI-THREADING, COLLECTIONS

java.lang.Thread, the main Thread, creation of new Threads, Thread priority, multithreading- using isalive() and join(), Synchronization, suspending and resuming Threads, Communication between Threads. Exploring java.io, Exploring java.util

Collections: Overview of Collection Framework : Array List, LinkedList, Vector, HastSet, Tree Set, HashMap, Hash Table, Tree Map, Iterator, Comparator

UNIT-V:

Introduction to Spring Framework Overview of the Spring ecosystem, concepts of Inversion of Control (IoC) and Dependency Injection (DI), Spring Boot basics for rapid application development, and building a simple REST API with Spring Boot.

Data Access with Java Introduction to JDBC, an overview of JPA (Java Persistence API), using Hibernate with Spring Data JPA, and creating a simple CRUD application as an example.

Teaching Methodologies:

Power Point Presentations
Tutorial Sheets
Assignments

TEXT BOOKS:

1. Java: The Complete Reference, 10thedition, Herbert Schildt, McgrawHill.
2. Java Fundamentals: A Comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
3. Java for Programming, P.J.Dietel Pearson Education.

REFERENCE BOOKS:

1. Object Oriented Programming through Java, P.Radha Krishna, Universities Press.
2. Thinking in Java, Bruce Eckel, Pearson Education
3. Programming in Java, S.Malhotra and S.Choudhary, Oxford University Press

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

INTRODUCTION TO DBMS
(OPEN ELECTIVE)

Course Code: GR24A3141 **L/T/P/C: 3/0/0/3**

Course Outcomes: On completion of the course, the student will be able to

1. Demonstrate the concepts of data mining, its applications
2. Apply data preprocessing techniques such as cleaning, integration, transformation, and reduction.
3. Implement clustering algorithms and evaluate their performance using similarity measures
4. Analyze association rules using Apriori and other frequent pattern mining techniques.
5. Examine outlier detection methods and justify their applications in real-world scenarios.

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.

Teaching Methodologies:

Power Point Presentations
Tutorial Sheets
Assignments

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 Management Systems", P. Radha Krishna HI-TECH Publications 2005.
2. "Database Management System", Elmasri Navate, Pearson Education.
3. "Database Management System", Mathew Leon, Leo

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

INTRODUCTION TO DATA MINING
(OPEN ELECTIVE)

Course Code: GR24A4124 **L/T/P/C: 3/0/0/3**

Prerequisites: Students are expected to have knowledge of transactional and relational databases, probability, and statistics.

Course Outcomes: On completion of the course, the student will be able to

1. Demonstrate the concepts of data mining, its applications
2. Apply data preprocessing techniques such as cleaning, integration, transformation, and reduction.
3. Implement clustering algorithms and evaluate their performance using similarity measures
4. Analyze association rules using Apriori and other frequent pattern mining techniques.
5. Examine outlier detection methods and justify their applications in real-world scenarios.

UNIT-I:

Introduction: Why Data mining, What is Data Mining, What Kinds of Data Can Be Mined, What Kinds of Patterns Can Be Mined, Which Technologies are used, 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.

UNIT-III:

Association Rule Mining: Introduction to association rule mining. Apriori algorithm and other frequent pattern mining techniques. Measuring the strength of association rules.

UNIT-IV:

Classification: Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation, k-Nearest-Neighbor Classifiers.

UNIT-V:

Clustering: Introduction to clustering and similarity measures.
Clustering algorithms: k-means, hierarchical clustering, density-based clustering.
Evaluating clustering results: silhouette score, Davies-Bouldin index.

Teaching Methodologies:

Power Point Presentations
Tutorial Sheets
Assignments

TEXT BOOKS:

1. Data Mining Concepts and Techniques - Jiawei Han & Micheline Kamber, Morgan Kaufmann Publishers, Elsevier, Third Edition, 2012.

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, Pearson Edn Asian

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
INTRODUCTION TO OPERATING SYSTEMS
(OPEN ELECTIVE)

Course Code: GR24A3143 **L/T/P/C: 3/0/0/3**

Prerequisite: Students should have prior knowledge of:
- Basics of Programming, and
- Fundamentals of Data Structures and Algorithms, such as stacks, queues, and linked lists.

