Academic Regulations
Programme Structure
&
Detailed Syllabus

Bachelor of Technology
(B. Tech)
(Four Year Regular Programme)
(Applicable for Batches admitted from 2018)

Department of Mechanical Engineering

GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING & TECHNOLOGY
Bachupally, Kukatpally, Hyderabad, Telangana, India
500 090

Academic Regulations

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY, HYDERABAD
DEPARTMENT OF MECHANICAL ENGINEERING (B. Tech)
GR18 REGULATIONS

Gokaraju Rangaraju Institute of Engineering and Technology 2018 Regulations (GR18 Regulations) are given hereunder. These regulations govern the programmes offered by the Department of Mechanical Engineering with effect from the students admitted to the programmes in 2018-19 academic year.

1. **Programme Offered:** The programme offered by the Department is B. Tech in Mechanical Engineering, a four-year regular programme.

2. **Medium of Instruction:** The medium of instruction (including examinations and reports) is English.
3. **Admissions:** Admission to the B. Tech in Mechanical Engineering Programme shall be made subject to the eligibility, qualifications and specialization prescribed by the State Government/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/Universityor 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.

4. **Programme Pattern:**
   a) Each Academic year of study is divided in to 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 is 160.
   e) Student is introduced to "Choice Based Credit System (CBCS)".
   f) 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.
   g) All the registered credits will be considered for the calculation of final CGPA.
   h) 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.

i) **Subject/Course Classification:** All subjects/ courses offered for the under graduate programme in E&T (B.Tech. degree programmes) are broadly classified as follows.

S. No.	Broad Course Classification	Course Group/ Category	Course Description
1	BSC	Basic Science Courses	Basic Science Courses
2	ESC	Engineering Science Courses	Includes Engineering subjects
3	HSMC	Humanities and Social sciences	Includes Management courses
4	PCC	Professional Core Courses	Includes core subjects related to the parent discipline/ department/ branch of Engineering.
5	PEC	Professional Elective Courses	Includes elective subjects related to the parent discipline/ department/ branch of Engineering.
6	OEC	Open Elective Courses	Electives from other technical and/or emerging subjects
7	LC	Laboratory Courses	Laboratory Courses
8	MC	Mandatory Courses	Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Traditional Knowledge
9	PROJ	Project Work	Project work, seminar and internship in industry or elsewhere

5. **Award of B. Tech Degree:** A student will be declared eligible for the award of B. Tech Degree if he/she fulfills the following academic requirements:
   a) He/She 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.
   c) A student, who fails to fulfill all the academic requirements for the award of the degree within eight academic years from the date of admission, shall forfeit his/her seat in B. Tech course.
   d) The Degree of B. Tech in Mechanical Engineering shall be conferred by Jawaharlal Nehru Technological University Hyderabad (JNTUH), Hyderabad, on the students who are admitted to the programme and fulfill all the requirements for the award of the degree.

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 Academic Council.

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 may seek reregistration for that semester when offered next with the academic regulations of the batch into which he/she gets re-registered.

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	30	70	100
2	Practical	30	70	100
3	Engineering Graphics	30	70	100
4	Mini Project	30	70	100
5	Project Work	30	70	100

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

Assessment Procedure:

S. No	Component of Assessment	Marks Allotted	Type of Assessment	Scheme of Examinations
1	Theory	30	Internal Examination & Continuous Evaluation	1) Two mid semester examination shall be conducted for 20 marks each for a duration of 2 hours. Average of the two mid exams shall be considered **i) Subjective - 15 marks** **ii) Objective - 5 marks** **2) Tutorials - 5 marks** **3) Continuous Assessment – 5 marks**
		70	Semester end examination	The semester-end examination is for a duration of 3 hours
2	Practical	30	Internal Examination & Continuous Evaluation	**i) Internal Exam-10 marks** **ii) Record - 5 marks** **iii) Continuous Assessment - 15 marks**
		70	Semester end examination	The semester-end examination is for a duration of 3 hours

d) **Mini Project with Seminar:** The Mini Project is to be taken up with relevance to Industry and is evaluated for 100 marks. Out of 100 marks, 30 marks are for internal evaluation and 70 marks are for external evaluation. The supervisor continuously assesses the students for 20 marks (Continuous Assessment – 15 marks, Report – 5 marks). At the end of the semester, Mini Project shall be displayed in the road show at the department level for the benefit of all students and staff and the same is to be evaluated by Mini Project Review Committee for 10 marks. The mini project report shall be presented before Project Review Committee in the presence of External Examiner and the same is evaluated for 70 marks. Mini Project Review Committee consists of HOD, Mini Project Coordinator and Supervisor.

e) **Summer Internship:** Summer Internship shall be done by the student in the summer break after III B. Tech II Semester and shall be evaluated in IV B. Tech I Semester along with the Project Work (Phase I).

f) **Project Work (Phase–I and Phase-II):** The project work is evaluated for 100 marks. Out of 100, 30 marksshall be for internal evaluation and 70 marksfor the external evaluation. The supervisor assesses the student for 20 marks (Continuous Assessment – 15 marks, Report –5 marks). At the end of the semester, projects shall be displayed in the road show at the department level for the benefit of all students and staff and the same is to be evaluated by the Project Review Committee for 10 marks. The external evaluation for Project Work is a Viva-Voce Examination which is conducted by the Project Review Committee in the presence of external examiner and is evaluated for 70 marks, Project Review Committee consists of HOD, Project Coordinator and Supervisor.These rules are applicable for both Phase I and Phase II.

g) Engineering Graphics:

- Two internal examinations, each is of 10 marks. The average of the two internal tests shall be considered for the award of marks.
- Submission of day to day work - 15 marks.
- Continuous Assessment - 5 marks.

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 appear for a supplementary examination, as per the schedule announced by the College.
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. **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	First year first semester to first year second semester	Regular course of study of first year first semester.
2	First year second semester to second year first semester	(i) Regular course of study of first year second semester. (ii) Must have secured at least 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 semester to fourth 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.
7	Fourth year first semester to fourth year second semester	Regular course of study of fourth year first semester.

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

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

Earning of Credit:

A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range O-P. Letter grade 'F' in any Course implies failure of the student in that course and no credits 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.,

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

Where C_i is the number of credits of the i^{th} course and G_i 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., upto and inclusive of S_k, where k ≥ 2.

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

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

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

	Class Awarded	CGPA Secured
14.1	First Class With Distinction	CGPA >= 8.00 with no F or below grade/ detention anytime during the programme
14.2	First Class	CGPA >= 8.00 with rest of the clauses of 14.1 not satisfied
14.3	First Class	CGPA ≥ 6.50 and CGPA < 8.00
14.4	Second Class	CGPA ≥ 5.50 and CGPA < 6.50
14.5	Pass Class	CGPA ≥ 5.00 and CGPA < 5.50

15. **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.

16. **Transfer of students from the Constituent Colleges of JNTUH or from other Colleges/ Universities:** Transfer of students from the Constituent Colleges of JNTUH or from other Colleges/ Universities shall be considered only on case-to-case basis by the Academic Council of the Institute.

17. **Transitory Regulations:** Students who have discontinued or have been detained for want of attendance, or who have failed after having undergone the Degree Programme, may be considered eligible for readmission/re-registration to the same or equivalent subjects as and when they are offered.

18. General Rules

a) The academic regulations should be read as a whole for the purpose of any interpretation.
b) In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.
c) In case of any error in the above rules and regulations, the decision of the Academic Council is final.
d) The college may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the college.

Academic Regulations for B.Tech (Lateral Entry) under GR18
(Applicable for Batches Admitted from 2019-2020)

1. All regulations as applicable for B.Tech Four 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 123 credits and secure all credits. The marks obtained in all 123 credits shall be considered for the calculation of the final CGPA.

c) Students who fail to fulfil all the academic requirements for the award of the degree within six academic years from the year of their admission, shall forfeit their seat in B.Tech programme.

2. Academic Requirements and Promotion Rules:

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

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

S. No.	Promotion	Conditions to be fulfilled
1	**Second year first semester to second year second semester.**	**Regular course of study of second year first semester.**
2	**Second year second semester to third year first semester.**	**(i) Regular course of study of second year second semester.** **(ii) Must have secured at least 50% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.**
3	**Third year first semester to third year second semester.**	**Regular course of study of third year first semester.**

4	**Third year second semester to fourth year first semester.**	**(i) Regular course of study of third year second semester.** **(ii) Must have secured at least 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 ofthe 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 123 credits.

	Class Awarded	CGPA Secured
3.1	**First Class With Distinction**	**CGPA >= 8.00 with no F or below grade/ detention anytime during the programme**
3.2	**First Class**	**CGPA >= 8.00 with rest of the clauses of 3.1 not satisfied**
3.3	**First Class**	**CGPA ≥ 6.50 and CGPA < 8.00**
3.4	**Second Class**	**CGPA ≥ 5.50 and CGPA < 6.50**
3.5	**Pass Class**	**CGPA ≥ 5.00 and CGPA < 5.50**

Gokaraju Rangaraju Institute of Engineering and Technology
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MECHANICAL ENGINEERING

I YEAR I SEMESTER

S.No.	Course Code	COURSE	Hours			Total Hours	Total Credits	Int	Ext	Marks
			L	T	P					
1	GR18A1001	Linear Algebra and Differential Calculus	3	1	0	4	4	30	70	100
2	GR18A1004	Engineering Physics	3	1	0	4	4	30	70	100
3	GR18A1007	Programming for Problem Solving	3	1	0	4	4	30	70	100
4	GR18A1010	Engineering Graphics	1	0	4	5	3	30	70	100
5	GR18A1012	Engineering Physics Lab	0	0	3	3	1.5	30	70	100
6	GR18A1015	Programming for Problem Solving Lab	0	0	3	3	1.5	30	70	100
		Induction Programme								
Total			**10**	**3**	**10**	**23**	**18**	**180**	**420**	**600**

I YEAR II SEMESTER

S.NO	Course Code	COURSE	Hours			Total Hours	Total Credits	Int	Ext	Marks
			L	T	P					
1	GR18A1002	Differential Equations and Vector Calculus	3	1	0	4	4	30	70	100
2	GR18A1005	Engineering Chemistry	3	1	0	4	4	30	70	100
7	GR18A1009	Engineering Mechanics	3	1	0	4	4	30	70	100
4	GR18A1006	English	2	0	0	2	2	30	70	100
5	GR18A1013	Engineering Chemistry Lab	0	0	3	3	1.5	30	70	100
6	GR18A1014	English Language and Communication Skills Lab	0	0	2	2	1	30	70	100
7	GR18A1017	Engineering Workshop	1	0	3	4	2.5	30	70	100
Total			**12**	**3**	**8**	**23**	**19**	**210**	**490**	**700**

II YEAR I SEMESTER

S.NO	Course Code	COURSE	Hours			Total Hours	Total Credits	Int	Ext	Marks
			L	T	P					
1	GR18A2036	Introduction to Electromagnetic Theory	3	0	0	3	3	30	70	100
2	GR18A2037	Materials Engineering	3	0	0	3	3	30	70	100
3	GR18A2015	Basic Electrical and Electronics Engineering	3	0	0	3	3	30	70	100
4	GR18A2039	Strength of Materials	3	0	0	3	3	30	70	100
5	GR18A2040	Thermodynamics	3	0	0	3	3	30	70	100
6	GR18A2041	Machine and Production Drawing	0	0	6	6	3	30	70	100
7	GR18A2042	Strength of Materials Lab	0	0	3	3	1.5	30	70	100
8	GR18A2043	Materials Science and Metallurgy Lab	0	0	3	3	1.5	30	70	100
Total			**15**	**0**	**12**	**27**	**21**	**240**	**560**	**800**
9	GR18A2001	Environmental Science	2	0	0	2	2	30	70	100
10	GR18A2083	Design Thinking	2	0	0	2	1	30	70	100

II YEAR II SEMESTER

S.NO	Course Code	COURSE	Hours			Total Hours	Total Credits	Int	Ext	Marks
			L	T	P					
1	GR18A2044	Applied Thermodynamics	3	1	0	4	4	30	70	100
2	GR18A2045	Fluid Mechanics and Fluid Machines	3	0	0	3	3	30	70	100
3	GR18A2046	Kinematics of Machinery	3	1	0	4	4	30	70	100
4	GR18A2005	Probability and Statistics	3	0	0	3	3	30	70	100
5	GR18A2047	Manufacturing Process	3	0	0	3	3	30	70	100
6	GR18A2048	Thermal Engineering Lab	0	0	3	3	1.5	30	70	100
7	GR18A2049	Manufacturing Process Lab	0	0	3	3	1.5	30	70	100
8	GR18A2050	Fluid Mechanics and Fluid Machines Lab	0	0	3	3	1	30	70	100
Total			**15**	**2**	**9**	**26**	**21**	**240**	**560**	**800**
9	GR18A2003	Constitution of India	2	0	0	2	2	30	70	100

III YEAR I SEMESTER

S.NO	Course Code	COURSE	Hours			Total Hours	Total Credits	Int	Ext	Marks
			L	T	P					
1	GR18A3023	Machine Design	3	0	0	3	3	30	70	100
2	GR18A3024	Dynamics of Machinery	3	0	0	3	3	30	70	100
3	GR18A3025	Heat Transfer	3	0	0	3	3	30	70	100
4	GR18A2004	Economics and Accounting for Engineers	3	0	0	3	3	30	70	100
5	GR18A3027	Manufacturing Technology	3	0	0	3	3	30	70	100
6		Professional Elective –I	3	0	0	3	3	30	70	100
7	GR18A3131	Computer Aided Modeling Lab	0	0	3	3	1	30	70	100
8	GR18A3032	Manufacturing Technology Lab	0	0	3	3	1	30	70	100
9	GR18A3033	Heat Transfer Lab	0	0	3	3	1	30	70	100
Total			**18**	**0**	**9**	**27**	**21**	**270**	**630**	**900**

PROFESSIONAL ELECTIVE – 1		
S. No.	**Course Code**	**COURSE**
1.	GR18A3028	Mechatronic Systems
2.	GR18A3029	Solid Mechanics
3.	GR18A3030	Internal Combustion Engines
4.	GR18A3031	Principles of Management

III YEAR II SEMESTER

S.NO	Course Code	COURSE	Hours			Total Hours	Total Credits	Int	Ext	Marks
			L	T	P					
1	GR18A3082	Design of Machine Elements	3	0	0	3	3	30	70	100
2	GR18A3083	Metrology and Surface Engineering	3	0	0	3	3	30	70	100
3	GR18A3115	Fundamentals of Management and Entrepreneurship	3	0	0	3	3	30	70	100
4		Professional Elective –II	3	0	0	3	3	30	70	100
5		Open Elective – I	3	0	0	3	3	30	70	100
6	GR18A3088	Computer Aided Analysis and Manufacturing Lab	0	0	3	3	1.5	30	70	100
7	GR18A3089	Metrology Lab	0	0	3	3	1.5	30	70	100
8	GR18A3116	Mini Project with Seminar	0	0	6	6	3	30	70	100
Total			**15**	**0**	**12**	**27**	**21**	**240**	**560**	**800**
9	GR18A2002	Value Ethics and Gender Culture	2	0	0	2	2	30	70	100

PROFESSIONAL ELECTIVE – 2		
S. No.	**Course Code**	**COURSE**
1	GR18A3084	Composite Materials
2	GR18A3085	Design for Manufacturing
3	GR18A3086	Refrigeration And Air Conditioning
4	GR18A3087	Microprocessor In Automation

IV YEAR I SEMESTER

S.NO	Course Code	COURSE	Hours			Total Hours	Total Credits	Int	Ext	Marks
			L	T	P					
1	GR18A4023	CAD/CAM	3	0	0	3	3	30	70	100
2	GR18A4024	Instrumentation and Control Systems	2	0	0	2	2	30	70	100
3		Professional Elective – III	3	0	0	3	3	30	70	100
4		Professional Elective – IV	3	0	0	3	3	30	70	100
5		Open Elective –II	3	0	0	3	3	30	70	100
6	GR18A4033	Instrumentation and Control Systems Lab	0	0	2	2	1	30	70	100
7	GR18A4061	Project –I	0	0	12	12	6	30	70	100
Total			**14**	**0**	**14**	**28**	**21**	**210**	**490**	**700**

PROFESSIONAL ELECTIVE – 3		
S. No.	**Course Code**	**COURSE**
1.	GR18A4025	Finite Element Analysis
2.	GR18A4026	Design of Material handling equipment
3.	GR18A4027	Computational Fluid Dynamics
4.	GR18A4028	Optimization Techniques

PROFESSIONAL ELECTIVE – 4		
S. No.	**Course Code**	**COURSE**
1.	GR18A4029	Process Planning And Cost Estimation
2.	GR18A4030	Tribology
3.	GR18A4031	Non Conventional Energy Sources
4.	GR18A4032	Automation in Manufacturing

IV YEAR II SEMESTER

S.NO	Course Code	COURSE	Hours			Total Hours	Total Credits	Int	Ext	Marks
			L	T	P					
1	GR18A4078	Rapid prototyping and Tooling	3	0	0	3	3	30	70	100
2		Professional Elective –V	3	0	0	3	3	30	70	100
3		Professional Elective –VI	3	0	0	3	3	30	70	100
4		Open Elective –III	3	0	0	3	3	30	70	100
5	GR18A4108	Project –II	0	0	12	12	6	30	70	100
Total			**12**	**0**	**12**	**24**	**18**	**150**	**350**	**500**

PROFESSIONAL ELECTIVE – 5		
S. No.	**Course Code**	**COURSE**
1	GR18A4109	Sustainable Manufacturing
2	GR18A4080	Design Of Transmission Systems
3	GR18A4081	Gas Dynamics and Jet Propulsions
4	GR18A4082	Production Planning And Control

PROFESSIONAL ELECTIVE – 6		
S. No.	**Course Code**	**COURSE**
1	GR18A4083	Flexible Manufacturing Systems
2	GR18A4084	Mechanical Vibrations
3	GR18A4085	Power Plant Engineering
4	GR18A4086	Total Quality Management

PROFESSIONAL ELECTIVES – 4 THREADS

MANUFACTURING	DESIGN	THERMAL	AUTOMATION
Mechatronic Systems	Solid Mechanics	IC Engines	Principles Of Management
Composite Materials	Design for Manufacturing	Refrigeration And Air Conditioning	Microprocessor In Automation
Finite Element Analysis	Design of Material handling equipment	Computational Fluid Dynamics	Optimization Techniques
Process Planning And Cost Estimation	Tribology	Non Conventional Energy Sources	Automation in Manufacturing
Sustainable Manufacturing	Design Of Transmission Systems	Gas Dynamics and Jet Propulsions	Production Planning And Control
Flexible Manufacturing Systems	Mechanical Vibrations	Power Plant Engineering	Total Quality Management

OPEN ELECTIVES – THREADS

S. No.	THREAD 1	THREAD 2
1	Soft Skills and Interpersonal Skills (GR18A3117)	CSE: 1. Principles of E-Commerce (GR18A3129) 2. Database Management Systems (GR18A2068) 3. Java Programming (GR18A2075)
2	Human Resource Development and Organizational Behavior (GR18A3118)	IT: 1. Multimedia and Application Development (GR18A3123) 2. Web Programming (GR18A3057) 3. Operating Systems (GR18A2074)
3	Cyber Law and Ethics (GR18A3119)	EEE: 1.Embedded Systems (GR18A4102) 2. Control Systems (GR18A2032) 3. Artificial Intelligence Techniques (GR18A3016)
4	History of Science (GR18A3120)	ECE:1.Artificial Neural Networks (GR18A3124) 2.Software Defined Radio and Cognitive Radio (GR18A3125) 3.Cloud Computing (GR18A3102)
5	Introduction to Art and Aesthetics (GR18A3121)	ME: 1.Operations Research (GR18A3126) 2. Automobile Engineering (GR18A3127) 3. Robotics (GR18A4079)
6	Economic Policies in India (GR18A3122)	CE: 1. Green Building Technology (GR18A3128) 2.Building Materials and Construction Planning (GR18A2007) 3. Introduction to Fluid Mechanics (GR18A2010)

Syllabus
I Year

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

LINEAR ALGEBRA AND DIFFERENTIAL CALCULUS

Course code: GR18A1001 **L/T/P/C: 3/1/0/4**

I Year I Semester

Course Objectives: To provide the student with

- The ideas of linearity and linear systems, which lie at the core of many engineering concepts.
- The concept of latent values of a matrix which is critical in many engineering applications.
- The ideas of function approximation using the tools of mean value theorems.
- The skill of using a definite integral for various geometrical applications.
- The skill of finding the optimal values of multi-variable functions.

Course Outcomes: After learning the contents of this paper the student must be able to

- Compute the rank of a matrix to determine the existence of solutions of a linear algebraic system.
- Determine the eigenvalues and eigenvectors of a square matrix which arise in several engineering applications.
- Determine approximate solution of over determined systems using the pseudo inverse.
- Apply the definite integral for various computational problems in geometry and Evaluate some improper integrals using special functions.
- Develop the skill of determining optimal values of multivariable functions using classical methods.

Unit I: VECTOR AND MATRIX ALGEBRA

Vector space (definition and examples), linear independence of vectors, orthogonality of vectors, projection of vectors, Gram-Schmidt ortho normalization of vectors, Symmetric, Hermitian, skew-symmetric, skew-Hermitian, orthogonal and UNIT-ary matrices; Rank of a matrix by echelon reduction, Solution of a linear algebraic system of equations (homogeneous and non-homogeneous).

Unit II: MATRIX EIGENVALUE PROBLEM AND QUADRATIC FORMS

Determination of eigenvalues and eigenvectors of a matrix, properties of eigenvalues and eigenvectors (without proof), diagonalization of a matrix, orthogonal diagonalization of symmetric matrices, Similarity of matrices, Quadratic Forms: Definiteness and nature of a quadratic form, reduction of quadratic form to canonical forms by orthogonal transformation.

