Institute Vision

To be a world class university providing value based education, conducting interdisciplinary research in cutting edge technologies leading to sustainable socio-economic development of the nation.

Institute Mission

- To produce technically competent and socially responsible engineers, managers and entrepreneurs, who will be future ready.
- To involve students and faculty in innovative research projects linked with industry, academic and research institutions in India and abroad.
- To use modern pedagogy for improving the teaching - learning process

ACADEMIC REGULATIONS

COURSE STRUCTURE

AND

DETAILED SYLLABUS

Mechanical Engineering

B.TECH. FOUR YEAR DEGREE COURSE

(Applicable for the batches admitted from 2011-2012)

VNR VIGNANA JYOTHI
INSTITUTE OF ENGINEERING AND TECHNOLOGY
(AFFILIATED TO JNTUH)
An Autonomous Institute under JNTUH
Bachupally, Nizampet (S.O),
Hyderabad – 500090
Andhra Pradesh, India

VNR VIGNANA JYOTHI INSTITUTE OF ENGINEERING AND TECHNOLOGY

HYDERABAD

An Autonomous Institute under JNTUH

ACADEMIC REGULATIONS 2011 FOR B.TECH. DEGREE COURSE

(Applicable for Students admitted from the academic year 2011-2012)

1. Courses of study

The following courses of study are offered at present for specialization for the B. Tech. Course:

Branch Code	Branch
01	Civil Engineering.
02	Electrical and Electronics Engineering
03	Mechanical Engineering
04	Electronics and Communication Engineering
05	Computer Science and Engineering.
10	Electronics and Instrumentation Engineering
12	Information Technology
24	Automobile Engineering

1.1 Eligibility Criteria for Admission

The eligibility criteria for admission into engineering programmes shall be as mentioned below:

The candidate shall be an Indian National.

The candidate should have completed 16 years of age as on 31st December of the academic year for which the admissions are being conducted.

The Candidate should have passed the qualifying examination (10+2) or equivalent as on the date of admission.

Seats in each programme in the Institution are classified into **Category** A and **Category** B as per the G.Os.

1.1.1 Category – A Seats

These seats will be filled through counseling as per the rank at the Common Entrance Test (EAMCET) conducted by the State Government and State Government GOs as per other admission criteria laid down in the G.Os.

1.1.2 Category - B Seats

These seats will be filled by the institute as per the G.Os Issued by State Government from time to time.

1.1.3 Category: Lateral Entry

The candidate shall be admitted into the Third Semester, based on the rank secured by the candidate at Engineering Common Entrance Test (ECET(FDH)) by the Convener, ECET.

2. Distribution and Weightage of Marks

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

ii. For theory subjects the distribution shall be **30 marks for Internal Evaluation** and **70 marks for the End-Examination**.

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

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

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

Two assignments are to be given to students covering the syllabus of first Mid and second Mid examinations and are evaluated for 5 marks each. .

The first assignment shall be submitted before first mid examinations and second Assignment should be submitted before second mid examination.

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

(a) 25 marks for the better of the two mid term examinations
(b) 5 marks is the average of the two assignment marks

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

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

iv For the subjects having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing, Production Drawing Practice, and Estimation etc., the distribution shall be 30 **marks for internal evaluation (15 marks for day-to-day work and 15 marks for internal tests (**the better of the two examinations will be taken into account**) and 70 marks for end examination.** There shall be **two internal tests** in a Semester.

iv. There shall be an **industry-oriented mini-Project**, in collaboration with an industry of their specialization, to be taken up during the vacation after III year II Semester examination. The **mini project shall be evaluated during the IV year I Semester.** The industry oriented mini project shall be submitted in report form and should be presented before a committee, which shall be evaluated for **50 marks.** The committee consists of Head of the Department, the supervisor of mini project and a senior faculty member of the department. There shall be **no internal assessment for industry oriented mini project.**

vi. There shall be a **Seminar presentation in IV year II Semester**. For the Seminar, the student shall collect the information on a specialized topic other than the project topic and prepare a technical report, showing his understanding of the topic, and submit to the department, which shall be evaluated by a Departmental committee consisting of the Head of the department, Seminar supervisor and a