Course Outcomes: After completing this course, students will be able to:
1. Explain the objectives, structure, and functions of an operating system, including process, memory, storage, and security management, and demonstrate how OS services interact with users and hardware.
2. Apply process management concepts such as process states, scheduling algorithms, and interprocess communication; design and solve synchronization problems using semaphores, monitors, and classical solutions.
3. Analyze memory management strategies such as paging, segmentation, and swapping, and evaluate virtual memory techniques including demand paging, page replacement, and thrashing control.
4. Implement basic file operations and explain file system structure, directory management, allocation methods, and disk scheduling techniques for efficient storage management.
5. Identify, prevent, and recover from deadlocks; apply system protection principles and access control mechanisms to safeguard resources and files in different operating system environments.

UNIT-I: Introduction:
Overview, Objectives, User view, System view, Operating system definition, Computer System Organization, Computer System Architecture, OS Structure, OS Operations, Process Management, Memory Management, Storage Management, Protection and Security.
Operating System services, User and OS Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, OS Structure.

UNIT-II: Process and CPU Scheduling:
Process concepts: The Process, Process State, Process Control Block, Threads, Process Scheduling-Scheduling Queues, Schedulers, Context Switch, Operations on Processes, System calls-fork(), exec(), wait(), exit(), Interprocess communication.
Process Scheduling: Basic concepts, Scheduling Criteria, Scheduling algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Thread scheduling. Process Synchronization, Critical Section Problem, Peterson's solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors.

UNIT-III: Memory Management and Virtual Memory:
Memory Management Strategies - Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table.
Virtual Memory Management - Background, Demand Paging, Page Replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing.

UNIT-IV: Storage Management and File System:

Storage Management - File System, Concept of a File, System calls for File Operations – open (), read (), write (), close (), seek (), unlink (), Access methods - Directory and Disk Structure, File System Mounting, File Sharing, Protection.

File System Structure, File System Implementation, Directory Implementation, Allocation methods, Free-space Management, Efficiency, and Performance. Mass Storage Structure – Overview, Disk Structure, Disk Attachment, Disk Scheduling.

UNIT-V: Deadlocks and Protection:

Deadlocks - System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

Protection – System Protection, Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Access Control, Revocation of Access Rights, Capability-based Systems, Language-based Protection.

TEXT BOOKS:

1. William Stallings, Operating Systems: Internals and Design Principles, 9th Edition, PHI, 2019.
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles, 7th Edition, Wiley, 2006.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum, Modern Operating Systems, 5th Edition, PHI, 2022.
2. Gary J. Nutt, Operating Systems: A Modern Perspective, 3rd Edition, Addison-Wesley, 2004.
3. R. Elmasri, A.G. Carrick, D. Levine, Operating Systems, First Edition, McGraw Hill, 2009.
4. Charles Crowley, Operating System: A Design-oriented Approach, Irwin Publishing, First Edition, 1996.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

INTERNET OF THINGS
(OPEN ELECTIVE)

Course Code: GR24A3145 **L/T/P/C: 3/0/0/3**

Prerequisite:
The fundamental knowledge in C programming, Data Structures and Operating Systems

Course Outcomes: On completion of the course, the student will be able to

1. Understand IoT architecture and fundamental networking protocols and models.
2. Develop Arduino-based IoT applications integrating sensors and actuators.
3. Program Raspberry Pi using Python for cloud-connected IoT solutions.
4. Analyse various IoT applications including smart home and industrial systems.
5. Apply cloud and edge computing for IoT data analytics.

UNIT-I:

Introduction to IoT and Sensor Networks: Introduction to Internet of Things (IoT), Characteristics and Applications of IoT, IoT Architecture and Reference Models(IETF, ITU-T), Physical Design of IoT- Devices, Gateways, and Data Centers, Functional Blocks of IoT- Sensing, Actuation, Communication, Enabling Technologies: RFID, Wireless Sensor Networks.

Networking and Communication Protocols: MQTT, CoAP, ZigBee, HTTP Sensor Networks-Types, Topologies, and Protocols, Introduction to IoT Security and Privacy Fundamentals.

UNIT-II:

Machine to Machine (M2M) and Embedded Programming for IoT: Machine-to-Machine Communications Overview, Difference between IoT and M2M, Interoperability in IoT, Standards and Protocols.

Arduino: Introduction to Arduino Programming for IoT, Integration of Sensors and Actuators with Arduino, Hands-on Exercises- Sensor Data Acquisition and Actuator Control, Basic Communication Protocols, Implementation on Arduino-IoT Device Interoperability, Challenges and Solutions.