Unit III: MATRIX DECOMPOSITION AND PSEUDO INVERSE OF A MATRIX

Spectral decomposition of a symmetric matrix, L-U decomposition, Q-R factorization, Singular value decomposition ,Moore-Penrose pseudo inverse of a matrix, least squares solution of an over determined system of equations using pseudo inverse.

Unit IV: SINGLE VARIABLE CALCULUS

Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem and Taylor's theorem (without proof), their geometrical interpretation and applications, approximation of a function by Taylor's series, Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (only in Cartesian coordinates), Evaluation of improper integral using Beta and Gamma functions.

Unit V: MULTIVARIABLE DIFFERENTIAL CALCULUS AND FUNCTION OPTIMIZATION

Partial Differentiation: Total derivative; Jacobian; Functional dependence, unconstrained optimization of functions using the Hessian matrix, constrained optimization using Lagrange multiplier method

Text/Reference Books:

1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa publishing house,
2. Fourth edition 2014
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
4. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thedition,Pearson, Reprint,
5. 2002.
6. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
7. GRIET reference manual.
8. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
9. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING PHYSICS

Course code: GR18A1004 **L/T/P/C: 3/1/0/4**

I Year I Semester

Course Objectives: At the end of the course the student is expected to

- Demonstrate skills in scientific inquiry and problem solving techniques.
- Illustrate the wave nature of light through the phenomena of interference and diffraction.
- Interpret the properties of Laser light and its uses in optical fiber communication.
- Classify and analyze the properties of solid and engineered semiconductor materials.
- Demonstrate competence and understanding of the concepts of Harmonic oscillations and waves.

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

- Apply the phenomenon of interference and diffraction of waves.
- Analyze the properties of Laser and its propagation in optical fibers.
- Classify materials based on free electron theory.
- Extend the knowledge of characterization techniques to know the composition of Nano material.
- Describe the quality factor for damped mechanical and electrical oscillators.

Unit I: WAVE OPTICS

Huygens's principle, Superposition of waves and interference of light by wave front splitting and amplitude splitting, Young's double slit experiment, Interference in thin films by reflection, Newton's rings, Michelson's interferometer, Fraunhofer diffraction from a single slit, double slit and N slits, Diffraction grating: Grating spectrum and resolving power.

Unit II: LASERS AND FIBER OPTICS

Lasers: Interaction of radiation with matter: Spontaneous and Stimulated emission and absorption, Einstein coefficients, Characterizes of lasers, Resonating cavity, Active medium, pumping, population inversion, Construction and working of laser: Ruby laser, He-Ne laser, application of lasers.

Fiber Optics: Introduction, Principle and Construction of an optical fiber, Acceptance angle, Numerical aperture, Types of Fibers, losses associated with optical fibers, Basic components in optical fiber communication system, Application of optical fibers.

Unit III: INTRODUCTION TO SOLIDS

Free electron theory of metals, Classical and quantum free electron theory, Density of states, Dependence of Fermi level on temperature, Bloch's theorem, Kronig – Penny model(Qualitative treatment), E – K diagram, origin of energy bands, Classification of materials on the basis of energy bands, Effective mass.

Unit IV: ENGINEERED SEMICONDUCTOR MATERIALS

Nanomaterials: Introduction, quantum confinement, surface to volume ratio, density of states in 2D, 1D and 0D (qualitatively), Practical examples of low-dimensional systems such as quantum wells, wires and dots.

Fabrication: Top-Down by CVD, Bottom –Up by Sol-Gel and characterization techniques: SEM, TEM and EDAX.

Unit V: HARMONIC OSCILLATIONS

Mechanical oscillators: Differential equation of simple harmonic motion, Phase relationship between displacement, velocity and acceleration, energy of a harmonic oscillator, damped harmonic oscillator: heavy, critical and light damping, Energy decay in a damped harmonic oscillator, Quality factor. Electrical oscillators: L-C Circuit.

Text/Reference Books:

1. Engineering Mechanics, 2nd ed.- MK Harbola, Cengage Learning
2. Mechanics, D S Mathur and P S Hemne, S Chand
3. I. G. Main, “Vibrations and waves in physics’, 3rd Edn, Cambridge University Press, 2018
4. Applied Physics, T. Bhīma Sankaram, BSP Publishers.
5. Engineering Physics, P.K Palanisamy, Scitech Publishers.
6. Ajoy Ghatak, “Optics”, McGraw Hill Education, 2012
7. H. J. Pain, “The physics of vibrations and waves”, Wiley, 2006
8. O. Svelto, “Principles of Lasers”
9. “Introduction to Mechanics”, M.K.Verma, Universities Press

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PROGRAMMING FOR PROBLEM SOLVING

Course Code: GR18A1007 **L/T/P/C: 3/1/0/4**

I Year I Semester

Prerequisite: Knowledge of Mathematics required.

Course Objectives:

- To learn the fundamentals of computers.
- To understand the various steps in program development.
- To learn the syntax and semantics of C programming language.
- To learn the usage of structured programming approach in solving problems.

Course Outcomes:

The Student will learn

- To write algorithms and to draw flowcharts for solving problems.
- To convert the algorithms/flowcharts to C programs.
- To code and test a given logic in C programming language.
- To decompose a problem into functions and to develop modular reusable code.
- To use arrays, pointers, strings and structures to write C programs.

Unit I: INTRODUCTION TO PROGRAMMING

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, compilers, creating, compiling and executing a program, Number systems

Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming

Introduction to C Programming Language: variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code , Operators, expressions and precedence, Expression evaluation, Storage classes (auto, extern, static and register), type conversion, The main method and command line arguments Bitwise operations: Bitwise AND, OR, XOR and NOT operators

Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, goto, Iteration with for, while, do-while loops

I/O: Simple input and output with scanf and printf, formatted I/O.

Unit II: ARRAYS, STRINGS, STRUCTURES AND POINTERS

Arrays: one and two dimensional arrays, creating, accessing and manipulating elements of arrays

Strings: Introduction to strings, handling strings as array of characters, basic string functions available in C (strlen, strcat, strcpy, strstr), arrays of strings

Structures: Defining structures, initializing structures, unions, Array of structures.

Pointers: Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self-referential structures, usage of self referential structures in linked list (no implementation)Enumeration data type

Unit III: PREPROCESSOR AND FILE HANDLING IN C

Preprocessor: Commonly used Preprocessor commands like include, define, undef, if, ifdef, ifndef

Files: Text and Binary files, Creating and Reading and writing text and binary files, Appending data to existing files, Writing and reading structures using binary files, Random access using fseek, ftell and rewind functions. Introduction to stdin, stdout and stderr.

Unit IV: FUNCTION AND DYNAMIC MEMORY ALLOCATION

Functions: Designing structured programs, Declaring a function, Signature of a function, Parameters and return type of a function, passing parameters to functions, call by value, Passing arrays to functions, passing pointers to functions, idea of call by reference, Some C standard functions and libraries

Recursion: Simple programs, such as Finding Factorial, Fibonacci series, Limitations of Recursive functions

Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays of different data types

Unit V: INTRODUCTION TO ALGORITHMS

Algorithms for finding roots of a quadratic equations, finding minimum and maximum numbers of a given set, finding if a number is prime number, Basic searching in an array of elements (linear and binary search techniques),Basic algorithms to sort array of elements (Bubble, Insertion and Selection sort algorithms), Basic concept of order of complexity through the example programs

Text/ Reference 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, (3^{rd} Edition)**:**
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice
4. Hall of India
5. R.G. Dromey, How to solve it by Computer, Pearson (16^{th} Impression)
6. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
7. Herbert Schildt, C: The Complete Reference, McGraw Hill, 4^{th} Edition

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING GRAPHICS

Course Code: GR18A1010 **L/T/P/C: 1/0/4/3**

I Year I Semester

Course Objectives:

- Provide basic conventions and standards used in Engineering Graphics.
- Impart knowledge on various Engineering curves and their significance.
- To draw orthographic, sectional and pictorial views of a given solid.
- To develop skills in three dimensional visualization of engineering components.
- To inculcate CAD packages on modelling and drafting.

Course Outcomes:

- Familiarize with BIS standards and conventions used in engineering graphics.
- Draw various engineering curves e.g., ellipse, parabola, cycloids and involutes etc and construct various reduced scales e.g., plain, diagonal and vernier scales.
- Differentiate between first angle and third angle methods of projection and distinguish parallel and perspective projection.
- Visualize different views like elevation and plan for a given line, plane figures or solid objects.
- Apply drafting techniques and use 2D software e.g., AutoCAD to sketch 2D plane figures.

Unit I: INTRODUCTION TO ENGINEERING DRAWING

Principles of Engineering Graphics and their Significance, Conic Sections including Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid, Scales – Plain and Diagonal.

Unit II: ORTHOGRAPHIC PROJECTIONS

Principles of Orthographic Projections, Conventions, Projections of Points and Lines, Projections of Plane regular geometric figures-Auxiliary Planes.

Unit III: PROJECTIONS OF REGULAR SOLIDS

Auxiliary Views - Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views – Sections of Sphere

Unit IV: DEVELOPMENT OF SURFACES OF RIGHT REGULAR SOLIDS

Prism, Cylinder, Pyramid and Cone, Intersection of Solids: Intersection of – Prism vs Prism- Cylinder Vs Cylinder

Unit V: ISOMETRIC PROJECTIONS

Principles of Isometric Projection – Isometric Scale – Isometric Views –Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts, Conversion of Isometric Views to Orthographic Views and Vice-versa – Conventions

Introduction to CAD: (**For Internal Evaluation Weightage only**): Introduction to CAD Software Package Commands.- Free Hand Sketches of 2D- Creation of 2D Sketches by CAD Package

Text /Reference Books:

1. Engineering Drawing by N.D. Bhatt/Charotar
2. Engineering Drawing/ N.S.Parthasarathy and Vela Murali/Oxford
3. EngineeringGraphics.ByBasanthAgrawal/CMAgrawal/McGrawHillEducation
4. Engineering Drawing by K.VenuGopal/New Age Publications.
5. Computer Aided Engineering Drawing / K Balaveera reddy et al-CBS publishers
6. Engineering Graphics and Design by Kaushik Kumar / Apurbakumar Roy / Chikesh Ranjan

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING PHYSICS LAB

Course Code: GR18A1012 **L/T/P/C: 0/0/3/1.5**

I Year I Semester

Course Objectives: At the end of the course the student is expected to

- Experiment with resonance phenomena using electrical source.
- Recall the basic properties of light like interference and diffraction through hands on experience.
- Apply the theoretical concepts of optical fibers in practical application.
- Analyze the mechanical properties of solid materials.
- Analyze the behavior of semiconductors in various aspects.

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

- Evaluate the frequency of tuning fork, spring constant through coupled oscillation and analyse the resonance phenomena in LCR circuit.
- Compare the rigidity modulus of wires of different materials using Torsional pendulum.
- Interpret the properties of light like interference and diffraction through experimentation.
- Asses the characteristics of Lasers and infer the losses in optical fibers.
- Identify the type of semiconductor by measuring energy gap.

LIST OF EXPERIMENTS:

TASK 1: Melde's experiment: To determine the frequency of a vibrating bar or turning fork using Melde's arrangement.

TASK 2: Torsional pendulum: To determine the rigidity modulus of the material of the given wire using Torsional pendulum.

TASK 3: Newton's rings: To determine the radius of curvature of the lens by forming Newton's rings.

TASK 4: Diffraction grating: To determine the number of lines per inch of the grating.

TASK 5: Dispersive power: To determine the dispersive power of prism by using spectrometer.

TASK 6: Coupled Oscillator: To determine the spring constant by single coupled oscillator.

TASK 7: LCR Circuit: To determine quality factor and resonant frequency of LCR circuit.

TASK 8: LASER: To study the characteristics of LASER sources.

TASK 9: Optical fiber: To determine the Numerical aperture and bending losses of Optical fibers.

TASK 10: Energy gap of P-N junction diode: To determine the energy gap of a semiconductor diode.

Note: Any 8 experiments are to be performed

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PROGRAMMING FOR PROBLEM SOLVING LAB

Course Code: GR18A1015 **L/T/P/C: 0/0/3/1.5**

I Year I Semester

Prerequisite: Basic operations of computer and knowledge of mathematics

Laboratory Objectives: The students will learn the following

- To work with an IDE to create, edit, compile, run and debug programs.
- To analyze the various steps in program development.
- To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc.
- To develop modular, reusable and readable C Programs using the concepts like functions, arrays etc.
- To write programs using the Dynamic Memory Allocation concept and to create, read from and write to text and binary files.

Laboratory Outcomes: The candidate is expected to be able to

- Formulate the algorithms for simple problems and translate given algorithms to a working and correct program.
- Correct syntax errors as reported by the compilers
- Identify and correct logical errors encountered during execution
- Represent and manipulate data with arrays, strings and structures and use pointers of different types
- Create, read and write to and from simple text and binary files and modularize the code with functions so that they can be reused

Task 1: (Practice sessions)

a. Write a simple program that prints the results of all the operators available in C (including pre/ post increment, bitwise and/or/not, etc.). Read required operand values from standard input.
b. Write a simple program that converts one given data type to another using auto conversion and casting. Take the values form standard input.

Task 2: (Simple numeric problems)

a. Write a program for fiend the max and min from the three numbers.
b. Write the program for the simple, compound interest.
c. Write program that declares Class awarded for a given percentage of marks, where mark <40%= Failed, 40% to <60% = Second class, 60% to <70%=First class, >= 70% = Distinction. Read percentage from standard input.

Task 3: (Simple numeric problems)

a. Write a program that prints a multiplication table for a given number and the number of rows in the table. For example, for a number 5 and rows = 3, the output should be:
    i. 5 x 1 = 5

ii. 5 x 2 = 10
iii. 5 x 3 = 15

b. Write a program that shows the binary equivalent of a given positive number between 0 and 255.

Task 4: (Expression Evaluation)

a. A building has 10 floors with a floor height of 3 meters each. A ball is dropped from the top of the building. Find the time taken by the ball to reach each floor. (Use the formula s = ut+(1/2)at^2 where u and a are the initial velocity in m/sec (= 0) and acceleration in m/sec^2 (= 9.8 m/s^2)).
b. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
c. Write a program that finds if a given number is a prime number

Task 5: (Expression Evaluation)

a. Write a C program to find the sum of individual digits of a positive integer and test given number is palindrome.
b. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
c. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Task 6: (Expression Evaluation)

a. Write a C program to find the roots of a Quadratic equation.
b. Write a C program to calculate the following, where x is a fractional value.
   1-x/2 +x^2/4-x^3/6
c. Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: 1+x+x^2+x^3+……+x^n. For example: if n is 3 and x is 5, then the program computes 1+5+25+125.

Task 7: (Arrays and Pointers and Functions)

a. Write a C program to find the minimum, maximum and average in an array of integers.
b. Write a functions to compute mean, variance, Standard Deviation, sorting of n elements in single dimension array.
c. Write a C program that uses functions to perform the following:
   i. Addition of Two Matrices
   ii. Multiplication of Two Matrices
   iii. Transpose of a matrix

   with memory dynamically allocated for the new matrix as row and column counts may not be same.

Task 8: (Arrays and Pointers and Functions)

a. Write C programs that use both recursive and non-recursive functions
    i. To find the factorial of a given integer.
    ii. To find the GCD (greatest common divisor) of two given integers.
    iii. To find x^n
b. Write a program for reading elements using pointer into array and display the values using array.
c. Write a program for display values reverse order from array using pointer.
d. Write a program through pointer variable to sum of n elements from array.

Task 9: (Files)

a. Write a C program to display the contents of a file to standard output device.
b. Write a C program which copies one file to another, replacing all lowercase characters with their uppercase equivalents.
c. Write a C program to count the number of times a character occurs in a text file. The file name and the character are supplied as command line arguments.

Task 10: (Files)

a. Write a C program that does the following: It should first create a binary file and store 10 integers, where the file name and 10 values are given in the command line. (hint: convert the strings using atoi function) Now the program asks for an index and a value from the user and the value at that index should be changed to the new value in the file. (hint: use fseek function).The program should then read all 10 values and print them back.
b. Write a C program to merge two files into a third file (i.e., the contents of the firs t file followed by those of the second are put in the third file).

Task 11: (Strings)

a. Write a C program to convert a Roman numeral ranging from I to L to its decimal equivalent.
b. Write a C program that converts a number ranging from 1 to 50 to Roman equivalent
c. Write a C program that uses functions to perform the following operations:
    i. To insert a sub-string in to a given main string from a given position.
    ii. To delete n Characters from a given position in a given string.

Task 12: (Strings)

a. Write a C program to determine if the given string is a palindrome or not (Spelled same in both directions with or without a meaning like madam, civic, noon, abcba, etc.)
b. Write a C program that displays the position of a character ch in the string S or – 1 if S doesn‘t contain ch.
c. Write a C program to count the lines, words and characters in a given text.

Task 13: (Miscellaneous)

a. Write a menu driven C program that allows a user to enter n numbers and then choose between finding the smallest, largest, sum, or average. The menu and all the choices are to be functions. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.

b. Write a C program to construct a pyramid of numbers as follows:

```
 1          *          1          1          *
1 2        * *        2 3        2 2        * *
1 2 3      * * *      4 5 6      3 3 3      * * *
 4 4 4 4    * *
 *
```

Task 14: (Sorting and Searching)

a. Write a C program that uses non recursive function to search for a Key value in a given list of integers using linear search method.

b. Write a C program that uses non recursive function to search for a Key value in a given sorted list of integers using binary search method.

c. Write a C program that implements the Bubble sort method to sort a given list of integers in ascending order.

Task 15: (Sorting and Searching)

a. Write a C program that sorts the given array of integers using selection sort in descending order.

b. Write a C program that sorts the given array of integers using insertion sort in ascending order.

c. Write a C program that sorts a given array of names.

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

Course Code: GR18A1002 **L/T/P/C: 3/1/0/4**

I Year II Semester

Course Objectives: To provide the student with

- The knowledge to visualize solutions to engineering problems governed by differential equations.
- The skill of evaluating multiple integrals needed for applications in mechanics and electro-magnetic field theory.
- The knowledge to visualize the functions arising in vector field theory and use mathematical tools for some computations.
- The skill of calculating work done by a field and flux across a surface.
- The skill of using specialized theorems for fast computation of work and flux.

Course Outcomes: After learning the contents of this paper the student must be able to

- Classify the differential equations of first order and solve them analytically by suggested methods.
- Solve linear differential equations of higher order under various forcing functions.
- Evaluate double and triple integrals and apply them to some problems in geometry and mechanics.
- Perform vector differential operations on scalar and vector fields and apply them to solve some field related problems.
- Apply classical vector integral theorems for fast computation of work done around closed curves and flux across closed surfaces.

Unit I: FIRST ORDER ODE

LDE of the first order: Solution of Exact, linear and Bernoulli equations, modelling of Newton's law of cooling, growth and decay models, modelling an R-L circuit.

Non - linear differential equations of the first order: Equations solvable for *p*, equations solvable for *x*, equations solvable for *y*.

Unit II: ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER

LDE with constant coefficients: Complementary function, over damping, under damping and critical damping of a system, Particular integrals for *f(x)* of the form $e^{ax}, x^n, cosax, sinax, e^{ax}V(x)$ *and* $x\,V(x)$ where $V(x) \equiv cosax$ *and* $sinax$, the method of variation of parameters

LDE with variable coefficients: Cauchy's homogeneous equation, Legendre's homogeneous equations

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: Areas (by double integrals) and volumes (by double integrals and triple integrals), Centre of mass and Gravity (constant and variable densities) by double and triple integrals (applications involving cubes, sphere and rectangular parallelepipeds

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 fields, irrotational fields, potentials.

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 proofs) and their applications

Text/Reference Books:

1. R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Narosa publishing house,
2. Fourth edition 2014
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
4. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006
5. 4.. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002.
6. GRIET reference manual
7. Paras Ram, Engineering Mathematics, 2nd Edition, CBS Publishes
8. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING CHEMISTRY

Course Code: GR18A1005 **L/T/P/C: 3/1/0/4**

I Year II Semester

Course Objectives:

The objectives of the course are to provide the students

- To relate how the basic concepts and principles of chemistry can be applied to practical utility in a broader perspective of the society.
- To distinguish the ranges of electromagnetic spectrum and its interaction with matter and to develop knowledge of various spectroscopic techniques at atomic and molecular levels.
- To identify and apply various principles of electrochemistry, corrosion and water treatment which are essential for an engineer in industry.
- To acquire knowledge of existence of different organic molecules in different stereochemical orientations useful for understanding reaction path ways.
- To bring adaptability to the concepts of chemistry and to acquire the required skills to become a perfect engineer.

Course Outcomes:

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

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

Unit I: ATOMIC AND MOLECULAR STRUCTURE

Atomic and molecular orbitals, Linear Combination of Atomic Orbitals (LCAO), Molecular orbitals of homo-nuclear diatomic molecules, MO energy diagrams of N_2, and O_2.Metallic bonding, Valence Bond Theory, Crystal Field Theory, Crystal Field Splitting of transition metal ion d-orbitals in tetrahedral, octahedral, and square planar geometries.

Unit II: SPECTROSCOPIC TECHNIQUES AND APPLICATIONS

Regions of electromagnetic spectrum, Molecular spectroscopy Rotational Spectroscopy: Rotation of molecules, rotational spectra of rigid diatomic molecules, selection rules.Vibrational Spectroscopy: The vibrating diatomic molecule, simple and anharmonic oscillators of a diatomic molecule, selection rules, applications of IR spectroscopy. Nuclear Magnetic Resonance: Basic concepts of NMR, Chemical shift, Magnetic resonance Imaging.