senior faculty member. The Seminar report shall be evaluated for **50 marks**. There shall be **no external examination for Seminar.**

vii. There shall be a **Comprehensive Viva-Voce in IV year II Semester**. The Comprehensive Viva-Voce will be conducted by a Committee consisting of the Head of the Department and three Senior Faculty members of the Department. The Comprehensive Viva-Voce is aimed to assess the student's understanding in various subjects studied during the B.Tech. course of study. The Comprehensive Viva-Voce is evaluated **for 50 marks** by the Committee. There will be **no internal assessment for the Comprehensive viva-voce.**

viii. The Project work shall be started by the student in the beginning of the IV year I Semester. Out of a total of **200 marks** for the project work, **60 marks shall be for Internal Evaluation** and **140 marks for the Semester end Examination**. The Semester end Examination (viva-voce) shall be conducted by a committee comprising of an external examiner, Head of the Department and the project supervisor. The evaluation of project work shall be conducted at the end of the IV year II Semester. **The Internal Evaluation shall be on the basis of three Seminars conducted during the IV year II Semester for 30 marks by the committee consisting of Head of the Department, project supervisor and senior faculty member of the Department and for 30 marks by the supervisor of the project.**

3. Semester end Examination

(a) Theory Courses

Each course is evaluated for 70 marks. Examination is of 3 hours duration.
Question paper contains two sections [Section-A and Section-B]

Section-A: Carries 30 marks [Five questions of one mark each, five questions of two marks each and another five questions of three marks each] which is compulsory.

Section-B: carries 40 marks consisting of six essay type questions out of which four questions are to be answered, each carrying 10 marks.

Drawing related subjects, question paper contains 8 questions (atleast one question from each unit), out of which the candidate has to answer any 5 questions, each carrying 14 marks.

(b) Practical Courses

Each lab course is evaluated for 50 marks. The examination shall be conducted by the laboratory teacher and another senior teacher concerned with the subject

of the same/other department/Industry. The external examiner may be appointed by the Chief Superintendent in consultation with HOD as and when required.

(c) Supplementary Examinations

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

4. Attendance Requirements

i. A student shall be eligible to appear for the Semester end examinations if he acquires a **minimum of 75% of attendance in aggregate of all the subjects** for Semester / year.

ii. Condonation of shortage of attendance in aggregate **up to 10% (65% and above and below 75%)** in a Semester may be granted by **Institute Academic Committee.**

iii. A student will not be permitted to write the end examination and not promoted to the next Semester unless he satisfies the attendance requirement of the present Semester, as applicable. He may seek re-admission for that Semester when offered next.

iv. Shortage of Attendance **below 65% in aggregate** shall in **NO case be condoned.**

v. Students whose shortage of attendance is not condoned in any Semester are not eligible to take their end examination of that Semester.

vi. A stipulated fee shall be payable towards condonation of shortage of attendance.

5. Minimum Academic Requirements

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item No.**4.**

i. A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory or practical design or drawing subject or project, if he secures **not less than 35% (25 out of 70 marks)** of **marks in the end examination and a minimum of 40% of marks in the sum total of the internal evaluation and end examination taken together.**

ii. A student shall be **promoted from II to III year** only if he fulfils the academic requirement of **37 credits from Two regular and one supplementary**

examinations of I year I Semester and One Regular and One Supplementary exam of I year II Semester, and one regular examination of II year I Semester irrespective of whether the candidate takes the examination or not.

iii. A student shall be **promoted from III year to IV year** only if he fulfils the academic requirements of total **62 credits from the following examinations,** whether the candidate takes the examinations or not.