UNIT-III:

Raspberry Pi with Python Programming for IoT: Introduction to Python Programming , Basics, Overview of Raspberry Pi and its Role in IoT, Interfacing Raspberry Pi with Sensors and Actuators (UART, SPI, I2C).

Data Acquisition and Processing: Data Acquisition and Local Processing, Sending Data to Cloud Platforms, Implementation of IoT Projects Using Raspberry Pi.

Case Studies: Smart Home Automation, Healthcare Monitoring, Environmental Sensing.

UNIT-IV:

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.

UNIT-V:

Cloud and Edge Computing Models with IoT Use Cases: Introduction to Cloud Computing

and Cloud Storage Models, Edge and Fog Computing Concepts for IoT, Web Servers and Cloud Platforms for IoT (AWS IoT, Azure IoT, etc.).

IoT Use Cases: Smart Cities, Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT

TEXT BOOKS:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
2. Vijay Madisetti, Arshdeep Bahga, "Internet of Things: A Hands-On Approach", 2015.
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. Terokarvinen, kemo, karvinen and villeyvaltokari, "Make sensors": 1st edition, Maker Media, 2014.
2. Waltenegus Dargie, Christian Poellabauer, Fundamentals of Wireless Sensor Networks: Theory and Practice, 2010.
3. Charles Bell, Beginning Sensor networks with Arduino and Raspberry Pi, Apress, 2013.
4. Fei Hu, Security and Privacy in Internet of Things (IoTs), CRC Press, Taylor & Francis Group, 2020.
5. S. Sahoo, S. Sahoo, S. Mishra, Software-Defined Networking for Future Internet Technology: Concepts and Applications, Routledge, 2022.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY
SCRIPTING LANGUAGES
(OPEN ELECTIVE)

Course Code: GR24A4134 **L/T/P/C: 3/0/0/3**

Prerequisites: Basic knowledge of programming concepts (loops, functions, arrays) and fundamentals of databases.

Course Outcomes: On completion of the course, the student will be able to

1. Understand PHP basics including variables, constants, control structures, arrays, and functions for web application development.
2. Apply MySQL database concepts with PHP to design, query, and manage relational databases securely.
3. Implement advanced PHP features such as authentication, file upload, email handling, and encryption in dynamic websites.
4. Design and develop Perl programs using arrays, hashes, subroutines, and advanced features like file system interaction, modules, and object-oriented constructs.
5. Apply Python programming concepts including functions, built-in modules, exception handling, and OOP paradigms for web and general-purpose scripting.

UNIT-I: PHP Basics:

Basics - Features, Data types, Variables, Constants, Expressions, String interpolation, Control structures, Embedding PHP Code in Web pages.

Functions: Creating a Function, Function Libraries, Arrays, Strings and Regular Expressions.

UNIT-II: MySQL Basics:

Introduction: Database Concepts, Overview of MySQL database, Installation. Connection establishment and Accessing MySQL Server, Querying the database. Data Definition Language. Functions and Logical operators, Access Privilege System.

UNIT-III: Advanced PHP Programming:

PHP and Web Forms, Files, PHP Authentication and Methodologies - File-based, Database-based, IP-based. Uploading Files with PHP, Sending Email, PHP Encryption Functions, 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, Syntax and Indentation, Statements, Functions, Built-in-Functions, Basics of Object-Oriented Paradigm, Modules and Packages, Exception Handling.

TEXT BOOKS:

1. David Barron, The World of Scripting Languages, Wiley India Pvt. Ltd., 1st Edition, 2003.

2. Jason Gilmore, Beginning PHP and MySQL, From Novice to Professional, Apress (Dreamtech India), 3rd Edition, 2008.
3. Steve Holden and David Beazley, Python Web Programming, New Riders Publications, 1st Edition, 2001.

REFERENCE BOOKS:

1. James Lee and Brent Ware, Open Source Web Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP, Addison-Wesley (Pearson Education), 1st Edition, 2003.
2. Julie Meloni and Matt Telles, PHP 6 Fast & Easy Web Development, Cengage Learning, 1st Edition, 2008.
3. Ivan Bayross and Sharanam Shah, PHP 5.1, The X Team, SPD Publications, 1st Edition, 2006.