Unit III: ELECTROCHEMISTRY AND CORROSION

Electrochemistry: Electrode potential, types of electrodes: calomel and glass electrodes-construction and working, electrochemical series and applications, electrochemical cells: Galvanic & electrolytic cells, Nernst equation- applications, numerical problems, Batteries: primary and secondary types, lithium metal, lithium ion and lead acid batteries. Fuel cells: hydrogen-oxygen fuel cell - applications and advantages.

Corrosion: Definition, causes and effects of corrosion, Theories of chemical and electro chemical corrosion with mechanism, Types of corrosion - Galvanic, concentration cell and pitting corrosions, factors affecting corrosion (Nature of metal & Nature of Environment), corrosion control methods: Proper designing, cathodic protection (sacrificial anodic and impressed current cathodic protection), Metallic coatings: Hot dipping- Galvanization and tinning, electroplating, electroless plating of nickel.

Unit IV: ENGINEERING MATERIALS AND WATER TECHNOLOGY

Semiconductors: Si and Ge, preparation, purification and crystal growth by zone refining and Czochralski pulling methods, doping.

Polymeric Materials: plastics-classification, types of polymerization, properties of polymers-crystallinity, melting and boiling points, glass transition temperature, viscoelasticity. Compounding and fabrication by compression moulding and injection moulding, conducting polymers – definition, classification, application.

Water: impurities, hardness- causes of hardness, types, Units. Boiler troubles- scales and sludges, caustic embrittlement, water purification by reverse osmosis (RO) method.

Unit V: STEREOCHEMISTRY AND ENERGY RESOURCES

Stereo chemistry: Structural isomers and stereoisomers, representations of 3D structures, configurations and symmetry, chirality, enantiomers, diastereomers, optical activity, conformational analysis of n-butane. Structure, synthesis and pharmaceutical applications of paracetamol and aspirin.

Energy sources: Fossil Fuels: Coal –types, analysis of coal- proximate and ultimate analysis and their significance, Petroleum-its composition-synthetic petrol – Fischer Tropsch's process, cracking - Definition and its significance, knocking and its mechanism in Internal Combustion engines, Octane rating and cetane number. Composition and Uses of Natural gas, LPG and CNG.

Text/Reference Books:

1. Engineering Chemistry by P.C. Jain and M. Jain; DhanpatRai Publishing Company (P) Ltd., New Delhi.
2. Engineering Chemistry by PrasantaRath, B. Rama Devi, Ch. VenkataRamanareddy, S.Chakroborty. Cengage publications, 2018.
3. University Chemistry, by B.H. Mahan.
4. Engineering Chemistry by B. Siva Sankar, McGraw Hill Publication.
5. Fundamentals of Molecular Spectroscopy, by C.N. Banwell. McGraw Hill Publication
6. A Text book of Engineering Chemistry by Shashi Chawla, DhanpatRai Publishing Company (P) Ltd., New Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING MECHANICS

Course Code: GR18A1009 **L/T/P/C: 3/1/0/4**

I Year II Semester

Course Objectives:

The objectives of the course are to provide the students to

- Explain the resolution of a system of forces, compute their resultant and solve problems using equations of equilibrium.
- Perform analysis of bodies lying on rough surfaces.
- Locate the centroid of a body and compute the area moment of inertia and mass moment of inertia of standard and composite sections.
- Explain kinetics and kinematics of particles, projectiles, curvilinear motion, centroidal motion and plane motion of rigid bodies.
- Explain the concepts of work-energy method, impulse-momentum and its applications to translation, rotation and plane motion.

Course Outcomes:

At the end of the course students will be able to

- Determine resultant of forces acting on a body and analyze equilibrium of a body subjected to a system of forces.
- Solve problem of bodies subjected to friction.
- Find the location of centroid and calculate moment of inertia of a given section.
- Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, fixed axis rotation and plane motion.
- Solve problems using work energy equations for translation, fixed axis rotation and plane motion of rigid bodies.

Unit I: INTRODUCTION TO ENGINEERING MECHANICS - FORCE SYSTEMS

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

Unit II: FRICTION

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack; Centroid and Centre of Gravity -Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections; Centre of Gravity and its implications. – Theorem of Pappus

Unit III: AREA MOMENT OF INERTIA

Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem, Mass Moment of Inertia, Moment of

Inertia of Masses - Transfer Formula for Mass Moments of Inertia – Mass moment of inertia of composite bodies.

Unit IV: REVIEW OF PARTICLE DYNAMICS

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

Unit V: KINETICS OF RIGID BODIES

Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work Energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation

Text/Reference Books:

1. Reddy Vijay Kumar K. and J. Suresh Kumar (2010), Singer's Engineering Mechanics – Statics & Dynamics
2. A. Nelson, "Engineering Mechanics: Statics & Dynamics", Tata McGraw-Hill Education, 2009.
3. Timoshenko S.P and Young D.H., "Engineering Mechanics", McGraw Hill International Edition,1983.
4. Andrew Pytel, Jaan Kiusalaas, "Engineering Mechanics", Cengage Learning, 2014.
5. Beer F.P & Johnston E.R Jr. "Vector Mechanics for Engineers", TMH, 2004.
6. Hibbeler R.C & Ashok Gupta, "Engineering Mechanics", Pearson Education, 2010.
7. Tayal A.K., "Engineering Mechanics – Statics & Dynamics", Umesh Publications, 2011.
8. Basudeb Bhattacharyya, "Engineering Mechanics", Oxford University Press, 2008.
9. Meriam. J. L., "Engineering Mechanics", Volume-II Dynamics, John Wiley & Sons, 2008.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGLISH

Course Code: GR18A1006 **L/T/P/C: 2/0/0/2**

I Year II Semester

INTRODUCTION

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop linguistic, communicative and critical thinking competencies of Engineering students.

In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts leading to reading comprehension and different passages may be given for practice in the class. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material etc. *The focus in this syllabus is on skill development, fostering ideas and practice of language skills in various contexts and cultures.*

Course Objectives: The course will help to

- Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
- Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
- Develop study skills and communication skills in formal and informal situations.
- Understand the importance of defining, classifying and practice the unique qualities of professional writing style.
- Employ the acquired knowledge in classroom with reference to various social and professional spheres thus leading to a life-long learning process.

Course Outcomes: Students will be able to

- Use English Language effectively in spoken and written forms.
- Comprehend the given texts and respond appropriately.
- Communicate confidently in various contexts and different cultures.
- Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
- Demonstrate the skills needed to participate in a conversation that builds knowledge collaboratively by listening carefully and respect others point of view.

Unit I

'The Raman Effect' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary Building: The Concept of Word Formation--The Use of Prefixes and Suffixes.
Grammar: Identifying Common Errors in Writing with Reference to Articles andPrepositions.

Reading: Reading and Its Importance- Techniques for Effective Reading.
Basic Writing Skills: 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: Letter Writing
Vocabulary: Synonyms and Antonyms. Use of phrases for formal and informal letter writing. Eg., I would like to apply, I regret to inform, This is to bring to your kind notice... etc.
Grammar: Identifying Common Errors in Writing with Reference to Noun-pronounAgreement and Subject-verb Agreement.
Reading: Improving Comprehension Skills – Techniques for Good Comprehension, Read a letter
Writing: Format of a Formal Letter-
Writing Formal Letters E.g.., Letter of Complaint,Letter of Requisition, Job Application with Resume. Reorganising of sentences /paragraphs in a letter.

Unit III
'Blue Jeans' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.
Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.
Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.
Reading: Sub-skills of Reading- Skimming and Scanning
Writing: Nature and Style of Sensible Writing-
Defining- Describing Objects, Places and Events – **Classifying**- Providing Examples or Evidence

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

Unit V
'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'English for Engineers' published by Cambridge University Press. Vocabulary: Technical Vocabulary and their usage
Grammar: Common Errors in English
Reading: Reading Comprehension-Exercises for Practice

Writing: **Technical Reports**- Introduction – Characteristics of a Report – Categories ofReports

Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Text/Reference Books:

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING CHEMISTRY LAB

Course code: GR18A1013 **L/T/P/C: 0/0/3/1.5**

I Year II Semester

Course Objectives:

- Introduce practical applications of chemistry concepts to engineering problems.
- Determine the rate constant of reactions from concentrations as a function of time.
- Measure the molecular or ionic properties such as conductance, redox potentials.
- Synthesize a drug molecule to learn how organic compounds are prepared in industry.
- Know the laboratory practices implemented in a research and industrial chemistry laboratory setting.

Course Outcomes:

- Perform experiments illustrating the principles of chemistry relevant to the study of science and engineering.
- Determination of parameters like hardness and chloride content in water.
- Understand the kinetics of reactions from a change in concentrations of reactants or products as a function of time.
- Synthesize a drug molecule as an example of organic synthesis methods widely used in industry.
- Determination of physical properties like adsorption and viscosity.

List of Experiments: (any 12 experiments out of 14)

TASK 1: Determination total hardness of water by complexometric method using EDTA.

TASK 2: Determination of chloride content of water by Argentometry.

TASK 3: Redox titration: Estimation of ferrous iron using standard $KMnO_4$

TASK 4: Estimation of HCl by Conduc to metric titrations

TASK 5: Estimation of Acetic acid by Conduc to metric titrations

TASK 6: Estimation of Ferrous iron by Potentio metry using dichromate

TASK 7: Determination of rate constant of acid catalyzed reaction of methyl acetate

TASK 8: Determination of acid value of coconut oil.

TASK 9: Adsorption of acetic acid by charcoal

TASK 10: Determination of surface tension of liquid by using stalagmometer

TASK 11: Determination of viscosity of liquid by using Ostwald's viscometer.

TASK 12: Determination of partition coefficient of acetic acid between n-butanol and water.

TASK 13: Synthesis of Aspirin

TASK 14: Synthesis of Paracetamol.

Text/Reference Books:

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

Course code: GR18A1014 **L/T/P/C: 0/0/2/1**

I Year II Semester

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Course Objectives:

- To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning.
- To sensitize students to the nuances of English speech sounds, word accent, intonation, rhythm and Neutralization of accent for intelligibility
- To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency of students in spoken English and neutralize their mother tongue influence
- To train students to use language appropriately for public speaking and interviews

Course Outcomes:

- Interpret the role and importance of various forms of communication skills.
- Demonstrate the skills needed to participate in a conversation that builds knowledge collaboratively by listening carefully and respect others point of view.
- Utilize various media of verbal and non-verbal communication with reference to various professional contexts.
- Recognise the need to work in teams with appropriate ethical, social and professional responsibilities.
- Evaluate and use a neutral and correct form of English.

English Language and Communication Skills Lab (ELCS) shall have two parts:

a. Computer Assisted Language Learning (CALL) Lab
b. Interactive Communication Skills (ICS) Lab

Listening Skills Objectives:

1. To enable students develop their listening skills so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation

2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions

- Listening for general content
- Listening for specific information

Speaking Skills
Objectives:

- To involve students in speaking activities in various contexts
- To enable students express themselves fluently and appropriately in social and professional contexts
- Oral practice: Just A Minute (JAM) Sessions
- Describing objects/situations/people
- Role play – Individual/Group activities

Exercise – I

CALL Lab:

Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening.

Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.

ICS Lab:

Understand: Communication at Work Place- Spoken vs. Written language.

Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

Exercise – II

CALL Lab:

Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.

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

ICS Lab:

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

Practice: Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

Exercise-III:

CALL Lab:

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

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

ICS Lab:

Understand: How to make Formal Presentations.

Practice: Formal Presentations.

Exercise – IV:

CALL Lab:

Understand: Listening for General Details.

Practice: Listening Comprehension Tests.

ICS Lab:

Understand: Public Speaking – Exposure to Structured Talks.

Practice: Making a Short Speech – Extempore.

Exercise – V:

CALL Lab:

Understand: Listening for Specific Details.

Practice: Listening Comprehension Tests.

ICS Lab:

Understand: Interview Skills.

Practice: Mock Interviews.

Minimum Requirement of infrastructural facilities for ELCS Lab:

1. **Computer Assisted Language Learning** (CALL) Lab

Computer systems, headphones and English language learning software for self- study by students.

- **Interactive Communication Skills (ICS) Lab:**

The Interactive Communication Skills Lab: A Spacious room with movable chairs, audio-visual aids with a Podium, LCD and a projector.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENGINEERING WORKSHOP

Course Code: GR18A1017 **L/T/P/C: 1/0/3/2.5**

I Year II Semester

Course objectives:

The objectives of the course are to provide the students

- To prepare and practice of scientific principles underlying the art of manufacturing in workshop/manufacturing practices.
- To demonstrate basic knowledge of various tools and their use in different sections.
- To make students to execute applications of various tools in carpentry.
- To make students recognize applications of manufacturing methods casting, forming machining, joining and advanced manufacturing methods.
- To develop generate safety rules, safe practices and workshop dress code.

Course Outcomes:

At the end of the course students will be able to

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

1. TRADES FOR EXERCISES: At least two exercises from each trade:

i. Carpentry
ii. Fitting Shop
iii. Tin-Smithy
iv. Casting
v. Welding Practice
vi. House-wiring
vii. Black Smithy

2. VIDEO LECTURES: Carpentry, Fitting operations, Tin-Smithy, Casting, Welding, Electrical and Electronics, Black Smithy, Plumbing, Power tools in construction and Wood Working, Manufacturing Methods,

Text/ Reference Books:

1. Workshop Practice /B. L. Juneja / Cengage
2. Workshop Manual / K. Venugopal / Anuradha.
3. Work shop Manual - P. Kannaiah/ K. L. Narayana/ SciTech
4. Workshop Manual / Venkat Reddy/ BSP
5. Workshop Manual/K. Venugopal/Dr.V. Prabhu Raja/ G.Sreekanjan

Syllabus
II Year

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

INTRODUCTION TO ELECTROMAGNETIC THEORY

Course Code: GR18A2036 **L/T/P/C: 3/0/0/3**

II Year I Semester

Course objectives

- Describe the calculation of electric fields for a given charge distributions and interpret electrostatic potential in Laplace and poissons equation.
- Calculate capacitance and polarization in dielectric materials.
- Identify, formulate Biot-savart's law, classification of magnetic materials.
- Discuss Maxwell's equation to describe how electric and magnetic fields are generated by charges, currents and changes of fields.
- Indentify the characteristics of electromagnetic waves in different media.

Course outcomes

- Apply vector calculus to understand the behavior of static electric fields.
- Describe and analyze electric field and electrostatic potential in boundary conditions.
- Determine and describe the charge distributions, the dipole, dielectric and conducting spheres immersed in electric fields.
- Explain vector calculus to understand the behavior of static magnetic fields.
- Interpret Maxwell's equation in different forms (Differtial and integral) and apply them to diverse engineering problems.
- Apply Maxwell's equation for electromagnetic wave propagation.
- Interpret the concept of guiding of electromagnetic waves by constructive multiple reflections from conductors and dielectrics.

Pre-requisites (if any) Mathematics course with vector calculus

Unit I

Electrostatics in vacuum (8 lectures) Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Farady's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Unit II

Electrostatics in a linear dielectric medium (4 lectures) Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Unit III

Magneto statics(9 lectures) Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

Magneto statics in a linear magnetic medium: - Magnetization and associated bound currents; auxiliary magnetic field; Boundary conditions on and . Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Unit IV

Faraday's law (9 lectures) Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field**. Displacement current, Magnetic field due to time-dependent electric field and Maxwell's equations** :- Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time dependent electric field; calculating magnetic field due to changing electric fields in quasistatic approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting vector with examples. Qualitative discussion of momentum in electromagnetic fields.

Unit V

Electromagnetic waves (8 lectures) The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

Teaching Methodologies

1. Power Point Presentations
2. Assignments uploaded in website.
3. Moodle Courses

Text Books/ Reference Books

1. David Griffiths, Introduction to Electrodynamics
2. Sadiku,mathew N.O-Element of electrodynamics
3. *William* H. *Hayt*, Jr. . John A. Buck. –Engineering Electromagnetics
4. Halliday and Resnick, Physic
5. W. Saslow, Electricity, magnetism and light

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MATERIALS ENGINEERING

Course Code: GR18A2037 **L/T/P/C: 3/0/0/3**

II Year I Semester

Course Objectives:

The objectives of this course are to provide the students

- To understand the concepts of fundamental science and engineering principles relevant to materials engineering.
- To expose the various methods to test mechanical properties on materials.
- To categorize the various equilibrium diagrams and describe the changes which occurs on metals.
- To explain the concepts on various heat treatment operations.
- To categorize the various ferrous and nonferrous metals with their properties and applications.

Course Outcomes:

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

- Relate crystal structures and identify the relation between different materials.
- Test the various mechanical properties of metal by suitable method.
- Relate the equilibrium transformation diagrams for various metals.
- Utilize appropriate techniques in treating a metal with proper heat treatment operations.
- Have knowledge on different types of ferrous and nonferrous metals.

Unit I: CRYSTALSTRUCTURE

Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Unit II: DUCTILE AND BRITTLE FAILURE MECHANISMS

Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to non- destructive testing (NDT)

Unit III: ALLOYS, SUBSTITUTIONAL AND INTERSTITIAL SOLID SOLUTIONS-PHASE DIAGRAMS

Interpretation of binary phase diagrams and microstructure development, eutectic,

peritectic, peritectoid and mono tactic reactions. IronIron-carbide phase diagram and micro structural aspects of ledeburite, austenite, ferrite and cementite, castiron.

Unit IV: HEAT TREATMENT OF STEEL

Annealing, tempering, normalizing and spheroidising, isothermal transformation diagrams for Fe-C alloys and micro structure development. Continuous cooling curves and interpretation of final microstructures and properties-austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

Unit V: ALLOYING OF STEEL

Properties of stainless steel and tool steels, maraging steels, cast irons; grey, white, malleable and spheroidal cast irons, copper and copper alloys; brass, bronze and cupro-nickel; aluminium and Al-Cu–Mg alloys-Nickel based super alloys and Titanium alloys.

Text/ReferenceBooks:

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 of India Private Limited, 4th Indian Reprint, 2002.
3. V.Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.
4. U.C.Jindal, "Engineering Materials and Metallurgy", Pearson, 2011.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Course Code: GR18A2015 **L/T/P/C: 3/0/0/3**

II Year I Semester

Course Objectives:

At the end of the course the student is expected to

- Prepare the students a basic knowledge in the analysis of Electric Circuits.
- Provide students with a strong back ground in induction machines, speed control techniques and its characteristics and different types of machines existing in present trend.
- Train the students to have the solid foundation in technical concepts required to engineering problems.
- Train the students in understanding the usage of electronic instruments in measuring techniques.
- Have a thorough understanding on transistors and its uses

Course Outcomes:

At the end of the course students will be able to

- Interpret and familiar with ac and dc circuits solving.
- An ability to find role of electrical machinery in simple & complex applications.
- To demonstrate the designing and conducting experiments, to analyze and interpret data and also provides the ability to visualize and work on laboratory and multidisciplinary tasks.
- Analyze performance of Transformers and Instruments.
- Evaluate the working of Diodes.

Unit I: ELECTRICAL CIRCUITS

Basic definitions, Types of elements, Ohm's Law, Resistive networks, Kirchhoff's Laws, Inductive networks, Capacitive networks, Series, Parallel circuits and Star-delta and deltastar transformations.

Unit II: DC MACHINES AND AC MACHINES

Principle of operation of DC Generator – emf equation - types – DC motor types – torque equation – applications – three point starter.

Principle of operation of alternators – regulation by synchronous impedance method –

Principle of operation of induction motor – slip – torque characteristics – applications.

Unit III: TRANSFORMERS AND INSTRUMENTS

Principle of operation of single phase transformers – EMF equation – losses – efficiency and regulation.Basic Principle of indicating instruments – permanent magnet moving coil and moving iron instruments.

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

Unit IV: **DIODE AND IT'S CHARACTERISTICS**

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

Unit V: TRANSISTORS

P-N-P and N-P-N Junction transistor, Transistor as an amplifier, SCR characteristics and applications.

Text/Reference Books:

1. David V. Kerns, JR. J. David Irwin, Essentials of Electrical and Computer Engineering.
2. V.K.Mehta, S.Chand & Co, Principles of Electrical and Electronics Engineering.
3. M.S Naidu and S. Kamakshaiah, Introduction to Electrical Engineering, TMH Publications.
4. Kothari and Nagarath, Basic Electrical Engineering, TMH Publications, 2nd Edition.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

STRENGTH OF MATERIALS

Course Code: GR18A2039 **L/T/P/C: 3/0/0/3**

II Year I Semester

Prerequisites: Knowledge in Engineering Mechanics (statics)

Course Objectives:

The objectives of this course are to provide the students:

- To provide the basic concepts and principles of strength of materials.
- To study stresses, strains and elastic constraints of different materials.
- To gain knowledge about shear stress and bending moment of different types of beams subjected to various loads.
- To obtain knowledge about the effect of torsion on shafts.
- To understand the flexural and shear stress concepts for different materials and shapes of structures.

Course Outcomes:

At the end of the course, the student shall be able to

- Understand the theory of elasticity including strain displacement and Hooke's law relationships.
- Analyse the shear stresses and bending moment diagrams with various types of loads.
- Calculate the slope and deflections in beams subjected to transverse loads.
- Analyse various situations involving structural members subjected to combined stresses and solve the torsion problems in bars.
- Evaluate the bending and shear stresses in beams.

Unit I: SIMPLE STRESSES & STRAINS

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

Unit II: SHEAR FORCE AND BENDING MOMENT DIAGRAMS

Shear forces and bending moments of determinate beams due to concentrated loads, uniformly distributed loads, uniformly varying loads and couples, relation between hear Force and Bending Moment diagrams for cantilevers, simply supported beams, and their construction- Maximum bending moment & point of contra flexure.