- Three regular and Two supplementary examinations of I B Tech I Semester.
- Two regular and two Supplementary examinations for I B Tech II Semester
- Two regular and one supplementary examinations up to the end of II year I Semester.
- One regular and one supplementary examinations of II year II Semester.
- One regular examination of III year I Semester.

iv. A student shall register and put up minimum academic requirement in all 200 credits and earn the 200 credits. Marks obtained in all 200 credits shall be considered for the calculation of percentage of marks.

v. Students who fail to earn 200 credits as indicated in the course structure **within eight academic years** from the year of their admission shall **forfeit their seat** in B.Tech. course and their **admission shall get stands cancelled.**

6. Course pattern

i. The entire course of study is of four academic years. **All the I, II, III and IV years are of Semester pattern .**

ii. A student eligible to appear for the end examination in a subject, but absent or has failed in the end examination may reappear for that subject at the supplementary examination whenever conducted.

iii. When a student is detained due to shortage of attendance in any Semester, he may be re-admitted into that Semester when it is offered next, **with the academic regulations of the batch into which he gets readmitted.**

iv. When a student is detained due to lack of credits in any year, he may be eligible to be promoted or for promotion into the next year after fulfillment of the academic requirements, **with the academic regulations of the batch into which he gets admitted**

7. Award of B.Tech. Degree and Class

A student will be declared eligible for the award of the B. Tech. Degree if he/she fulfils the following academic regulations:

I. Pursued **a course of study for not less than four academic years and not more than eight academic years.**

ii. Registered for **200 credits** and secured **200 credits.**

NOTE: Students, who fail to fulfill all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall forfeit their seat in B.Tech. Course.

Iii After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	% of marks to be secured	
First Class with Distinction	70% and above	From the aggregate marks secured for the 200 Credits.
First Class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	
Fail	Below 40%	

(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum).

8. Withholding of Results

If the student has not paid dues to College, or if any case of indiscipline is pending against him, the result of the candidate may be withheld and he will not be allowed to go into the next higher Semester. The award or issue of the Degree may also be withheld in such cases.

9. Transitory Regulations

Students who have discontinued or have been detained for want of attendance or any other academic requirements, may be considered for readmission as and when they become eligible. They have to take up Equivalent subjects, as substitute subject in place of repetition of subjects as decided by the Institute Academic Committee.

10. Minimum Instruction Days

The minimum instruction days for each Semester shall be **90 clear instruction days.**

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

12. The decision of the Institute Academic Committee will be final in respect of equivalent subjects for those students who are transferred from other colleges. The procedure for permitting students to transfer from other colleges will be decided by the principal / Institute Academic Committee keeping the Government Rules concerned in view.

13. General

i. Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

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

iii. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

iv. In the case of any discrepancy/ambiguity/doubt arises in the above rules and regulations, the decision of the Principal shall be final.

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

14. Academic Regulations for B.Tech. (Lateral Entry Scheme)

(Applicable for students admitted from the academic year 2012-2013)

(i) A student shall register for all 150 credits and earn all the 150 credits. Marks obtained in all 150 credits shall be considered for the calculation of the class.

(ii) A student who fails to earn 150 credits as indicated in the course structure within **six** academic years from the year of their admission shall forfeit their seat in B.Tech. programme and their admission stands cancelled.

(iii) The same attendance regulations are adopted as that of B.Tech. Four year degree course.

(iv) A student shall be promoted from third year to fourth year only on fulfilling the academic requirements of securing 37 credits from the following examinations.

a. Two regular and one supplementary examination of II year I Semester

b. One regular and one supplementary examination of II year II Semester

c. One regular examination of III year I Semester.

Irrespective of whether the candidate appears the Semester-End examination or not as per the normal course of study and in case of getting detained for want of credits the student may make up the credits through supplementary exams of the above exams before the date of commencement of class work for IV year I Semester.

(v) Award of B.Tech. Degree and Class

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	% of marks to be secured	
First Class with Distinction	70% and above	From the aggregate marks secured for the 150 Credits. (i.e., II year to IV year)
First Class	Below 70% but not less than 60%	
Second Class	Below 60% but not less than 50%	
Pass Class	Below 50% but not less than 40%	
Fail	Below 40%	

(The marks in internal evaluation and end examination shall be shown separately in the marks memorandum)

All other regulations as applicable to B.Tech. four year degree course will hold good for B.Tech. (Lateral Entry Scheme).