Unit III: SLOPE & DEFLECTION OF BEAMS

Relation between BM & slope, slope & deflection of determinate beams, double integration method (Macaulay's method), derivation of formula for slope & deflection for standard cases

Unit IV: PRINCIPAL STRESSES AND STRAINS

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

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.

Unit V: STRESSES IN MACHINE ELEMENTS

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

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

Text/Reference Books:

1. Strength of Materials: Ramamrutham.
2. Strength of Materials R K Bansal, Laxmi Publications.
3. Analysis of structures by Vazirani and Ratwani.
4. Mechanics of Structures Vol-III, by S.B.Junnarkar.
5. Strength of Materials by S.Timshenko.
6. Strength of Materials by Andrew Pytel and Ferdinond L.Singer Longman.
7. Solid Mechanics, by Popov.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMODYNAMICS

Course Code: GR18A2040 **L/T/P/C: 3/0/0/3**

II Year I Semester

Course Objectives:

The objectives of this course are to provide the students to

- Understand the nature and role of the following thermodynamic properties of matter: internal energy, enthalpy, entropy, temperature, pressure and specific volume.
- Be able to represent a thermodynamic system by a control mass or control volume, distinguish the system from its surroundings, and identify work and/or heat interactions between the system and surroundings.
- Recognize and understand the different forms of energy and restrictions imposed by the first law of thermodynamics on conversion from one form to another.
- Understand implications of the second law of thermodynamics and limitations placed by the second law on the performance of thermodynamic systems.
- Be able to quantify the performance of Diesel engine, Petrol engine, Gas turbine, refrigeration and heat pump systems.

Course Outcomes:

At the end of the course students will be able to

- Understand the first and second laws of thermodynamics and their application to a wide range of systems.
- Understand the first law of thermodynamics and various forms of work that can occur.
- Evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations.
- Understand the calculations of the efficiencies of heat engines and other engineering devices.
- Understand the construction and principles governing the form of simple and complex one-component pressure-temperature diagrams and the use of volume-temperature and pressure-volume phase diagrams and the steam tables in the analysis of engineering devices and systems.

Unit I: FUNDAMENTALS

System & Control volume, Property, State & Process, Exact & Inexact differentials, Work-Thermodynamic definition of work, examples, Displacement work, Path dependence of displacement work and illustrations for simple processes, electrical, magnetic, gravitational, spring and shaft work.

Temperature, Definition of thermal equilibrium and Zeroth law, Temperature scales, Various Thermometers- Definition of heat, examples of heat/work interaction in systems-First Law for Cyclic & Non-cyclic processes, Concept of total energy E, Demonstration that E is a property, Various modes of energy, Internal energy and Enthalpy.

Unit II

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems-Const. temperature and Const. pressure heating of water, Definitions of saturated states, P-v-T surface, Use of steam tables and R134a tables, Saturation tables, Superheated tables, Identification of states & determination of properties, Mollier's chart.

Unit III

First Law for Flow Processes-Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.

Second law-Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.

Unit IV

Clausius inequality, Definition of entropy S, Demonstration that entropy S is a property, Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes, Determination of s from steam tables-Principle of increase of entropy, Illustration of processes in T-s coordinates, Definition of Isentropic efficiency for compressors, turbines and nozzles-Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume, Exergy balance equation and Exergy analysis.

Unit V: **THERMODYNAMIC CYCLES**

Basic Rankine cycle, Basic Brayton cycle, Basic vapor compression cycle and comparison with Carnot cycle.

Text/Reference Books:

1. Sonntag.R.E, Borgnakke.C and Van Wylen,G.J., 2003, 6 th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
2. Jones.J.B. and Duggan,R.E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran,M.J. and Shapiro,H.N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag,P.K, 1995, *Engineering Thermodynamics*, Tata Mc Graw-Hill Publishing Co. Ltd.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MACHINE AND PRODUCTION DRAWING

Course Code: GR18A2041 **L/T/P/C: 0/0/6/3**

II Year I Semester

Course Objectives:

The objectives of this course are to provide the students

- To develop an understanding of the conventional representation of different materials and machine parts.
- To analyze the various limits, fits, tolerances and surface roughness symbols adopted in the production drawings.
- To provide an understanding on various forms of screw threads, nuts, bolts, joints and rivets.
- To create assembly drawings of machine parts from the given part drawings.
- To create part drawing assemblies by using specifications and standards.

Course Outcomes:

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

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

Unit I: CONVENTIONAL REPRESENTATION

Materials, Machine elements, screw, riveted and welded joints. Springs, gears. electrical, hydraulic and pneumatic circuits. Types of section – drawing of sections and auxiliary sectional views.

Unit II

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

Unit III

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

Unit IV: ASSEMBLY DRAWINGS

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. Engine parts – stuffing boxes, cross head, eccentric, petrol engine connecting rod, piston assembly.

Unit V: PART DRAWINGS

Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors etc. Part Drawing Assemblies- Plummer block, Screw jack, Lathe tail stock. Valves: Feed check valve, air cock.

Text/Reference Books:

1. Machine Drawing –K.L.Narayana, P.Kannaiah & K. Venkata Reddy / New Age/ Publishers
2. Production and Drawing – K.L. Narayana & P. Kannaiah/ New Age
3. Machine Drawing – Dhawan, S. Chand Publications
4. Machine drawing with Auto CAD-Pohit and ghosh, PE
5. Machine Drawing – N. D. Bhatt
6. Machine Drawing – Rajput
7. Geometric dimensioning and tolerancing-James D. meadows/ B.S Publications
8. Engineering Metrology, R.K Jain, Khanna publications

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

STRENGTH OF MATERIALS LAB

Course Code: GR18A2042 **L/T/P/C:0/0/3/1.5**

II Year I Semester

Prerequisites: Fundamentals of Engineering Mechanics, Mechanics of materials.

Course Objectives:

The objectives of this course are to provide the students

- Opportunity to apply loads to various materials under different equilibrium conditions.
- Perform tests on materials in tension, compression, torsion, bending, and impact.
- Reinforce classroom theory by having the student perform required tests, analyze subsequent data, and present the results in a professionally prepared report.
- Study engineering properties of materials, force-deformation, and stress-strain relationship.
- Gain a fundamental understanding of the concepts of stress and strain by analysis of solids and structures.

Course Outcomes:

Upon completion of this course, the students will be able to

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

Following experiments need to be conducted;

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 testing machine.

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)

a) Tension test to determine young's modulus and

b) 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 the material

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 Torsion testing machine.

Task-12: To determine impact strength of the given material using Impact testing equipment (Izod and Charpy).

Teaching Methodology:

Experimental Test rig

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

MATERIAL SCIENCE AND METALLURGY LAB

Course Code: GR18A2043 **L/T/P/C: 0/0/3/1.5**

II Year I Semester

Course Objectives:

The objectives of this course are to provide the students

- To know the micro structure of different materials.
- To know the properties of materials at higher elevated temperatures.
- Refine grain size by various heat treatment processes.
- To gain knowledge on various materials for product based on microstructure.
- To know differences between ferrous and nonferrous metals with their properties.

Course Outcomes:

Upon completion of this course, the students will be able to

- Relate properties to microstructure.
- Choose suitable metals and alloys for industrial applications.
- Find out the hardness of various treated and untreated metals.
- Tell the chemical composition of various ferrous and nonferrous metals.
- Select a suitable heat treatment process for a material.

List of Experiments:

1. Preparation and study of micro structure of Mild steel and Low carbon steel.
2. Preparation and study of micro structure of High carbon steel and Stainless steel.
3. Preparation and study of micro structure of Medium carbon steel.
4. Preparation and study of micro structure of Grey cast iron and White cast Iron.
5. Preparation and study of micro structure of Malleable cast iron and Spheroidal cast iron.
6. Preparation and study of micro structure of Aluminium.
7. Preparation and study of micro structure of copper.
8. Preparation and study of micro structure of Titanium (Ti6Al4V).
9. Preparation and study of the micro structure of Inconel 718 –Super alloy.
10. Preparation and microscopic examination of heat treated and untreated metallic samples.
11. Hardenability of steels by Jominy End Quench test.
12. Find out the hardness of various treated and untreated steels.

Teaching Methodology:

Experimental Test rigs & Microscopes

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ENVIRONMENTAL SCIENCE

Course Code: GR18A2001 **L/T/P/C: 2/0/0/2**

II Year I Semester

Course Objectives:

The objectives of the course are

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures.
- Understanding the environmental policies and regulations.
- Integrate human ecology and science of environmental problems.
- The effect of human activities on atmospheric pollution

Course Outcomes:

Based on this course, the Engineering graduate will

- Understand the harmonious co-existence in between nature and human being.
- Recognize various problems related to environment degradation.
- Develop relevant research questions for environmental investigation.
- Generate ideas and solutions to solve environmental problems due to soil, air and water pollution.
- Evaluate and develop technologies based on ecological principles and environmental regulations which in turn helps in sustainable development.

Unit I: ECOSYSTEMS

Definition, Scope, and Importance of ecosystem, Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Bio magnification, ecosystem value, services and carrying capacity, Field visits.

Unit II: NATURAL RESOURCES

Classification of Resources: Living and Non-Living resources, water resources: use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy resources: growing energy needs, renewable and non-renewable energy sources, use of alternate energy source, case studies.

Unit III: BIODIVERSITY

Biodiversity And Biotic Resources: Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. **Threats to biodiversity:** habitat loss, poaching of wildlife, man-wildlife conflicts; **Conservation of biodiversity**: In-Situ and Ex-situ conservation. National Biodiversity act.

Unit IV: ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES

Environmental Pollution: Classification of pollution, Air Pollution: Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. Water pollution: Sources and types of pollution, drinking water quality standards. Soil Pollution: Sources and types, Impacts of modern agriculture, degradation of soil. Noise Pollution: Sources and Health hazards, standards, Solid waste: Municipal Solid Waste management, composition and characteristics of e-Waste and its management.

Pollution control technologies: Waste water Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation. Global **Environmental Issues and Global Efforts**: Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives.

Unit V: ENVIRONMENTAL POLICY, LEGISLATION & EIA

Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economic aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). Towards Sustainable Future: Concept of Sustainable Development Goals, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

Text/Reference Books:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Raja gopalan, Oxford University Press.
3. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
4. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela.2008 PHI Learning Pvt. Ltd.
5. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
6. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
7. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.
8. Introduction to Environmental Science by Y. Anjaneyulu, BS Publications.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

DESIGN THINKING

Course Code: GR18A2083 **L/T/P/C: 2/0/0/2**

II Year I Semester

Course Objectives and Outcomes:

- Study a problem from multiple perspectives.
- Learn how to frame the design challenge properly.
- Ideate, prototype and Iterate solutions.
- Learn from the overall design process how to create value as entrepreneurs.
- Students will be equipped with all the skills in the design mind set.

UNIT I: Introduction to Design Thinking

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

UNIT II: Design Thinking Methodology

The 5 Stages of the Design Thinking Process- Empathise, Define (the problem), Ideate, Prototype, and Test, Ideation tools & exercises. Sample Design Challenge, Introduction to the Design Challenge Themes

UNIT III: Story telling and Tools for Innovation

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

UNIT IV:

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

References:

- Designkit.org
- Ideo.org
- Adobe Kickbox

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

APPLIED THERMODYNAMICS

Course Code: GR18A2044 **L/T/P/C: 3/1/0/4**

II Year II Semester

Course Objectives:

The objectives of this course are to provide the students

- To understand about I law for reacting systems and heating value of fuels.
- To learn about gas and vapor cycles and their first law and second law efficiencies.
- To understand about the properties of dry and wet air and the principles of psychrometry.
- To study about gas dynamics of air flow and steam through nozzles.
- To analyze about reciprocating compressors with and without inter cooling and analyze the performance of steam turbines.

Course Outcomes:

At the end of the course, the student shall be able to

- Understand and explain the various practical power cycles and heat pump cycles.
- Analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.
- Understand phenomena occurring in high speed compressible flows, necessity of staging of reciprocating compressors and performance improvement methods.
- To focus on the working principles of components of gas turbine power plant and can illustrate the methods to enhance the performance of the plant.
- Elaborate the principles of Psychrometry using properties of dry and wet air.

Unit I

Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis-First law analysis of combustion reactions-Heat calculations using enthalpy tables-Adiabatic flame temperature-Chemical equilibrium and equilibrium composition calculations using free energy.

Unit II

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra super-critical Rankine cycle-Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and inter cooling-Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.

Unit III

Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

Unit IV

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows-normal shocks-use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation-compressible flow in diffusers, efficiency of nozzle and diffuser.

Unit V

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of inter cooling, minimum work for multi stage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines.

Text/ReferenceBooks:

1. Sonntag,R.E, Borgnakke,C.and Van Wylen,G.J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
2. Jones, J. B. and Duggan, R.E.,1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran,M.J. and Shapiro,H.N.,1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag,P.K, 1995, *Engineering Thermodynamics*, Tata Mc Graw-Hill Publishing Co. Ltd

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

FLUID MECHANICS AND FLUID MACHINES

Course Code: GR18A2045 **L/T/P/C: 3/0/0/3**

II Year II Semester

Course Objectives:

The objectives of this course are to provide the students

- To learn about the application of mass and momentum conservation laws for fluid flows.
- To understand the importance of dimensional analysis.
- To obtain the velocity and pressure variations in various types of simple flows.
- To analyze the flow in water pumps and turbines.
- To learn about the application of Energy conservation laws for fluid flows.

Course Outcomes:

Upon completion of this course, the students will be able to

- Apply concept of mathematics, science and engineering.
- Use the governing equations of fluid flow and applying them to simple flow problems.
- Explain the mathematical formulation of various flow problems.
- Analyze the boundary layer concept to the fluid flow problems.
- Apply 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 Poisuielle flow, laminar flow through circular conduits and circular annuli-concept of boundary layer– measures of boundary layer thickness–Darcy Weisbach equation, friction factor, Moody's diagram.

Unit III

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

Unit IV

Euler's equation–theory of roto dynamic machines–various efficiencies–velocity components at entry and exit of the rotor, velocity triangles–Centrifugal pumps, working principle, work done by the impeller, performance curves–Cavitation in pumps-Reciprocating pump–working principle.

Unit V

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/Reference Books:

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by R K Rajput.
3. Fluid Mechanics and Hydraulic machines by R K Bansal, Laxmi publications.
4. Fluid Mechanics & Hydraulic Machines: Problems & Solutions by K.Subrmanya /TMH private limited.
5. Hydraulic Machines by Banga& Sharma, Khanna Publishers.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

KINEMATICS OF MACHINERY

Course Code: GR18A2046 **L/T/P/C: 3/1/0/4**

II Year II Semester

Course Objectives:

The objectives of this course are to provide the students

- To understand the kinematics and rigid-body dynamics of kinematically driven machine components.
- To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.
- To be able to design some linkage mechanisms and cam systems to generate specified output motion.
- To understand the kinematics of gear trains.
- To estimate of transmission of power by belts drives.

Course Outcomes:

After completion of each course student should be able to

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

Unit I

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

Unit II

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

Unit III

Classification of cams and followers-Terminology and definitions-Displacement diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions-derivatives of follower

motions-specified contour cams-circular and tangent cams-pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.

Unit IV

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

Unit V

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

Text/Reference Books:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. Cleghorn W.L.Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L.Norton, Kinematics and Dynamics of Machinery, Tata Mc Graw Hill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHN

PROBABILITY AND STATISTICS

Course Code : GR18A2005 **L/T/P/C: 3/0/0/3**

II Year II Semester

Course objectives:

On completion of this Course, the student shall be able to

- State the fundamentals of Probability and Statistics.
- Describe the properties of random variables and distributions.
- Interpret the measures of central tendency, dispersion, and association.
- Distinguish between explanatory and response variables and analyze multi variable data using correlation and regression.
- Apply the tests of hypothesis.

Course Outcomes:

The expected outcomes of the Course are to

- Estimate the chance of occurrence of various uncertain events in different random experiments with strong basics of probability.
- Compute and interpret descriptive statistics.
- Evaluate random processes which occur in engineering applications governed by the Binomial, Poisson, Multinomial, Exponential, Normal and Gamma distributions.
- Forecast the models using Regression Analysis.
- Apply Inferential Statistics to make predictions or judgments about the population from which the sample data is drawn.

Module 1: **BASIC PROBABILITY AND RANDOM VARIABLES** (10 hours)

Probability spaces, conditional probability, independence, Bayes' rule; Discrete random variables, Continuous random variables and their properties, Distribution functions and densities

Independent random variables, Sums of independent random variables; Expectation of Discrete and Continuos Random Variables, Moments, Variance of a sum, Chebyshev's Inequality.

Module 2: BASIC STATISTICS AND DISCRETE PROBABILITY DISTRIBUTIONS (10 hours)

Measures of Central tendency: Moments, Skewness and Kurtosis.

Probability distributions: Infinite sequences of Bernoulli trials, Binomial, Poisson, Poisson approximation to the binomial distribution, multinomial distribution and evaluation of statistical parameters for Binomial and Poisson distributions.

Module 3: **CONTINUOUS PROBABILITY DISTRIBUTIONS AND BIVARIATE DISTRIBUTIONS** (8 hours)

Bivariate distributions and their properties, Distribution of sums and qu otients, Conditional densities. Normal, Exponential and Gamma density functions, Evaluation of statistical parameters for Normal distribution.

Module 4: CURVE FITTING, CORRELATION AND REGRESSION(6 hours)
Curve fitting by the method of least squares- fitting of straight line, Second degree parabola, Exponential and Power curves. Correlation (Karl Pearson's Correlation coefficient and Spearman's Rank correlation (Statements of their properties and problems)), Regression (including Multiple regression with two independent random variables), (Statements of their properties and problems only).

Module 5: APPLIED STATISTICS (6 hours)
Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations. Test for single mean, difference of means and correlation coefficient, test for ratio of variances in small samples Chi- square test for goodness of fit and independence of attributes.

Text / Reference Books:

1. E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, "Introduction to Probability Theory", Universal Book Stall, 2003.
3. S. Ross, "A First Course in Probability", Pearson Education India, 2002.
4. W. Feller, "An Introduction to Probability Theory and its Applications", Vol. 1, Wiley, 1968.
5. N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
6. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2000.
7. T. Veerarajan, "Engineering Mathematics", Tata McGraw-Hill, New Delhi, 2010.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MANUFACTURING PROCESSES

Course Code: GR18A2047 **L/T/P/C: 3/0/0/3**

II Year II Semester

Course Objectives:

The objectives of this course are to provide the students

- Inculcate the knowledge of various casting and forming methods in manufacturing.
- Impart knowledge about tool geometry, cutting forces, chip formation and various machine tools used in metal cutting processes.
- Inculcate the knowledge in joining processes and advancements in manufacturing.
- Impart knowledge about unconventional processes.
- Inculcate the knowledge on surface finish and economics in machining process.

Course Outcomes:

At the end of the course, the student shall be able to

- Apply primary and secondary manufacturing methods in producing the component.
- Design the tool based on the process parameters, cutting forces, and chip formation.
- Execute the joining methods and additive manufacturing methods in real time application.
- Execute the unconventional machining process.
- Perform economics of machining, surface finish and tool life estimation.

Unit I

Conventional Manufacturing processes: Casting and moulding, Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

Unit II

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Unit III

Additive manufacturing: Rapid prototyping and rapid tooling

Joining/fastening processes: Physics of welding, brazing ands oldering, design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

Unit IV

Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters, laser beam Machining (LBM), Plasma Arc Machining (PAM) and Electron BeamMachining.

Unit V

Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish.

Text/Reference Books:

1. Kalpakji anand Schmid, Manufacturing processes for engineering materials (5thEdition)-Pearson India, 2014.
2. Mikell P.Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems
3. Degarmo, Black & Kohser, Materials and Processes in manufacturing

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

THERMAL ENGINEERING LAB

Course Code: GR18A2048 **L/T/P/C: 0/0/3/1.5**

II Year II Semester

Course Objectives:

The objectives of the course are to provide the students

- Understand the working principles of the each component of internal combustion engines, refrigeration system, Boilers etc.
- Explore to measuring devices functioning for air, fuel, temperature, pressure, loading, speed etc.
- Recollect the basic conservation of energy principles, laws of thermodynamics for real time applications.
- Explain the process involved in the thermal systems for assessing the performance and its enhancement using graphs, balance sheets etc.
- Summarize the differences between internal and external combustion engines, reciprocating and rotary type with merits and limitations.

Course Outcomes:

At the end of the course student will be able to

- Explain the functioning of measuring devices such as manometer, thermocouples, loading devices, fuel measurements etc. by applying the conservation laws and demonstrate the function of parts of 4 stroke diesel/petrol engines by assembling and dismantling.
- Evaluate the properties of fuels such as flash & fire points, calorific values using basic concepts by conducting experimentation.
- Assess the performance parameters of different thermal systems such as diesel/Petrol engines, refrigeration system, air compressors, Boilers etc.,
- Enumerate and calculate the amount of dissipation of heat/energy in different ways by drawing balance sheets for an IC Engine.
- 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: Disassembly/Assembly of 4 stroke single cylinder diesel and petrol engine

Task-2: Valve timing diagram for 4 stroke single cylinder diesel and petrol engine

Task-3: Determination of the p-V diagram and the performance of a 4-stroke diesel engine with Electrical loading

Task-4: Heat balance test on 4 stroke single cylinder diesel engine with Electrical loading

Task-5: Performance test on single cylinder 4 stroke diesel engine with eddy Mechanical loading

Task-6: Heat balance test on single cylinder 4 stroke diesel engine with eddy Mechanical

loading

Task-7: Determination of the calorific value of a given fuel

Task-8: Determination of the flash & fire points of a given fuel

Task-9: Determination of the density and viscosity of a given oil

Task-10: Performance test on two stage reciprocating air compressor

Task-11: Study of Babcock and Wilcox boiler

Task-12: Determination of COP of a vapour compression refrigeration system

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

MANUFACTURING PROCESS LAB

Course Code: GR18A2049 **L/T/P/C:0/0/3/1.5**

II Year II Semester

Prerequisites: Fundamentals of Production of Technology

Course Objectives:

The objectives of this course are to provide the students

- To provide practical experience in various welding processes with different materials.
- To give knowledge and practical exposure on how to form plastic formation by using plastic moulding machine.
- To impart Knowledge in casting process with various types of tools.
- To know various welding processes.
- To impart knowledge on various production processes in manufacturing a product.

Course Outcomes:

- To design and manufacture simple patterns for castings.
- Knowledge on different kinds of joining processes.
- To manufacture plastic components.
- Knowledge on different kinds of production processes available for shaping or moulding several daily used components.
- To 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. TIG Welding-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 operations

Task-4: PROCESSING OF PLASTICS

1. Injection Moulding
2. Blow Moulding

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

FLUID MECHANICS AND FLUID MACHINES LAB

Course Code: GR18A2050 **L/T/P/C: 0/0/3/1**

II Year II Semester

Prerequisites: Fundamentals of Fluid Mechanics and Hydraulic Machinery

Course Objectives:

The objectives of the course are to provide the students

- To provide practical knowledge in verification of principles of fluid flow.
- To impart knowledge in measuring pressure, discharge and velocity of fluid flow.
- To understand Major and Minor Losses.
- To gain knowledge in performance testing of Hydraulic Turbines and Hydraulic Pumps at constant speed and Head.
- To familiarize laminar and turbulent flows in pipes.

Course Outcomes:

At the end of the course student should be able to

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

LIST OF EXPERIMENTS:

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

CONSTITUTION OF INDIA

Course Code: GR18A2003 **L/T/P/C: 2/0/0/2**

II Year II Semester

Course Objectives:

- To create an awareness about the Constitution of India, Fundamental Rights and Duties, Directive Principles.
- To Learn the role of Prime Minister, President and the Council of Ministers and the State Legislature.
- To learn the divisions of executive, legislative and judiciary and so on.
- To know how a municipal office, panchayat office etc. works.
- To understand the importance and role of Election Commission Functions.

Course Outcomes:

- Students will be able to know the importance of Constitution and Government.
- Students will be able to become Good Citizens and know their fundamental rights, duties and principles.
- Students will learn about the role of PM, President, Council of Ministers and Local Administration.
- The Students understand the importance of Election Commission.
- 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, Importance of grass root democracy

Unit V

Election Commission: 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 and women

Text/Reference Books:

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 lakshminarain agarwal publication

Syllabus
III Year

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

MACHINE DESIGN

Course Code: GR18A3023 **L/T/P/C: 3/0/0/3**

III Year I Semester

Course Objectives:

The objectives of this course is to provide the students to

- Understand the design procedures for finding out the various dimensions of machine parts
- An appreciation of the relationships between component level design and overall machine system design and performance
- Analyze design procedure to find the dimensions of riveted joints.
- Apply the design procedure to find the dimensions of key, cotters and Knuckle joints.
- Employ the design procedure to find dimensions of shafts subjected to combined loading

Course Outcomes:

At the end of the course students will be able to

- Compute the dimensions of the members subjected to bi-axial loading using theories of failure.
- Design the machine members subjected to simple stresses and fatigue loading.
- Solve the dimensions of the riveted, welded and bolted joints subjected different loading.
- Design of keys, cotters and knuckle joints subjected to tensile and compressive loading.
- Compute the dimensions of the shafts and shaft couplings subjected to torsional loading, 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. Simple stresses – Various theories of failure.

UNIT II: Strength of Machine Elements

Stress concentration – Theoretical stress Concentration factor – Fatigue stress concentration factor-notch sensitivity – Endurance limit – Design of members subjected to variable loading –Estimation of Endurance strength – Gerber's parabola, Goodman's line – Soderberg's line

UNIT III:

Bolted joints: Design of bolts with pre-stresses – Design of joints under eccentric loading.

Riveted and Welded Joints: Design of joints with initial stresses – eccentric loading.

UNIT IV: Keys, Cotters and Knuckle Joints

Design of Keys-stresses in keys- Cotter joints-Spigot and Socket, Sleeve and Cotter, Gib and Cotter joints-Knuckle joints.

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. Machine Design – R.S.Khurmi& J K Gupta
2. Design of Machine Elements Design, V. B. Bandari -TMH Publishers
3. Machine Design – Pandya and Shah.

REFERENCES:

1. Machine Design / Schaum Series
2. Machine Design by Shigley, MH Publishers
3. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
4. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

DYNAMICS OF MACHINERY

Course Code: GR18A3024 **L/T/P/C: 3/0/0/3**

III Year I Semester

Course Objectives:

The objectives of this course are to provide the students to

- Understand the concept of gyroscopic couple and its effect on aero plane, ship, two and four wheel drive.
- Introduce the approaches and mathematical models used in static and dynamic analysis of machinery
- Impart the knowledge of Various Governors, Brakes and operation of Dynamometers.
- Understand the concepts of balancing of rotating masses and reciprocating masses.
- Introduce of mathematical models and solution methods to study Vibration of the mechanical systems

Course Outcomes:

At the end of the course students will be able to

- Analyze complete motion analysis of machines in running condition and able to know friction and its effect on mechanical efficiency.
- 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.
- Apply the knowledge regarding use of turning moment diagram and energy fluctuations with in systems.
- Explain how to balance forces and moments produced by rotating or reciprocating masses of machine members.
- Analyze the vibrations, which is the major disturbance in machines while in the running condition and also precautions to reduce vibration.

UNIT I:

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

UNIT II:

Static Force Analysis: Introduction, Static Equilibrium, Equilibrium of Two-force and Three force members, Member with Two force

Dynamic force Analysis: Introduction, D'Alemberts principle, Equivalent Offset inertia force, Dynamic analysis of Four bar and Single slider mechanisms, Piston effort, Turning moment on crank shaft, Inertia of connecting rod, Inertia forces in reciprocating Engines.

UNIT III:

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

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

UNIT IV:

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

UNIT V:

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

TEXT BOOKS

1. Theory of Machines / S.S Ratan/ Mc. GrawHill Publ.
2. Theory of machines/Khurmi/S.Chand.

REFERENCES

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

Teaching Methodology: Power point Presentations, Working models, white board & marker

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

HEAT TRANSFER

Course Code: GR18A3025 **L/T/P/C: 3/0/0/3**

III Year I Semester

Course Objectives:

The objectives of this course is to provide the students to

- Build solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
- Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
- Analyze the physics of thermal radiation and its concepts for global context.
- Briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.
- Explore to the knowledge of heat transfer with phase change through boiling and condensation and build the similarity between heat and mass transfer.

Course Outcomes:

At the end of the course students will be able to

- Formulate and analyze a heat transfer problem involving conduction heat transfer both steady and unsteady state conditions
- Recognize the significance of different types of convection and empirical correlation for solving real time problems with concepts including hydrodynamic and thermal boundary layers
- Apply the concept of radiation shape factor in real time applications and Explore to the relations for radiation heat transfer for black and gray bodies
- Analyze the performance parameters of heat exchangers using LMTD and NTU methods
- Explore to the knowledge of heat transfer with phase change through boiling and condensation with relevant theories and correlations for analysis and importance of mass transfer analysis

UNIT I:

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins, one dimensional conduction solutions for both steady and unsteady heat transfer, Approximate solution to unsteady conduction heat transfer using Heissler charts.

UNIT :II

Heat convection, basic equations, boundary layers, Forced convection, external and internal flows- Natural convective heat transfer, Dimensionless parameters for forced and free convection heat transfer, Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external

flow, Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

UNIT III:

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.

UNIT IV:

Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε-NTU methods.

UNIT V:

Boiling and Condensation heat transfer, Pool boiling curve
Introduction mass transfer, Similarity between heat and mass transfer

Text Books:

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J.P.Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P.Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. MassoudKaviany, Principles of Heat Transfer, John Wiley, 2002
5. Yunus A Cengel, Heat Transfer: A Practical Approach, McGraw Hill, 2002

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

ECONOMICS AND ACCOUNTING FOR ENGINEERS

Course Code: GR18A2004 **L/T/P/C: 3/0/0/3**

III Year I Semester

Course Objectives:

- To provide the student with a clear understanding of demand analysis, elasticity of demand and demand forecasting;
- To provide the insight on theory of production and cost analysis.
- To describe different types of markets and competition, forms of organization and methods of pricing.
- To make the students understand various capital budgeting techniques.
- To describe fundamentals of accounting.

Course Outcomes:

- After studying this course, students will be in a position to
- The student will be able to scan the economic environment and forecast demand of products through demand forecasting techniques.
- The student will be able to plan the production levels in tune with maximum utilization of organizational resources and with maximum profitability and list out various costs associated with production and able to compute breakeven point.
- To outline the different types markets and competition, forms of business organization and methods of pricing.
- To analyze the profitability of various projects using capital budgeting techniques
- The students will be able prepare the financial statements.

Unit-1: Introduction & Demand Analysis: ***Definition and Scope:*** Introduction to Economics, Nature and Scope of Managerial Economics. ***Demand Analysis***: Demand Determinants, Law of Demand and its exceptions. ***Elasticity of Demand***: Definition, Types, Measurement and Significance of Elasticity of Demand. ***Demand Forecasting***, Factors governing demand forecasting, methods of demand forecasting.

Unit-2: Production & Cost Analysis: ***Production Function*** – Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, Laws of Returns, Internal and External Economies of Scale. ***Cost Analysis*****:** Cost concepts. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems) - Managerial Significance.

Unit-3: Markets and Forms of Business organizations: ***Types of competition and Markets***, Features of Perfect competition, Monopoly and Monopolistic Competition. ***Pricing*****:** Objectives and Policies of Pricing. Methods of Pricing. ***Business:*** Features and evaluation of different forms of Business Organisation: Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises and their types.

Unit-4: Capital Budgeting: Capital and its significance, Types of Capital, Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (ARR) and Net Present Value (NPV) Method and Internal Rate of Return (IRR) (simple problems) and Profitability Index (PI)

Unit-5: Introduction to Financial Accounting: ***Accounting Concepts and Conventions*** - Double-Entry Book Keeping. ***Accounting Cycle:*** Journal, Ledger, Trial Balance, Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments).

Text Books

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

Reference Books

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

MANUFACTURING TECHNOLOGY

Course Code: GR18A3027 **L/T/P/C: 3/0/0/3**

III Year I Semester

Course Objectives:

The objectives of this course is to provide the students to

- Provide knowledge on machines and related tools for manufacturing various components.
- Understand the relationship between process and system in manufacturing domain.
- Provide knowledge on various Assembly practices
- Identify the techniques for the quality assurance of the products
- Identify the optimality of the process in terms of resources and time management.

Course Outcomes:

At the end of the course students will be able to

- Analyze the tooling need for manufacturing,
- Asses the dimensional accuracy and tolerances of the products
- Make use of production planning & control to forecasting models
- Apply the optimization methods in manufacturing practices
- Formulate various Inventory Models in manufacturing practices.

UNIT I: Tooling for conventional and non-conventional machining processes

Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design.

UNIT II: Metrology

Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, Inspection and workpiece quality.

UNIT III: Assembly practices

Manufacturing and assembly, process planning, selective assembly, Material handling and devices. Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling.

UNIT IV: Production planning& control

Forecasting models, aggregate production planning, materials requirement planning.

UNIT V: Inventory Models

Economic Order Quantity, quantity discount models, stochastic inventory models, practical inventory control models, JIT. Simple queuing theory models.

Text Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
2. Taha H. A., Operations Research, 6^{th} Edition, Prentice Hall of India, 2003.
3. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

COMPUTER AIDED MODELING LAB

Course Code: GR18A3131 **L/T/P/C: 0/0/3/1**

III Year I Semester

Course Objectives:

The objectives of this course is to provide the students to

- Model 3D parts using CAD software.
- Application of CAD software in creating assembly of machine components.
- Importance of parametric curves to model complex machine parts.
- Different layouts of drawings, orthographic projections.
- Introduction to various file formats.

Course Outcomes:

At the end of the course, the student shall be able to

- Create complex geometry machine components
- Create engineering assemblies using appropriate assembly constraints
- Model complex parts using Advance feature options
- Convert CAD models into various file formats which are compatible to other software
- Create detailed drawing for parts and assemblies of engineering components

Syllabus:

Introduction to CAD Software

Part Modeling

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

Assembly of Parts

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

Modeling of complex Parts and surfaces

To create complex 3D parts and surfaces using parametric curves

Drafting

To create layout, orthographic views, detailing

Exercises in Modeling, Assembly, and Drafting

Task 1: Practice Exercise related to Sketch Options
Task 2: Practice Exercise related to Basic Feature Options
Task 3: Creating Parts related to Plummer Block Assembly
Task 4: Creating Parts related to Pipe vice
Task 5: Creating Parts related to Footstep Bearing

Task 6: Assembly of Plummer Block
Task 7: Assembly of Pipe vice
Task 8: Assembly of Footstep Bearing
Task 9: Part and Assembly Drawings of Plummer Block Assembly
Task 10: Part and Assembly Drawings of Pipe vice
Task 11: Part and Assembly Drawings of Footstep Bearing
Task 12: Practice Exercise related to Advanced Feature Options

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

MANUFACTURING TECHNOLOGY LAB

Course Code: GR18A3032 **L/T/P/C: 0/0/3/1**

III Year I Semester

Course Objectives:

The objectives of this course is to provide the students to

- Inculcate the knowledge of tool geometry in manufacturing
- Use the basic machine tools like computer controlled lathes, milling machines, drill press and cutting machines
- Impart knowledge about cutting forces and chip formation in metal cutting
- Impart knowledge about select the gear cutting processes.
- Inculcate the principles of safety and economics in machining process

Course Outcomes:

At the end of the course, the student shall be able to

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

List of Experiments

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

HEAT TRANSFER LAB

Course Code: GR18A3033 **L/T/P/C: 0/0/3/1**

III Year I Semester

COURSE OBJECTIVES:

The objectives of this course is to provide the students to

- Understand the basic laws of heat transfer and its applications.
- Recognize the practical significance of various parameters those are involved in different modes of heat transfer
- Apply the knowledge of heat transfer in an effective manner of different application.
- Study the process of Condensation.
- Gain experience in designing experiments for thermal systems.

COURSE OUTCOMES

At the end of the course students will be able to

- Evaluate heat transfer through lagged pipe, insulating powder and drop and film wise condensation.
- Experiment the thermal conductivity of a given metal rod.
- Measure the heat transfer coefficient for Pin fin, Forced convection, Natural Convection and parallel and counter flow heat exchanger and to experiment on Transient heat conduction.
- Test emissivity, Stefan Boltzmann constant and critical heat flux.
- Determine the overall heat transfer coefficient for a composite slab.

LIST OF EXPERIMENTS:

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Heat transfer in forced convection apparatus.
7. Heat transfer in natural convection
8. Parallel and counter flow heat exchanger.
9. Emissivity apparatus.
10. Stefan Boltzmann Apparatus.
11. Heat transfer in drop and film wise condensation.
12. Critical Heat flux apparatus.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

MECHATRONIC SYSTEMS

(PROFESSIONAL ELECTIVE I)

Course Code: GR18A3028 **L/T/P/C: 3/0/0/3**

III Year I Semester

Course Objectives:

The Objective of this course is to provide the student to

- Introduce fundamentals of interdisciplinary components and their integration in Mechatronics system design approach.
- Impart the knowledge of Micro Processors, Micro Controllers, Programmable Logic Controllers and its role in mechatronic system.
- Understand the use of Micro Sensors and their applications in various fields.
- Understand the Principle of automatic control and real time motion control systems, with the help of electrical drives and actuators.
- Develop an ability to design a system, component, or process of mechatronic systems.

Course Outcomes:

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

- Be proficient in Programming Micro controllers.
- Select appropriate sensors, transducers and actuators to monitor and control the behaviour of a process or product.
- Apply design principles of electrical, mechanical, hydraulic and pneumatic systems to develop actuators and motion controllers.
- Develop PLC system and programs for a given task.
- Integrate mechanical electronics, control engineering in design of mechatronics systems.

UNIT I: Introduction

Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface.

UNIT II: Sensors and transducers

Classification, Development in Transducer technology, Opto- electronics-Shaft encoders, CD Sensors, Vision System, etc.

UNIT III: Drives and Actuators

Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems.

UNIT IV: Smart materials

Shape Memory Alloy, Piezoelectric and Magneto strictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.;

UNIT V: Micromechatronic systems

Microsensors, Microactuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

Text Books:

1 Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)

2Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education

3 A Textbook of Mechatronics, R.K.Rajput, S. Chand & Company Private Limited

4 Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

SOLID MECHANICS

(PROFESSIONAL ELECTIVE I)

Course Code: GR18A3029 **L/T/P/C: 3/0/0/3**

III Year I Semester

Course Objectives:

The objectives of this course are to provide the students to

- Apply fundamental 'principle stress' concept and determine stresses, strains and deformations when thin or thick pressure vessels subjected to internal fluid pressure.
- Classify statically indeterminate structures and use various energy methods.
- Interpret and compare continuous beam with fixed beams and sketch shear force and resultant bending moment diagrams
- Choose appropriate theorem to compute critical loads and stresses in the analysis of columns.
- Develop necessary formulae to calculate stresses in rotating discs and curved beams.

Course Outcomes:

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

- Calculate principle stresses in thin and thick pressure vessels.
- Solve for stresses and deflections of fixed beams under different loading conditions;
- Compute reactions and support moments in continuous beams
- Obtain solutions to column buckling and plate problems;
- Analyze stresses in curved beams and rotating discs

Unit I:

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

Unit II: Fixed Beams

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

Unit III: Continuous Beams

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

Unit IV:

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

Unit V:
Bending of Curved Beams: Stresses in bars of circular, rectangular andTrapezoidal sections.

Stresses due to rotation: Wheel rim, disc of uniform thickness, disc of uniform strength.

Text Books:

1 Strength of materials by Dr. Sadhu Singh, Khanna Publishers
2 Strength of Materials by R.K .Rajput
3 G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.
4 Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
5 Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.

References:

1 Analysis of Structures, Vol. 1, 1993 edition, by Vazirani and Ratwani.
2 Mechanics of solids by Crandal, Dahl and Lardner.
3 Theory of structures by S.Ramamrutham and R. Narayan, Dhanpat Rai Publishers.

Teaching Methodology:
Power point Presentations, Working models, white board & marker.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

INTERNAL COMBUSTION ENGINES

(PROFESSIONAL ELECTIVE I)

Course Code: GR18A3030 **L/T/P/C: 3/0/0/3**

III Year I Semester

Course Objectives:

The Objective of this course is to provide the student to

- Understand the concept of working principles of various cycles involved in internal in internal combustion engines.
- Understand the concept of working principles of various components of SI and CI Engines.
- Improve the analytical skills in finding the engineering solutions and redesign the system to improve the performance of IC engine by modifying the variable valve timings to improve fuel economy and control of emissions in global, environmental and social contexts
- Understand the concept of working principles of various types of compressors and different compression.
- Understand the factors which influence the performance of the compressors in steam power plants, gas turbines and jet propulsions etc., for better engineering practice.

Course Outcomes:

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

- Understand cycles on which S.I and C.I engine work. Student can also differentiate air standard cycles and actual cycle. Student also understands the necessity and method of cooling and lubrication.
- Get an idea about fuel supply, injection and Student can be familiar with stage of combustion in both S.I and C.I engine. Student can also understand knocking phenomenon.
- Inculcate knowledge on indicated power, brake power and friction power and their methods of measurement. Student can also understand the various factors affecting engine performance.
- Calculate work done by single and multi stage reciprocating air compressors and can understand how inter cooling reduces the work done /kg of air.
- Differentiate the working of reciprocating and rotary air compressors and also calculate the work done of dynamic compressors.

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 in S.I. Engines

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 knock additives – combustion chamber – requirements, types.

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

Unit III:

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

Unit 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, Lysholmcompressor –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.

Teaching Methodology:

Power point Presentations, Working models, white board & marker

Text Books:

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

References:

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

GOKARAJUJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

PRINCIPLES OF MANAGEMENT

(PROFESSIONAL ELECTIVE I)

Subject Code: GR18A3031 **L/T/P/C: 3/0/0/3**

III Year I Semester

Course Objectives:

The Objective of this course is to provide the student to

- Understand the principles of management and their application to the influence of an organization
- Understand the role of management in Production, Plant location and Layout Techniques.
- Study HRM by Recruitment, Selection, Training & Development and Job evaluation and merit rating
- Manage and control Productive problems
- Understand budget and no-budgetary control techniques

Course Outcomes:

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

- Understanding of management functions in an Organization
- Apply the concepts and Principles of management in real life industry
- Apply the concepts of HRM in Recruitment, Selection, Training & Development.
- Design & Develop organization chart and structure for an Enterprise
- Design and plan a good plant Layout

UNIT I:

Definition of management, science or art, manager vs entrepreneur; Types of managers-managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

UNIT II:

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.

UNIT III:

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.

UNIT IV:

Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT V:

Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Text Books:

1. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.
2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
3. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

DESIGN OF MACHINE ELEMENTS

Course Code: GR18A3082 **L/T/P/C: 3/0/0/3**

III Year II Semester

Course Objectives:

The objectives of this course is to provide the students to

- A strong background in mechanics of material-based failure criteria underpinning the safety-critical design of machine components
- An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
- An overview of codes, standards and design guidelines for different elements
- An appreciation of parameter optimization and design iteration
- An appreciation of the relationships between component level design and overall machine system design and performance

Course Outcomes:

At the end of the course students will be able to

- Design a Journal bearings subjected to static and dynamic loading.
- Compute the dimensions of I.C engine parts subjected to variable loads.
- Solve the dimensions of I.C engine rotary parts subjected to variable loads.
- Design of spur gears subjected to static and dynamic loading.
- Compute the dimensions of the power screws and springs considering various types of loads.

Unit I: Bearings

Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings– Clearance ratio–Heat dissipation of bearings, bearing materials

Journal bearing design–Ball and roller bearings–Static loading of Ball& Roller bearings, Bearing life. Design- Dynamic load, equivalent radial load, selection of Ball and Roller bearings.

Unit II: Engine parts

Pistons, Forces acting on piston–Construction, Design and Proportions of piston, Cylinder and Cylinder liners.

Unit III:

Connecting Rod: Thrust in connecting rod – stress due to whipping action on connecting rod ends.

Crank and Crank shafts: Crank pin, Crankshaft - strength and proportions of over hung and center cranks.

Unit IV: Gears

Spur gears -Causes of gear tooth failure-Lewis equation-Dynamic load factor-compressive strength-Design analysis of gears-Estimation of centre distance, module and face width, Check for dynamic and wear considerations.

Unit V:

Mechanical Springs: Stresses and deflections of helical springs–Extension- compression springs – Springs for fatigue loading – 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. Machine Design – R.S.Khrumi& J K Gupta
2. Design of Machine Elements Design, V. B. Bandari -TMH Publishers
3. Machine Design – Pandya and Shah.

REFERENCES:

1. Machine Design / Schaum Series
2. Machine Design by Shigley, MH Publishers
3. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
4. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998
5. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

METROLOGY AND SURFACE ENGINEERING

Course Code: GR18A3083 **L/T/P/C: 3/0/0/3**

III Year II Semester

COURSE OBJECTIVES:

The objectives of this course is to provide the students to

- Provide a basic understanding of the wide range of activities encompassed by personnel working in standards and calibration laboratories.
- Measure length and angles using line-graduated instruments, i.e. vernier calipers, micrometers, bevel protractor, sine bar and use comparative length-measuring instruments, i.e. dial indicator, to measure variations in the distance between two or more surfaces.
- Measure straightness, flatness, roundness, profile, screw threads and gear teeth
- Develop in production and manufacturing fields to lead the industrial organizations.
- Introduce the measurement process, types and correct use of measurement and test equipment, and measurement standards.

COURSE OUTCOMES:

At the end of the course students will be able to

- Identify the uncertainties in dimensional metrology and define the measurement standards and describe the fundamentals of dimensional and geometrical tolerances.
- Measure lengths and angles using line-graduated instruments, i.e., vernier calipers, micrometers, bevel protractor, sine bar and surface plates and use comparative length-measuring instruments, i.e. dial indicator, comparator to measure variations in the distance between two or more surfaces.
- Operate optical measuring instruments like contour projector, tool makers microscope and demonstrate coordinate measuring machine to record measurements of complex profiles with high sensitivity.
- Explain the effect of surface roughness and demonstrate the surface roughness measurement methods for improving the quality
- Use effective methods of measuring straightness, flatness, roundness, surface profile, screw threads, gear teeth and alignment tests on milling, lathe and drilling machine.

UNIT I: Systems of limits and fits

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

UNIT II:

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

MEASUREMENT OF ANGLES AND TAPERS: Different methods – Bevel protractor – angle slip gauges – spirit levels – sine bar – Sine plate, rollers and spheres used to determine the tapers.
LIMIT GAUGES: Taylor's principle – Design of Go and No Go gauges, plug ring, snap, gap, taper, profile and position gauges.

UNIT III:
OPTICAL MEASURING INSTRUMENTS: Tool maker's microscope and its uses – collimators, optical projector – optical flats and their uses, interferometer.
FLAT SURFACE MEASUREMENT: Measurement of flat surfaces – instruments used – straight edges – surface plates – optical flat and auto collimator.

UNIT IV:
SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness-Numerical assessment of surface finish – CLA, R.M.S Values – Rz values, Methods of measurement of surface finish-profilograph, Talysurf, ISI symbols for indication of surface finish.
MEASUREMENT THROUGH COMPARATORS: Comparators – Mechanical, Electrical and Electronic Comparators, pneumatic comparators and their uses in mass production.

UNIT V:
SCREW THREAD MEASUREMENT: Element of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.
MACHINE TOOL ALIGNMENT TESTS: Requirements of Machine Tool Alignment Tests, Alignment tests on lathe, milling, drilling machine tools.. Preparation of acceptance charts.
GEAR MEASUREMENT: Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch pressure angle and tooth thickness.
Coordinate Measuring Machines: Types of CMM, Role of CMM, and Applications of CMM.

TEXT BOOKS:

1. Engineering Metrology / I C Gupta./DanpathRai
2. Engineering Metrology / R.K. Jain / Khanna Publishers

REFERENCES:

1. BIS standards on Limits & Fits, Surface Finish, Machine Tool Alignment etc.
2. Fundamentals of Dimensional Metrology 4e / Connie Dotson / Thomson
3. Handbook of Tribology: Materials, Coating, and Surface Treatments/ Bharat Bhushan and B.K.Gupta.
4. Surface Engineering with Lasers/ Dehosson J.T.
5. Surface Engineering for corrosion and wear resistance / JR Davis/ Woodhead Publishers.

Teaching Methodology: Power point Presentations, Working models, white board & marker

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

FUNDAMENTALS OF MANAGEMENT AND ENTREPRENEURSHIP

Course Code: GR18A3115 **L/T/P/C: 3/0/0/3**

III Year II Semester

Course Objectives:

- To provide engineering and science students with an accelerated introduction to the basics of management.
- The course provides a framework that will enhance a person's effectiveness in the business world and make familiarize management language.
- To understand the management concepts and applications of concepts in practical aspects of business and development of managerial skills.
- To provide the student with a clear understanding of Entrepreneurship.
- To give hands on experience on how to generate ideas, evaluate business model.

Course Outcomes:

- The students understand the significance of Management in their Profession.
- The various Management Functions like Planning, Organizing, Staffing, Leading, Motivation and Control aspects are learnt in this course.
- To know and adopt motivational theories and leadership styles and apply controlling techniques at right time for better decision making.
- The student will be exposed to the basic concepts of entrepreneurship and its development process.
- The student will acquire the ability of developing a business plan / model.

UNIT–I: Introduction to Management: Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills; **Evolution of Management Thought**- Classical Approach- Scientific and Administrative Management; The Behavioural approach; The Systems Approach; Contingency Approach, IT Approach.

UNIT– II: Planning and Organizing: Planning – Planning Process, Types of Plans, Decision making and Steps in Decision Making; Principles of Organization: Span of control, organizational Design & Organizational Structures; Departmentalization, Delegation; Centralization, Decentralization.

UNIT–III: Leading, Motivation and Controlling: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills. Motivation – Types; Motivational Theories – Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y. - **controlling** – basic control process – control techniques.

UNIT–IV: Nature of Entrepreneurship: Characteristics and skills of an entrepreneur, Entrepreneur scenario in India and abroad. Types of entrepreneur, types of ownership, Small business in Indian economy. The entrepreneur and the law (Trademarks, patents, copy rights) Financial aspects: sources of rising capital, schemes of Department of Industries (DIC), KVIC, SIDBI, NABARD, NSIC, APSFC, IFCI and IDBI.

UNIT–V: Creating and Starting the venture: Creativity and the business idea (Self-discovery, Opportunity discovery); Developing the business plan (Business model – Lean canvas by Alexander Osterwalder); Marketing plan (Customer & Solution- Value proposition, Marketing & Sales); Financial plan (Validation, money), Human Resource Plan (Team).

TEXT BOOKS:

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.
3. Principles and Practice of Management, L. M. Prasad, Sultan Chand & Sons, 2012
4. Entrepreneurship- Robert D Hisrich, Michael P Peters, Dean A Shepherd, TMH.2009

REFERENCES:

1. Essentials of Management, Koontz Kleihrich, Tata Mc – Graw Hill.
2. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.
3. Entrepreneurship- Rajeev Roy, Oxford, 2011
4. Intellectual Property- Deborah E.Bouchoux, Cengage, 2012

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

COMPUTER AIDED ANALYSIS AND MANUFACTURING LAB

Course Code: GR18A3088 **L/T/P/C: 0/0/3/1.5**

III Year II Semester

Course Objectives:

The objectives of this course is to provide the students

- Simulation of one-dimensional structural problems
- Simulation of two-dimensional structural problems
- Solving problems in heat transfer and mechanics of materials
- Gain the knowledge of CNC programming
- Produce the machine components using CNC machines.

Course Outcomes:

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

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

List of experiments:

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

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

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

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

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

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

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

Task 8: Dynamics Problem 1: Model analysis of a beam

Task 9: Simulation and Execution of CNC program on turning machine using G70 & G71 Turning cycle

Task 10: Simulation and Execution of CNC program on Turning machine using G74 drilling cycle, G75 grooving cycle, G76 threading cycle and G70 & G71 Turning cycle

Task 11: Simulation and Execution of CNC program on Milling machine using G91 surface milling cycle for given different profiles

Task 12: Simulation and Execution of CNC program on Milling machine – drilling holes on plate

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

METROLOGY LAB

Course Code: GR18A3089 **L/T/P/C: 0/0/3/1.5**

III B.Tech II Semester

Course Objectives:

The objectives of this course is to provide the students to

- Get an idea of the dimensional & form accuracy of products
- Identify and use reference materials, to ensure good quality, accurate, traceable measurement results
- Explain highlights and key concepts of each topic to each other and to your managers and show how these topics fit into a management system like ISO/IEC 17025
- Recognize various national and international organizations from which we get many of our metrology references, resources, and standards;
- Apply dimensional analysis concepts correctly by looking up reference values for unit conversions, accurately perform associated mathematics, and present final values with the correct units/symbols

Course Outcomes:

At the end of the course students will be able to

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

List of Experiments:

1. Measurement of lengths, heights, diameters by vernier callipers and vernier height gauge.
2. Measurement of internal, external diameters using internal and external micrometres.
3. Measurement of bores by internal micrometers and dial bore indicators.
4. Using gear tooth Vernier calipers and checking the chordal addendum and chordal height of spur gear.
5. Machine tool alignment of test on the lathe.
6. Machine tool alignment test on milling machine.
7. Tool maker’s microscope and its application
8. Angle measurement by Bevel protractor, Sine bars.

9. Use of spirit level in finding the flatness of surface plate.
10. Thread measurement by three wire method or Tool maker's microscope.
11. Surface roughness measurement by Surface roughness tester.
12. Measurement of screw thread by using Profile Projector

OKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

VALUE ETHICS AND GENDER CULTURE

Course Code: GR18A2002 **L/T/P/C:2/0/0/2**

III Year II Semester

Course Objectives:

- To understand about the importance of ethical values
- To understand the significance of human conduct and self-development
- To enable students to imbibe and internalize the value and Ethical behaviour in personal and professional lives.
- To provide a critical perspective on the socialization of men and women.
- To create an awareness on gender violence and condemn it.

Course Outcomes:

- To enable the student to understand the core values that shapes the ethical behaviour.
- Student will be able to realize the significance of ethical human conduct and self-development
- Students will be able to inculcate positive thinking, dignity of labour and religious tolerance.
- Students will attain a finger grasp of how gender discrimination works in our society and how to counter it.
- 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.

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.

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.

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

Text Books

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.

2. Ethics in Engineering Practice & Research, Caroline Whit beck, 2e, Cambridge University Press 2015.

3. A Bilingual Textbook on Gender" written by A. Suneetha, Uma Bhrugubanda, 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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

COMPOSITE MATERIALS

(PROFESSIONAL ELECTIVE II)

Course Code: GR18A3084 **L/T/P/C: 3/0/0/3**

III Year II Semester

Course Objectives

The Objective of this course is to provide the student to

- understand the mechanical behavior of composite materials
- Impart various methods of manufacturing of composite materials
- Identify importance of polymeric matrix composites with respect to metals
- Introduce the concepts of modern composite materials
- Provide knowledge on various analysis of composite materials

Course Outcomes:

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

- Identify and explain the types of composite materials and their characteristic features
- Understand and explain the methods employed in composite fabrication.
- Understand the differences in the strengthening mechanism of composite and its corresponding effect on performance and application;
- Understand the various criterions for isotropic, anisotropic and composite materials, prediction of laminates failure.
- Appreciate the theoretical basis of the 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.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

DESIGN FOR MANUFACTURING

(PROFESSIONAL ELECTIVE II)

Course Code: GR18A3085 **L/T/P/C: 3/0/0/3**

III Year II Semester

Course Objectives:

The Objective of this course is to provide the student

- Understand modern manufacturing operations their capabilities, limitations and how to design for lowest cost.
- Gain insight into how designers influence manufacturing schedule and cost.
- Learn how to analyze products and be able to improve their manufacturability and lower costs.
- Understand the relationship between customer desires, functional requirements, product materials, product design, and manufacturing process selection.
- Understand constraints of manufacturing processes that limit design possibilities with respect to cycle time, material handling, and other factory costs.

Course Outcomes:

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

- Understand the design process and selection of materials.
- Apply various casting processes in manufacturing mechanical components
- Apply metal joining process in the manufacturing
- Apply automatic transfer lines to improve productivity
- Apply various material handling systems to enhance the production.

UNIT I: Introduction

Engineering Design Process, Considerations of a good design, Description of design process, Creativity in Design, Creative thinking methods, Materials: Relation of Material selection to design and process, Process selection.

UNIT II:

Design for Manufacturing: DFM guidelines and specific design rules

Machining Process: Overview of various machining processes- general design rules for machining, Dimensional tolerance and surface roughness.

Material Casting: Appraisal of various casting processes, Design guidelines for casting, Use of solidification simulation in casting design, chart. Performance characteristics, material selection process and economics of materials.

Design of Forgings: DFM guidelines for closed - die forging, parting lines of die drop forging die design.

UNIT III:

Metal Joining: Appraisal of various processes, Factor in the design of weldments, General design guidelines, Pre and post treatment of welds, Effect of thermal stresses in weld joints, design for brazed joints.

Sheet metal forming: Stamping, Bending, Stretching and deep drawing, General design guide lines, Keeler, Goodman forming line diagram.

UNIT IV:

Assemble Advantages: Development of assemble process, choice of assemble methods, assemble advantages, social effects of automation.

Atomic Assembly Transfer Systems: Continuous transfer, intermittent transfer, Indexing Mechanism, Operator paced free transfer machine.

UNIT V: Design of Manual Assembly

General design guidelines for manual assembly, Assembly efficiency, Classification system for manual handling, Insertion and fastening, Effect of part symmetry, part thickness, size and weight on handling time, parts required for two hands for manipulation, effect of symmetry and chamfer design on insertion operations, Estimation of insertion time.

Text Books:

1. Engineering Design - George E Dieter.
2. Assembly automation and product design, Geoffrey Boothroyd.

References:

1. Henry Peck – "Designing for manufacture", Sir Isaac Pitman & Sons Ltd.,1973.
2. Matousek – "Engineering Design", Blackie & sons, 1956.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

REFRIGERATION AND AIR CONDITIONING

(PROFESSIONAL ELECTIVE II)

Course Code: GR18A3086 **L/T/P/C: 3/0/0/3**

III Year II Semester

Course Objectives:

The Objective of this course is to provide the student to

- Familiarize with the terminology associated with refrigeration systems and air conditioning
- Understand basic VCRS and the effects of sub cooling and super heating.
- Understand VARS systems and cryogenic systems
- Understand the basics of psychrometry practice of applied psychrometry and acquire the skills required to model, analyze and design different refrigeration as well as air conditioning processes and components.
- Student should understand various types and its adoptability in the various environment and application areas of different components.

Course Outcomes:

At the end of the course, students are able to

- Explain the conventional and alternate refrigerants and air refrigeration methods
- Understand various refrigeration systems and its components.
- Apply the theoretical and mathematical principles to simple, complex vapour compression and vapour absorption refrigeration system.
- Discuss the physical and mathematical aspects of Refrigeration & Air-Conditioning systems.
- 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:(A) 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, Multistaging.

UNIT IV:

Psychrometry & Air Conditioning Processes: Properties of Air-water vapour mixture-Gibbs Dalton 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 & 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; Temperature sensors, Pressure sensors, Humidity sensors, Actuators, Safety controls; Accessories; Problems. Refrigeration and Air Conditioning Equipments: 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 & Air Conditioning – Arora & Domkundwar, Dhanpat Rai & sons.
2. Refrigeration & Air conditioning –C.P. Arora, TMH, New Delhi.

REFERENCES:

1. Refrigeration & Air conditioning –R.C. Jordan and G.B. Priester, Prentice Hall of India.
2. Refrigeration & Air conditioning –W.F. Stocker and J.W. Jones, TMH, New Delhi.
3. Refrigeration & Air conditioning- Manohar Prasad Wiley Estern limited, New Delhi.
4. Refrigeration & Air conditioning by R.S.Khurmi.

Data book: Refrigeration and Psychrometric Properties (charts and tables) by C P Kothandaraman

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

MICROPROCESSORS IN AUTOMATION

(PROFESSIONAL ELECTIVE II)

Course Code: GR18A3087 **L/T/P/C: 3/0/0/3**

III Year II Semester

Course Objectives:

The objectives of this course is to provide the students to

- Memorize the basic concepts of digital electronics and microprocessors.
- Explain the microprocessor instruction cycles and interfacing.
- Develop knowledge on microprocessor programming and its application to real time.
- Experiment on interfacing microprocessor with various input and output devices.
- State the concepts on digital control and digital algorithm.

Course Outcomes:

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

- Gain knowledge on digital electronics concepts.
- Understand the instruction cycles and timings of microprocessor.
- Demonstrate program with microprocessor's according to the required application.
- Relate interface, Microprocessor's with various input and output devices.
- 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 & 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
2. Digital Computer Electronics: An Introduction to Microcomputers, Albert Paul Malvino, Tata McGraw-Hill Publishing Company Ltd.
3. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.
4. Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition, 2007).
5. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

OPERATIONS RESEARCH

(OPEN ELECTIVE)

Course Code: GR18A3126 **L/T/P/C: 3/0/0/3**

III Year II Semester

Course Objectives:

The Objective of this course is to provide the student to

- Analyze quantitative methods and techniques for effective Decisions–making.
- Constructing models that are used in solving business decision problems.
- Introduce the students to the use of basic methodology for the solution of linear programs and integer programs.
- Introduce the students to the methods to solve large-scale transportation and assignment problems.
- Illustrate how sequencing is carried out in assigning jobs to machines

Course Outcomes:

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

- Apply the various linear programming techniques for optimal allocation of limited resources such as machine, material and money
- Solve transportation problems to minimize cost and understand the principles of assignment of jobs and recruitment polices.
- Distinguish various inventory models and develop proper inventory policies.
- Solve sequencing problems.
- Develop optimum replacement policy and Dynamic Programming Techniques.

UNIT I: INTRODUCTION

Development – Definition– Characteristics and Phases of operations Research– Types of models – operation Research models– applications.

ALLOCATION: Linear Programming Problem Formulation – Graphical solution – Simplex method –Artificial variables techniques -Two–phase method, Big-M method – Duality Principle.

UNIT II:

TRANSPORTATION MODELS: Formulation – Methods for finding feasible solution, optimal solution, unbalanced transportation problem –Degeneracy.

ASSIGNMENT MODELS - Formulation – Optimal solution - Variants of Assignment Problem

UNIT III:

SEQUENCING: Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through ‘m’ machines.

INVENTORY : Introduction – Single item – Deterministic models – Purchase inventory models

with one price break and multiple price breaks – shortages are not allowed – Stochastic models – demand may be discrete variable or continuous variable – Instantaneous production. Instantaneous demand and continuous demand and no set up cost.

UNIT IV:

THEORY OF GAMES: Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – dominance principle– m X 2 & 2 X n games -graphical method.

WAITING LINES: Introduction – Single Channel – Poisson arrivals – exponential service times – with infinite population and finite population models– Multichannel – Poisson arrivals – exponential service times with infinite population single channel Poisson arrivals.

UNIT V

REPLACEMENT: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely, group replacement.

DYNAMIC PROGRAMMING: Introduction – Bellman's Principle of optimality – Applications of dynamic programming- capital budgeting problem – shortest path problem – linear programming problem.

TEXT BOOKS:

1. Operations Research/ Prem Kumar Gupta,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 &Libermann (TMH).
5. Operations Research /A.M.Natarajan,P.Balasubramani,A. Tamilarasi/Pearson Education.
6. Operations Research: Methods & Problems / Maurice Saseini, ArhurYaspan& Lawrence Friedman
7. O.R/Wayne L.Winston/Thomson Brooks/cole

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

Soft Skills and Interpersonal Skills

(OPEN ELECTIVE)

Course Code: GR18A3117 **L/T/P/C: 2/1/0/3**

III Year II Semester

Course Objectives:
The learner will be able to:

- Know the importance of soft skills
- Identify good leadership skills /qualities
- Recognize the importance of interpersonal skills
- Demonstrate the significance of confidence building
- Define and differentiate between a report and a proposal

Course Outcomes:
After the end of the course the learners will be able to:

- Develop soft skills communication skills, leadership skills etc
- Implement goal setting techniques to build a promising career
- Design formal report and proposals with appropriate formal expressions
- Analyze their own experiences of leading and participating in teams with suitable examples
- Describe team dynamics and exchange ideas about the elements of positive teamwork
- Create healthy workplace environment by treating others with respect and dignity
- Evaluate the power of confidence building and self-esteem with examples

Unit 1: Soft Skills

- Introduction to soft skills, Definition of Soft skills, Importance of soft skills
- Communication skills, Usage of English in Business/Corporate scenario
- Nonverbal communication
- Presentation skills

Unit 2: Leadership development

- Qualities of a good leader
- Decision making and problem solving skills
- Strategic management
- Crisis management

Unit3: Confidence building

- Motivation
- Goal setting
- Self-esteem
- Team skills

Unit 4: Developing reports and proposals

- Understanding reports and proposals

- Planning reports and proposals
- Writing beginning, body and ending
- Formats of reports and proposals

Unit 5: Interpersonal skills

- Understanding professional relationships
- Networking professionally
- Showing basic office courtesies
- Interview skills

Text Books:

1. Soft Skills-Key to success in workplace and life Meenakshi Raman, Raman Upadhyay, CENAGE

Reference books:

1. Soft skills for Everyone Jeff Butterfield, CENAGE Learning

2. Soft skills for Interpersonal Communication S.Balasubramaniam,ORIENT BLACKSWAN

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

HUMAN RESOURCE DEVELOPMENT AND ORGANIZATIONAL BEHAVIOUR

(OPEN ELECTIVE)

Course Code: GR18A3118 **L/T/P/C: 3/0/0/3**

III Year II Semester

Course Objectives:

- To make student aware of the concepts, techniques and practices of human resource development.
- This course is intended to make students capable of applying the principles and techniques as professionals for developing human resources in an organization.
- OB provides perspectives and skills that enhance understanding of our own behaviour and our ability to influence the behaviour of others in organizational settings
- OB and HRM together can instill sustainability deep within an organizations' culture.
- To equip them with behavioural skills in managing people at work.

Course Outcomes :

- To familiarize the concepts, techniques and practices of human resource development in the current organizational view and to impart and apprise the capable of applying the principles and techniques as professionals for developing human resources in an organization.
- Develop, implement, and evaluate organizational human resource development strategies aimed at promoting organizational effectiveness in different organizational environments.
- To acquaint the student with the determinants of intra -individual, inter-personnel and inter-group behaviour in organisational setting.
- To Understand individual behavior in organizations, including diversity, attitudes, job satisfaction, emotions, moods, personality, values, perception, decision making, and motivational theories and apply in the organizational context.
- To assess the group behavior in organizations, including communication, leadership, power and politics, conflict, and negotiations in the frame work of organization.

Unit I -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 II-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.

Unit III - 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 IV- 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 V-Inter-personal and Group Behaviour

Interpersonal communication and Feedback; Transactional Analysis (TA); Johari Window.Group Behaviour: Group Dynamics, Cohesiveness and Productivity; Management ofDysfunctional groups; Group Decision Making. Leadership- Concept and Styles.

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.

Syllabus

IV Year

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

CAD/CAM

Course Code: GR18A4023 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Course Objectives:

The objectives of this course is to provide the student to

- Gain knowledge in CAD/CAM hardware and softwares.
- Understand how to create wire-frame, surface and solid models of the components.
- Understand various surface entities.
- Apply CNC and APT programming knowledge in Manufacturing of machine members
- Analyze the quality of product using advanced inspection and testing instruments.

Course Outcomes:

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

- Understand the fundamentals of CAD/CAM, 2D and 3D transformation methods
- Apply analytical and synthetic curves to develop wire-frame models of the objects.
- Apply synthetic surfaces and solids entities to create surface and solid models of the objects.
- Apply CNC and APT programming and Group Technology in industry to improve the production rate and quality.
- Apply process plans, computer controlled instruments and various manufacturing systems to increase the production rate and quality of the product.

UNIT I: Introduction to CAD/CAM

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

UNIT II:

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

Wireframe modelling-analytical entities, synthetics entities-Hermitte cubic curve, Bezier curve, B-Spline and NURBS.

UNIT III:

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

Solid Modelling-analytical and synthetic solid entities. Boundary, CSG and Sweep representations.

UNIT IV:

Numerical control: NC, CNC, NC basic elements and structure, NC coordinate, motion control systems, applications, benefits. CNC Manual Part Programming, Computer Aided Part Programming-APT programming.

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

UNIT V:

Computer Aided Processes Planning (CAPP), Retrieval type and Generative type, benefits. **Computer Aided Quality Control (CAQC):** Terminology in quality control, the computer in QC, contact inspection methods, noncontact inspection methods-optical, noncontact inspection methods-non-optical, and 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 byMikell P. Groover and E.W. Zimmers. JR /PHI-Eastern Economy Edition
2. CAD / CAM Theory and Practice by Ibrahim Zeid / TMH

REFERENCES :

1. Automation, Production systems & Computer integrated Manufacturing/ Groover/P.E
2. CAD / CAM / CIM / Radhakrishnan and Subramanian / New Age
3. Principles of Computer Aided Design and Manufacturing / FaridAmirouche / Pearson
4. CAD/CAM: Concepts and Applications/Alavala/ PHI
5. Computer Numerical Control Concepts and programming / Warren S Seames / Thomson.

Teaching Methodology: Power point Presentations, Working models, white board & marker

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

INSTRUMENTATION AND CONTROL SYSTEMS

Course Code: GR18A4024 **L/T/P/C: 2/0/0/2**

IV Year I Semester

Course Objectives:

The objectives of this course is to provide the students to

- Explain basic concepts measuring instruments and sources of error, classification and elimination of error.
- Illustrate on measurements of displacement, temperature, pressure, Level, Flow, Speed, Vibration measurements by using various devices also can be learned as these are essential in real time working zones.
- Apply the concepts of physics and electric/electronics to measurement and control systems.
- Analyze information about measurement of acceleration, vibration, force, torque and power.
- Get sufficient knowledge on stress strain measurements, measurement of humidity and element of control systems (open and closed systems servomechanisms).

Course Outcomes:

At the end of the course students will be able to

- Use the appropriate sensor to do the measurement including powering the sensor.
- Understand and explain the concepts of measurement of displacement, temperature using various devices.
- Understand the working of various pressure measuring instruments
- Illustrate level, flow, speed, vibration measurements.
- Categorize methods of usage of resistance strain gauge for bending compressive and tensile strains and explain different elements of control systems.

UNIT I:

Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. Dynamic performance characteristics –sources of error, Classification and elimination of error.

UNIT II:

Measurement of Displacement: Theory and construction of various transducers to measure displacement Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers, Calibration procedures.

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

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 – capacitative, ultrasonic, magnetic, cryogenic fuel level indicators – Bubler 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, Noncontact type of tachometer

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

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.

EASUREMENT OF HUMIDITY – Moisture content of gases, sling psychrometer, Absorption psychrometer, Dew point meter.

MEASUREMENT OF FORCE, TORQUE AND POWER- Elastic force meters, load cells, Torsionmeters, Dynamometers.

ELEMENTS OF CONTROL SYSTEMS: Introduction, Importance – Classification – Open and closed systems Servomechanisms–Examples with block diagrams–Temperature, speed & position control systems.

TEXT BOOKS :

1. Measurement Systems: Applications & design by D.S Kumar.
2. Mechanical Measurements / BeckWith, Marangoni,Linehard, PHI / PE

REFERENCES :

1. Measurement systems: Application and design, Doeblin Earnest. O. Adaptation by Manik andDhanesh/ TMH
2. Instrumentation and Control systems/ S.Bhaskar/ Anuradha Agencies.
3. Experimental Methods for Engineers / Holman.
4. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers.
5. Instrumentation & mech. Measurements by A.K. Tayal ,Galgotia Publications
6. Instrumentation, measurement & analysis by B.C.Nakra&K.K.Choudhary, TMH
7. Mechanical Measurements /sahani

Teaching Methodology:

Power point Presentations, Working models, white board & marker

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

INSTRUMENTATION AND CONTROL SYSTEMS LAB

Course Code: GR18A4033 **L/T/P/C: 0/0/2/1**

IV Year I Semester

Course Objectives:

The objectives of this course is to provide the students to

- Impart an adequate knowledge and expertise to calibrate instruments available in an Industry
- impart knowledge on various working principles and design of Instruments
- Understand how physical quantities are measured and how they are converted to electrical or other forms.
- Develop the knowledge of Inductance and Capacitance
- Differentiate the applications of Thermocouples, RTDs and Thermistors

Course Outcomes:

At the end of the course students will be able to

- Analyze errors, integrate and interpret different types of measurements
- Review, prepare and present technological developments
- Establish a course of action to solve problems
- Illustrate load, flow, speed, vibration, temperature and pressure measurements.
- 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 & TECHNOLOGY

FINITE ELEMENT ANALYSIS

(PROFESSIONAL ELECTIVE III)

Course Code: GR18A4025 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Course Objectives:

The Objective of this course is to provide the student to

- Get the fundamental concepts of the theory of the finite element method
- Develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code
- develop the ability to generate the governing FE equations for systems governed by partial differential equations
- Illustrate the principle of mathematical modeling of engineering problems
- Introduce applications of finite element method

Course Outcomes:

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

- provide the fundamental understanding of the theory of the finite element method
- develop proficiency in the application of the finite element method (modeling, analysis, and interpretation of results) to realistic engineering problems through the use of a major commercial general-purpose finite element code to develop the ability to generate the governing FE equations for systems governed by partial differential equations
- write the principle of mathematical modeling of engineering problems
- Provide the complete idea of applications of finite element method
- 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 Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, 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 and heat transfer, longitudinal vibration and mode shapes, beam equation, transverse deflections and natural frequencies.

UNIT III:

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors;

UNIT IV:

Application to thermal problems, 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, isoparametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software.

Text Books:

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

DESIGN OF MATERIAL HANDLING EQUIPMENT

(PROFESSIONAL ELECTIVE III)

Course Code: GR18A4026 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Course Objectives:

The objectives of this course are to provide the students to

- Study the material handling equipment Elevators, Cranes, its characteristics and applications.
- Understand the design of material handling equipment like Elevators, cranes and its drives.
- Understand the design methodology of crane structures.
- Gain the knowledge in design of various drive mechanisms.
- Inculcate the knowledge in design of grabbling attachments.

Course Outcomes:

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

- Understand the characteristics of material handling equipment.
- Design various material handling equipment of shop floor.
- Understand the design concept of cranes.
- Apply the various drive mechanisms in material handling.
- Understand the concepts arresting mechanism.

UNIT I: INTRODUCTION

Types of material handling equipment – Characteristics – applications – selection of the system.

UNIT II: DESIGN OF ELEVATORS

Design of hoisting elements – ropes, chains, pulleys. Sheaves. Hooks of different types. - Design of Conveyors - Types – Design of Chain and bucket elevators – belt and bucket elevators – discharge.

UNIT III: DESIGN OF CRANE STRUCTURES

Types – superstructure of rotary cranes with fixed radius – cantilever and overhead cranes – stability analysis.

UNIT IV: SELECTION OF DRIVES

Types of drive – rail traveling mechanisms – slewing mechanism with rotary pillar and turn tables – traveling gear.

UNIT V: DESIGN OF GRABBLING ATTACHMENTS

Crane grabs – grabbing attachments for loose pieces – lifting magnets – grab buckets and liquid handling buckets. Design of Arresting Mechanisms - Brakes – shoe, band, cone, disc and centrifugal types.

REFERENCES:

1. Spivakovsky, A. and Dyachkov, V.K., Conveying Machines Volume I & II MIRPublishers, Moscow, 1985.
2. Hudson, Wilbur, G., “Conveyors and c related equipments”, John Wiley andsons, 1949.
3. Boltz, Hord, A., “Material Handling Hand Book”, the Ronald Press Company, 1958.
4. Rudenko, N., “Material Handling Equipments”, MIR Publishers, Moscow, 1969.
5. Duglas, R Woodley, “Encyclopedia of Material Handling – Volume I Pergaman”, 1964.
6. Broughton, H.H., “Electric Cranes”, Spon, London, 1958.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

COMPUTATIONAL FLUID DYNAMICS

(PROFESSIONAL ELECTIVE III)

Course Code: GR18A4027 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Course Objectives:
The Objective of this course is to provide the student to

- Describe the physical significance of each term in the governing equation for CFD
- Identify the use of a commercial CFD package to solve practical CFD problems
- Formulate explicit and implicit algorithms for solving the Navier-stokes equations
- Quantify and analyze the numerical error in CFD discretization schemes
- Develop finite difference and finite volume forms of the CFD equation for heat transfer and fluid flow

Course Outcomes:
At the end of the course, students are able to

- Classify the partial differential equations to understand the behavior of the equations
- Analyze the semi implicit and explicit algorithms for staggered grid and non-staggered grids
- Calculate the flow field with SIMPLE and SIMPLER schemes
- Compare the various discretization schemes for convection diffusion equation
- Assess the pressure velocity coupling and checker board pressure 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, 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 modelling: 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 & SIMPLER schemes. FVM for diffusion problems, FVM for 1-D steady state diffusion problems, FVM for 2D diffusion problems.

TEXT BOOKS:

1. Computational fluid dynamics - Basics with applications - John. D. Anderson / Mc Graw Hill.
2. Numerical heat transfer and fluid flow / Suhas V. Patankar- Butter-worth Publishers
3. Computational fluid dynamics/ T. J.C'hung/ Cambridge University press, 2002.
4. Introduction to Computational fluid dynamics, Finite Voume Method H.Versteeg,Malala Sekra
5. Computational fluid dynamics for Engineers Vol.1,2 & 3 Klaus A. Hoffmann and Steve T. Chiang
6. Computational Methods for Fluid Dynamics 3rd Edition Joel H. Ferziger & Milovan Peric

REFERENCES:

1. Computational Fluid Flow and Heat Transfer/ Niyogi, Pearson Publications
2. Fundamentals of Computational Fluid Dynamics – Tapan K. Sengupta / Universities Press.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

OPTIMIZATION TECHNIQUES

(PROFESSIONAL ELECTIVE III)

Course Code: GR18A4028 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Course Objectives:

The Objective of this course is to provide the student to

- Develop a systematic approach to handle problems to design of electrical circuit etc; with a goal of maximizing the profit and minimizing cost.
- Understand the various optimization techniques such as classified optimization, linear programming. One dimensional minimization methods, unconstrained optimization techniques, constrained optimization techniques and dynamic programming.
- Understand the necessary sufficient conditions for finding the solution of the problems in classical optimization.
- Comprehend the numerical methods for finding approximate solution of complicated problems.
- Have a thorough understanding on algorithms utilization.

Course Outcomes:

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

- Explain the need in optimization techniques and formulating the optimization problems
- Apply linear and non linear programming for single and multi variable by prior different algorithm
- Solve geometric programming with and without constraints
- Apply dynamic programming concepts in multi stage decision process like inventory allocation and etc.,
- Apply integer and stochastic programming for different simulation.

UNIT I:

Linear programming – Formulation – Sensivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints.

UNIT II: SINGLE VARIABLE NON-LINEAR UNCONSTRAINED OPTIMIZATION

One dimensional Optimization methods:- Uni-modal function, elimination methods, ,, Fibonacci method, golden section method, interpolation methods – quadratic & cubic interpolation methods. Multi variable non-linear unconstrained optimization: Direct search method – Univariant method – pattern search methods – Powell's- Hook -Jeeves, Rosenbrock search methods- gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

UNIT III: GEOMETRIC PROGRAMMING

Polynomials – arithmetic - geometric inequality – unconstrained G.P- constrained G.P

UNIT IV :DYNAMIC PROGRAMMING

Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory, allocation, scheduling replacement.

UNIT V:

Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method STOCHASTIC PROGRAMMING: Basic concepts of probability theory, random variables- distributions-mean, variance, correlation, co variance, joint probability distribution- stochastic linear, dynamic programming. Simulation – Introduction – Types- steps – application – inventory – queuing – thermal system.

Text Books:

1. Optimization theory & Applications / S.S.Rao / New Age International.
2. Introductory to operation Research / Kasan & Kumar / Springar
3. Optimization Techniques theory and practice / M.C.Joshi, K.M.Moudgalya/ Narosa Publications.
4. Optimization Techniques by N V S Raju/PHI

References:

1. S.D.Sharma / Operations Research
2. Operation Research / H.A.Taha /TMH
3. Optimization in operations research / R.LRardin
4. Optimization Techniques /Benugundu&Chandraputla / Pearson Asia

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

PROCESS PLANNING AND COST ESTIMATION

(PROFESSIONAL ELECTIVE IV)

Course Code: GR18A4029 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Course Objectives

The Objective of this course is to provide the student to

- Understand the methods of process planning and drawing interpretation
- Understand Process planning activities like selection of equipment, tools,jigs and fixtures.
- study the importance of different methods costing and estimation
- estimate and calculate machine time for different machines like lathe, drilling and boring
- manage control different production costs for different jobs like forging ,welding, foundry and machining

Course Outcomes

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

- Apply knowledge of mathematics, science, and engineering fundamentals.
- Design a system, component, or process to meet the desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
- Apply reasoning informed by the knowledge of contemporary issues.
- Analyze the impact of engineering solutions in a global, economic, environmental, and Societal context.
- Use the concepts of process planning and cost estimation for various Products

UNIT I:

Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection

UNIT II:

Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies

UNIT III:

Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost

UNIT IV:

Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for

Milling, Shaping, Planing and Grinding

UNIT V:

Production costs- different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost

Text Books:

1. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci.&Tech. 2002.
2. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.
3. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., Prentice Hall 2002.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

TRIBOLOGY

(PROFESSIONAL ELECTIVE IV)

Course Code: GR18A4030 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Course objectives:

The Objective of this course is to provide the student to

- Provide broad based understanding of the interdisciplinary subject 'tribology' and its technological significance.
- Understand the nature of engineering surfaces, their topography and learn about surface characterization techniques.
- Understand the genesis of friction, the theories/laws of sliding and rolling friction.
- Learn about the contact of solid surfaces and their interactions.
- Learn about consequences of wear, wear mechanisms, wear theories and analysis of wear problems.

Course Outcomes:

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

- Know broad based understanding of the interdisciplinary subject 'tribology' and its technological significance
- Apply the principles of lubrication, lubrication regimes, theories of hydrodynamic, elasto hydro dynamic and mixed/ boundary lubrication
- Apply the basic theories of friction to predictions about the frictional behavior of commonly encountered sliding interfaces.
- Analyze about consequences of wear, wear mechanisms, wear theories and analysis of wear problems.
- 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 & TECHNOLOGY

NON CONVENTIONAL ENERGY SOURCES

(PROFESSIONAL ELECTIVE IV)

Course Code: GR18A4031 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Course Objectives:

The Objective of this course is to provide the student to

- Introduce the need of the non-convectional energy sources.
- Differentiate various solar collectors
- Identify the energy resources utilization systems.
- Recognize the source and potential of wind energy and understand the classifications of wind mills.
- Summarize the principles of bio-conversion, ocean energy and geo thermal energy.

Course Outcomes:

At the end of the course students will be able to

- Choose the appropriate renewable energy as an alternate for conventional power in any application.
- Understand principles of various solar collectors and use them in different applications
- Inculcate the knowledge on usage of alternate energy sources in I.C Engines
- Know various energy conversion techniques
- Analyze large scale demand of heat energy for meeting day to day domestic, institutional and industrial requirements can be met by utilizing solar thermal systems, biogas, PV cells, wind energy, Geothermal, MHD etc.

UNIT I: Principles of Solar Radiation

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

UNIT II: Solar Energy Collection

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

UNIT III: Wind Energy

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

economic aspects.

UNIT IV: Geothermal Energy

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

UNIT V: Direct Energy Conversion

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

TEXT BOOKS:

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

REFERENCES:

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

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

AUTOMATION IN MANUFACTURING

(PROFESSIONAL ELECTIVE IV)

Course Code: GR18A4032 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Course Objectives:

The objectives of this course are to provide the students to

- Impart knowledge on automation of Plant Layout, Production concepts and mathematical models
- Learn about analysis of automated flow lines, assembly systems and line balance
- Learn about automation of material handling systems
- Impart knowledge on automated assembly systems and line balancing methods.
- Impart knowledge on automated material handling systems

Course Outcomes:

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

- Explain the major automation theories, approaches and methodologies used in manufacturing;
- Build up the skills in the actual implementation of automation methods
- Apply the knowledge for implementing the automated flow lines
- Employ and implement the automation systems in machining process.
- Design the automated flow line for new products.

UNIT I: Introduction

Why automation, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools. Flexible automation: Computer control of Machine Tools and Machining Centers.

UNIT II:

NC and NC part programming, CNC-Adaptive Control, Automated Material handling. Assembly, Flexible fixturing.

Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods.

UNIT III: Computer Aided Manufacturing

CNC technology, PLC, Micro-controllers, CNC- Adaptive Control.

UNIT IV: Low cost automation

Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies.

UNIT V: Introduction to Modeling and Simulation

Product design, process route modeling, Optimization techniques, Case studies & industrial applications.

Text Books:

1. Mikell P.Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prentice Hall
2. SeropeKalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology, 7th edition, Pearson
3. YoramKoren, Computer control of manufacturing system, 1st edition
4. Ibrahim Zeid, CAD/CAM : Theory & Practice, 2nd edition.

REFERENCES:

1. Automotive Engineering / Newton Steeds & Garrett
2. Automotive Mechanics / G.B.S. Narang
3. Automotive Mechanics / Heitner
4. Automotive Engines / Srinivasan
5. Automobile Engineering – K.K. Ramalingam / Scitech Publications (India) PVT.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

AUTOMOBILE ENGINEERING

(OPEN ELECTIVE)

Course Code: GR18A3127 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Course Objectives:

The Objective of this course is to provide the student to

- Introduction to various systems in automobile and their function for effective parameters
- Explain the components of engine, fuel system, lubrication system, electrical system and importance of their effective designs
- Illustrate the working of transmission system and its components such as clutch, gear box, propeller shaft and differential of the automobile
- Discuss the particulates of combustion in CI and SI engines, reasons for formation of particulates and methods adopted to control the pollution
- Elaborate the function of each accessories of steering, suspension and braking system and their role for effective performance of automobile relevant to performance and emission

Course Outcomes:

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

- Illustrate the function of each and every component of an automobile. As well as able to analyze the reasons for performance parameters
- Demonstrate about emission standards, emission control techniques and electrical systems. Student can identify thrust areas for carrying their dissertation in future.
- Describe the every component of transmission system of an automobile viz clutch, gear box, propeller shaft and differential
- Analyze the geometry of the steering mechanism and the effect of the same on tyre performance and other components of an automobile
- 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 SYSTEM

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

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

UNIT II: FUEL SYSTEM AND COOLING SYSTEM

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

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

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

UNIT III: IGNITION SYSTEM AND ELECTRICAL SYSTEM

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

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

UNIT IV: TRANSMISSION AND STEERING SYSTEM

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 AND BRAKING SYSTEM

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.

TEXT BOOKS:

1. Automobile Engineering -R B Gupta
2. Automotive Mechanics – William Crouse
3. Automobile Engineering Vol. 1 & Vol. 2 / Kripal Singh

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

CYBER LAW AND ETHICS

(OPEN ELECTIVE)

Course Code: GR18A3119 **L/T/P/C: 3/0/0/3**

IV Year I Semester

Course Objectives:

- The course objective is to provide the fundamental skill to understand cyber laws.
- It enable to understand the legal frameworks
- It helps the student understand different cyber crimes
- It provides overview on Intellectual Property, copy rights, patents rights etc.
- Given rapid changes in technology and the corresponding changes in crime and the law

Course outcomes:

- Students identify and analyze statutory, regulatory, constitutional, and organizational laws that affect the information technology professional.
- Students locate and apply case law and common law to current legal dilemmas in the technology field.
- Students apply diverse viewpoints to ethical dilemmas in the information technology field and recommend appropriate actions.
- Students will be able understand cybercrime and ethical practices.
- The student will be able to know and learn web technologies and related issues.
- The student will be in position to interface with various issues pertaining to Intellectual Property, copy rights, patents rights etc.
- 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.

Unit –III - Constitutional & Human Rights Issues in Cyberspace

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.

References

1. Chris Reed & John Angel, Computer Law, OUP, New York, (2007).
2. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012)
3. Verma S, K, Mittal Raman, Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)
4. Jonthan Rosenoer, Cyber Law, Springer, New York, (1997).
5. Sudhir Naib, The Information Technology Act, 2005: A Handbook.
6. S. R. Bhansali, Information Technology Act, 2000
7. University Book House Pvt. Ltd. Jaipur (2003).
8. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

RAPID PROTOTYPING AND TOOLING

Course Code: GR18A4078 L/T/P/C: 3/0/0/3

IV Year II Semester

Course Objectives:

The objectives of this course is to provide the students to

- Familiarize the basics of RPT
- Study the modern prototyping tool Rapid prototyping, its types and applications.
- Gain knowledge in various processes of RP
- Understand the use of tooling in quick production
- Understand he principles of Rapid tooling and reverse Engineering

Course Outcomes:

AT the end of the course, the student will be able to

- Understand the concepts of rapid prototyping.
- Understand the various processes of 3D printing processes
- Apply FDM and LOM for complex parts manufacturing
- Apply various RPT tools for quick manufacturing.
- Apply 3D scanning for reverse engineering.

UNIT I: INTRODUCTION

Definitions, evolution, CAD for RPT. Product design and rapid product development. The cost and effects of design changes during conceptual modeling, detail designing, Prototyping, manufacturing and product release. Fundamentals of RPT technologies, Various CAD issues for RPT. RPT and its role in modern manufacturing mechanical Design. 3D solid modeling software and their role in RPT. Creation of STL or SLA file from a 3D solid model.

UNIT II: LIQUID AND POWDER BASED RP PROCESSES

Liquid based process: Principles of STL and typical processes such as the SLA process, solid ground curing and others - Powder based process: Principles and typical processes such as selective laser sintering and some 3D printing processes.

UNIT III: SOLID BASED RP PROCESSES

Principles and typical processes such as fused deposition modeling, laminated object modeling and others.

UNIT IV: RAPID TOOLING

Principles and typical processes for quick batch production of plastic and metal parts though quick tooling.

UNIT V: REVERSE ENGINEERING

3D scanning, 3D digitizing and Data fitting, high speed machining- Hardware and software - Applications: Evaluation, bench marking and various case studies.

REFERENCES:

1. Burns. M, “Automated Fabrication”, PHI, 1993.
2. Chua. C.K, “Rapid Prototyping”, Wiley, 1997.
3. Hilton. P.D. et all, “Rapid Tooling”, Marcel, Dekker 2000.
4. Beaman J.J et all, “Solid freeform fabrication”, Kluwer, 1997.
5. Jacohs P.F., “Stereolithography and other Rapid Prototyping and Manufacturing Technologies”, ASME, 1996.
6. Pham D.T. and Dimov S.S., “Rapid Manufacturing; the tec

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

SUSTAINABLE MANUFACTURING

(PROFESSIONAL ELECTIVE V)

Course Code: GR18A4109 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Course Objectives:

The Objective of this course is to provide the student to

- Inculcate the environmental valuation related to sustainable manufacturing.
- Apply the concepts of evaluating sustainable manufacturing.
- Develop the importance manufacturing strategy for sustainable manufacturing.
- Provide the students with the knowledge of supply chain management techniques.
- Identify the importance of sustainable operations in developing the product.

Course Outcomes

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

- Exhibit competence on the usage and applicability of sustainability techniques.
- Apply the knowledge on various manufacturing strategy for sustainable manufacturing.
- Use the concept of supply chain management for the development of products.
- Recommend suitable sustainable operations for the required application.
- Analyze the various environmental valuation techniques related with sustainable manufacturing.

UNIT I: ENVIRONMENTAL VALUATION

Introduction to the environmental issues pertaining to the manufacturing sector , Pressure to reduce Costs, Processes that minimize negative environmental impacts, Environmental legislation and Energy costs, Adoption of low carbon technologies, Need to reduce the carbon footprint of manufacturing operations. Techniques for non-market valuation: Cost and Income based approaches, Demand estimation methods, Multi-criteria analysis, Stakeholder analysis.

UNIT II: EVALUATING SUSTAINABILITY

Sustainability performance evaluators, Frameworks and techniques, Environmental management Systems, Life cycle assessment, Strategic and environmental impact assessments, Carbon and water Foot-Printing.

UNIT III: MANUFACTURING STRATEGY FOR SUSTAINABILITY

Concepts of Competitive Strategy, Manufacturing Strategies, Manufacturing strategy in business success Strategy formation and formulation, Structured strategy formulation, Sustainable manufacturing system design options, Approaches to strategy formulation, Realization of new strategies/system designs.

UNIT IV: SUPPLY CHAIN MANAGEMENT

Challenges in logistics and supply chain, developing the right supply chain strategy for the products, need to align the supply network around the strategy, Tools that can be used systematically to identify areas for improvement in supply chains, Specific challenges and new thinking in the plan, source and delivering of sub-processes.

UNIT V: SUSTAINABLE OPERATIONS

Principles of sustainable operations - Life cycle assessment Manufacturing and service activities Influence of product design on operations - Process analysis - Capacity management - Quality management -Inventory management - Just-In-Time systems, Sustainable well-being and Consumerism.

Text Books:

1. Seliger, G ,"Sustainable Manufacturing: Shaping Global Value Creation", Springer, 2012.
2. Seliger, G.,"Sustainability in Manufacturing: Recovery of Resources in Product and Material Cycles", 2007.
3. Jovane, F., Ęmper, W.E. and Williams, D. J., "The ManuFuture Road: Towards Competitive and Sustainable High-Adding-Value Manufacturing", Springer, 2009.

References:

1. Kutz, M.," Environmentally Conscious Mechanical Design", John Wiley & Sons, 2007.
2. Davim, J.P., "Sustainable Manufacturing", John Wiley & Sons, 2010.
3. G. Atkinson, S. Dietz, E. Neumayer, — "Handbook of Sustainable Manufacturing". Edward Elgar Publishing Limited, 2007.
4. D. Rodick, "Industrial Development for the 21st Century: Sustainable Development Perspectives", UN New York, 2007.
5. Rogers, P.P., Jalal, K.F. and Boyd, J.A., "An Introduction to Sustainable Development", Earthscan, London, 2007.
6. S. Asefa, "The Economics of Sustainable Development", W.E. Upjohn Institute for Employment Research, 2005.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

DESIGN OF TRANSMISSION SYSTEMS

(PROFESSIONAL ELECTIVE V)

Course Code: GR18A4080 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Course Objectives:

The Objective of this course is to provide the student to

- Learn about the design procedures for mechanical power transmission components.
- Gain insight into how designer's requirements for gears and its manufacturing.
- Learn how to design the Bevel gears and other consideration factors.
- Understand thoroughly about gear box function and various techniques in it.
- Understand Cams working, design factors and analysis.

Course Outcomes:

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

- Illustrate the function of each and every component transmission system.
- Demonstrate about gears design, standards, and materials. Students can identify various design methods.
- Describe the every component of worm gear transmission system and its analysis.
- Explain the working principles of the different gear box of the automobile based on different applications.
- List the different types of cams and clutch system of an automobile and importance of each type based on real time applications.

UNIT I:

Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets

UNIT II:

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

UNIT III:

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

UNIT IV:

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

UNIT V:

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Text Books:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
3. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

GAS DYNAMICS AND JET PROPULSIONS

(PROFESSIONAL ELECTIVE V)

Course Code: GR18A4081 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Course Objectives:

The Objective of this course is to provide the student to

- The basic concept and importance of gas dynamics
- Interpret the flow pattern in flow and non-flow systems
- Understand of the Isentropic and non-isentropic flows
- Understand of thermodynamic cycles of jet engines.
- Analyze jet engines; determine propulsion efficiency and design inlets and nozzles.

Course Outcomes:

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

- Explain basic concepts of gas dynamics and describe the basic fundamental equations of one dimensional flow of compressible fluid and isentropic flow of an ideal gas.
- Analyze the steady one-dimensional is entropic flow, frictional flow and isothermal flow and express the concepts of steady one dimensional flow with heat transfer.
- Discuss the effect of heat transfer on flow parameters.
- Describe the jet propulsion engines
- Describe the basic concepts of rocket propulsion

UNIT I:

Compressible flow, definition, Mach waves and Mach cone, stagnation states Mass, momentum and energy equations of one-dimensional flow

UNIT II:

Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow.

UNIT III:

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables

UNIT IV:

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT V:

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket

propulsion, performance study, staging, terminal and characteristic velocity, space flights

Text Books:

1. Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008.
2. H.S. Mukunda,“ Understanding Aerospace Chemical Propulsion” , Interline Publishing, 2004.
3. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.
4. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.
5. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING AND TECHNOLOGY

PRODUCTION PLANNING AND CONTROL

(PROFESSIONAL ELECTIVE V)

Subject Code: GR18A4082 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Course Objectives:

The Objective of this course is to provide the student to

- Facilitate the understanding of Production Planning and Control in manufacturing and service organizations
- Develop an understanding on forecasting techniques for effective real life applications
- Provide a brief review of routing and scheduling techniques and to understand the factors affecting scheduling
- Provide an understanding on scheduling policies and scheduling methods and to examine several aggregate planning methods
- Provide an understanding on dispatching its procedures and follow up.

Course Outcomes:

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

- Develop an understanding on objectives, functions, applications of Production Planning and Control
- Develop in-depth knowledge on various techniques of forecasting both Qualitative and Quantitative
- Critically assess the routing and scheduling techniques and to understand the factors that are affecting scheduling process
- Analyze the problems in Line Balancing and the methods of aggregate planning
- Develop analytical skills for investigating and analyzing production planning and control in the industry and suggest implementable solutions.

UNIT I: Introduction

Definitions- objectives of production on planning and control- function of production planning and control- elements of production control- types of production – organization of production planning and control – internal organizations of department.

UNIT II: FORECASTING

Importance of forecasting – types of forecasting, their uses – general principles of forecasting techniques- Qualitative methods and quantitative methods MRP: Introduction to MRP and ERP, LOB (Line Of Balance). JIT – Japanese concepts.

UNIT III: ROUTING & SCHEDULING

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

UNIT IV: Scheduling

Scheduling policies – techniques, standard scheduling methods- job shop, flow shop. Line balancing, aggregate planning – methods for aggregate planning – Chase planning, expediting, control aspects.

UNIT V:

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

TEXT BOOKS:

1. Production Planning and Control-M.Mahajan –Dhanpatirai & Co.
2. Production Planning and Control – Jain & Jain – Khanna publications

REFERENCES:

1. Production Planning and Control – Text & cases/ SK Mukhopadhyaya/PHI.
2. Production Planning and Control – R.PaneerSelvam – PHI
3. Operations Management by Chase/PHI
4. Management Science- A R Aryasri-4e-TMH
5. Operations management – Heizer – Pearson

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

FLEXIBLE MANUFACTURING SYSTEMS

(PROFESSIONAL ELECTIVE VI)

Course Code: GR18A4083 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Course Objectives:

The Objective of this course is to provide the student to

- Inculcate the knowledge on basics of Flexible Manufacturing System
- Impart knowledge about the design, operation, and selection of Flexible Manufacturing System unit
- Impart knowledge on Group Technology and its importance.
- Familiarized processing stations and material handling systems used in FMS
- Provide knowledge on cutting tools and tool management.

Course Outcome:

At the end of the course, the student shall be able to

- Apprehend the importance of FMS system in present manufacturing world
- Compare FMS and other manufacturing systems
- Design and analyze FMS using simulation and analytical techniques.
- Design automated manufacturing environment with CMM and AMM
- Understand tool management and cutting tools in FMS system.

UNIT I: Introduction

Basic components of FMS – Types of FMS layouts- Advantages and Disadvantages of FMS Implementation – Various Equipment's and their Functions Required for an FMS – CIM Technology & CIM Technology – FMS Concepts.

UNIT II: Manufacturing Cell & Just in time System

Manufacturing Cell: Introduction and definition of cell – Classification of Cells – Standalone NC Machine Tools – Single NC Machine Cellor Mini Cell – Integrated Multi Machine Cell – Unattended Machining – Differences between FMC and FMS.

Just in time (JIT) System: Introduction and definition of JIT – goals of JIT and concept – objectives and ingredients of JIT – Quality and Quantity Principles of JIT – Benefits and implementations of JIT.

UNIT III: Group Technology & Machining Centres

Introduction and definition of Group Technology – Reasons for Adopting Group Technology – Benefits of Group Technology Affecting Many Areas of a Company – Obstacles to Application of GT.

Introduction and types of machining centres – horizontal Machining Centres merits and demerits – vertical machine centre merits and demerits – Automated Features and Capabilities of Machining Centre.

UNIT IV: Coordinate Measuring Machines &Automated Material Movement and Storage System

Introduction – CMM construction – probe – machine structure - types of CMM – functions of CMM Computers – Operational Cycle Description – CMM Applications and advantages.

Introduction – types of AVGS – Unit Load Carries: - Side Loading and High Lifting Types – Automated Guided Transport Carts- Analysis of AGV Systems – Automated Storage and Retrieval Systems(AS/RS) – Unit Load AS/RS -Mini Load AS/RS – Carousel AS/RS – Analysis of AS/RS – Industrial Robots – Basic Components types of a Robotic System – Applications of Industrial Robots.

UNIT V: Cutting Tools and Tool Management

Introduction - Tool Management - Tool Room Service - Tool Delivery, allocation and data transfer- Fault Sensing - Tool Strategies - Tool Preset, Identification and Data Transfer - Bar Code Scanning - Radio Frequency Identification - The Microchip - Data Transfer - Tool Monitoring and Fault Detection - Experimental Setup and Data Collection.

TEXT BOOKS:

1. Flexible manufacturing system by H. K. Shivanand, M. M. Benal and V. Koti.

REFERENCES:

1. Hand books of flexible manufacturing systems by Nand K. Jha
2. Flexible manufacturing system: Recent Developments by A. Raouf and M.Ben – Daya

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

MECHANICAL VIBRATIONS

(PROFESSIONAL ELECTIVE VI)

Course Code: GR18A4084 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Course Objectives:

The Objective of this course is to provide the student to

- Understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in dynamic conditions.
- Obtain linear vibratory models of dynamic systems with changing complexities.
- Perform vibration analysis of single and multi-degree of freedom linear systems.
- Develop the differential equation of motion of vibratory systems.
- Understand the concept of acoustics.

Course Outcomes:

At the end of the course, the student shall be able to

- Acquire knowledge about the free and forced vibrations.
- Develop mathematical model of dynamic systems with multiple degree of freedom.
- Calculate natural frequency and period of simple vibrating mechanical systems.
- Obtain the analytical solution for system's time response.
- 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'smethod. 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. Groover.
2. Mechanical Viabrations byV.Ram Murthy.

References:

1. Vibrations by W.T. Thomson.
2. Mechanical Vibrations – Schaum series.
3. Vibration problems in Engineering by S.P. Timoshenko.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

POWER PLANT ENGINEERING

(PROFESSIONAL ELECTIVE VI)

Course Code: GR18A4085 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Course Objectives:

The Objective of this course is to provide the student to

- Understanding of Thermal Power Plant Operation, different types of high pressure boilers including supercritical and supercharged boilers, Fluidized bed combustion systems
- Design the components of gas turbine plant and IGCC Systems
- Basic knowledge of Different types of Nuclear power plants including Pressurized water reactor, Boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor.
- Understanding of the operation of Hydroelectric, wind, solar PV, solar thermal, geothermal, biogas and fuel cell power systems.
- Understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc. and discussing environmental and safety aspects of power plant operation.

Course Outcomes:

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

- Demonstrate knowledge of thermal power plant and its working procedure with the complete plant layout.
- Identify and apply fundamentals to solve problems like performance of gas turbine and IGCC power plant systems
- List the principal components and types of nuclear reactors.
- Classify various Hydroelectric power plants and its auxiliaries
- Explain the concepts of power plant economics and impact of its effluents on environment

UNIT I:

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

UNIT II:

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

UNIT III:

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water

Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

UNIT IV:

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

UNIT V:

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

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

TOTAL QUALITY MANAGEMENT

(PROFESSIONAL ELECTIVE VI)

Course Code: GR18A4086 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Course Objectives:

- The Objective of this course is to provide the student to
- understand total quality management principles and processes
- Develop tools and techniques for effective real time applications in both manufacturing and services
- Provide the fundamentals of statistics and probability and their applications in quality management
- Provide knowledge on quality improvement techniques to diagnose, reduce and eliminate causes of variation and to assist in process improvement, production control and decision-making
- inculcate knowledge on various quality systems and control techniques

Course Outcomes:

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

- Develop an understanding on quality management philosophies and frameworks
- Develop in-depth knowledge on various tools and techniques of quality management in manufacturing and service sectors
- Critically assess the organizational, communication and teamwork requirements for effective quality management
- Analyze the problems in quality improvement process and apply various quality improvement techniques
- Explain the regulation and the phases of a quality system certification process.

UNIT I: Introduction

Need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

UNIT II:

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT III:

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

UNIT IV:

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

UNIT V:

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Text Books:

1. Besterfield D.H. et al., Total qualityManagement, 3rd ed., Pearson Education Asia, 2006.
2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

ROBOTICS

(OPEN ELECTIVE)

Course Code: GR18A4079 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Course Objectives:

The Objective of this course is to provide the student to

- Introduce the automation and brief history of robot and applications.
- Impart knowledge of familiarities with the kinematics of robots.
- Develop knowledge about robot end effectors and their design.
- Develop an ability on Robot Programming methods & Languages of robot.
- Impart knowledge about various Sensors and their applications in robots.

Course Outcomes:

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

- be familiarized with the Robot Anatomy and Robot Configurations
- create the automation and Robot applications.
- apply the kinematic motions of robot and knowledge about robot end effectors.
- integrate the Programming methods & various Languages of robots.
- select appropriate Sensors and their applications in robots

UNIT I: Introduction

Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – presentand future applications – classification by coordinate system and control system.

UNIT II: Components of the Industrial Robotics

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

UNIT III:

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

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

UNIT IV:

Differential transformation and manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion – Robot programming, languages and software packages.

UNIT V:

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

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

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K &Nagrath I J / TMH.

REFERENCES:

1. Robotics / Fu K S/ McGraw Hill.
2. An Introduction to Robot Technology, / P. Coiffet and M. Chaironze / Kogam Page Ltd. 1983 London.
3. Robotic Engineering / Richard D. Klafter, Prentice Hall
4. Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter-Science.
5. Introduction to Robotics / John J Craig / Pearson Edu.
6. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.

GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY

ECONOMIC POLICIES IN INDIA

(OPEN ELECTIVE)

Course Code: GR18A3122 **L/T/P/C: 3/0/0/3**

IV Year II Semester

Course Objectives:

- To analyse the overall business environment and evaluate its various components in business decision making.
- To Provide an analysis and examination of significant contemporary ethical issues and challenges.
- To Emphases the manager's social and environmental responsibilities to a wide variety of stakeholders.
- To know the various Government policies governing industry.
- To know economic terms and its scope.

Course Outcomes:

- Familiarize with the nature of business environment and its components.
- The students will be able to demonstrate and develop conceptual framework of business environment.
- Understand the definition of ethics and the importance and role of ethical behaviour in the business world today.
- Explain the effects of government policy on the economic environment.
- Outline how an entity operates in a business environment.

Unit 1:
Business environment-factors effecting Business Environment-need for industrial policies-Overview of Indian Economy, Trends towards market economy, problems of underdevelopment – meaning, Main problems, reasons, of underdevelopment. Development-

Unit II:
Factors and measure, Meaning of Economic development, National income, Per capital income, Quality of life, Capital Formation – Savings, Investment.

Unit III:
Planning in India, 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 policy – 1948, 1956, 1977, 1980, 1990, 1991, 2000-2001 Industrial Licensing, Monetary and Fiscal Policy.

References:

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