Vision

To develop into a Centre of Excellence in Education and Research in the field of Mechanical Engineering, consistent with the contemporary and future needs of the country

Mission

- To impart **high quality education** by using **modern pedagogical tools** so as to make the students **technically competent** in their chosen fields and **socially responsible**
- To inculcate **quality research** by developing **linkages with Industry** and **R & D organizations** in India & abroad

B.TECH. (MECHANICAL ENGINEERING):

Degree:	**B.Tech.**	Specialization:	**Mechanical Engineering**
Duration:	**4 Years**	Details:	**8 semesters**
Mode of	**Full-time**	Year of starting:	**1995**
Intake:	**120**	Regulations:	**R11**

- **Overview of the programme:**

  Mechanical engineering is a broad and diverse discipline that derives its breadth from the need to design, analyze and manufacture everything from small to large components, assemblies., and systems either stationary or in motion. The four year programme is designed to prepare graduates with creative thinking that allows them to design a product, use the analytical tools to achieve the design goals, ability to overcome constraints, work in a team to find solutions with social relevance. The programme has been running for the last 16 years and is regularly updated in line with the subject developments and changing industrial practices. Mechanical engineers learn about materials, solid and fluid mechanics, thermodynamics, heat transfer, control, instrumentation, design, and manufacturing processes, etc., to understand mechanical systems. Specialized mechanical engineering subjects include unconventional machining processes, composite materials, MEMS, nanotechnology, tribology, vibrations etc.

B.TECH. (MECHANICAL ENGINEERING)

❖ PROGRAMME EDUCATIONAL OBJECTIVES:

I. To prepare students for successful careers as mechanical engineers in organizations that meet the needs of Indian and global/multinational industrial/research establishments.

II. To provide a strong foundation in mathematical, scientific and engineering fundamentals in both domain and cross domain spheres, that enables students to visualize, analyze and solve mechanical engineering problems and be innovative and research oriented.

III. To train students with a wide spectrum of scientific and engineering courses so that students could comprehend, analyze, design and create products and services that address real life problems, which are efficient and cost effective.

IV. To inculcate in students a professional and ethical attitude, impart effective communication skills and ability to work in teams with multidisciplinary approach, be part of and interact with professional bodies so as to resolve engineering issues of social relevance.

V. To provide students with an academic environment that fosters excellence, leadership, yearning to pursue higher studies and passion for lifelong learning so as to have a successful professional career.

❖ **PROGRAMME OUTCOMES:**

a. Demonstrate basic knowledge of mathematics, sciences and mechanical engineering and essential computational techniques/procedures that aid in problem solving and be in a position to face competitive examinations.
b. Identify, critically analyze, formulate and solve mechanical engineering problems.
c. Design a system, a component or a process in the domain of mechanical engineering, prepare a model, conduct experiments, analyze and interpret data.
d. Visualize and work in engineering and science laboratories on multidisciplinary tasks as teams, conduct investigations and solve complex problems.
e. Use modern engineering tools, equipment, processes and state-of-the- art software packages on modeling and analysis for solving problems.
f. Demonstrate an understanding of the impact of engineering solutions on society to ensure that no ill effects befall; and also be aware of contemporary issues.
g. Understand the impact of engineering solutions on the environment to mitigate any ill effects and ensure sustainability of solutions arrived at.
h. Possess knowledge, understanding and application of professional and ethical responsibilities and human values in all professional transactions.
i. Utilize ability to work as individuals as well as team members on engineering problems and be able to understand group dynamics and play their role appropriately in the group and develop entrepreneurial skills.
j. Communicate effectively in both verbal and written form.
k. Administer and execute projects with emphases on time management, financial management and personnel management.
l. Develop a penchant for self-education, inclination for updating with developments, participate in professional societies, interact with stalwarts in the field and continue life-long learning.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

B. Tech. MECHANICAL ENGINEERING

I YEAR I SEMESTER **COURSE STRUCTURE**

Subject Code	Subject Name	Lectures	T/P/D	Credits
R11MTH1101	Mathematics I	3	1	3
R11PHY1101	Engineering Physics I	3	0	3
R11CHE1102	Chemistry of Engineering Materials	3	0	3
R11CSE1101	Computer Programming	3	0	3
R11MED1101	Engineering Mechanics I	4	1	4
R11EEE1130	Elements of Engineering	3	0	3
R11MED1102	Engineering Graphics I	2	3	2
R11EPC1201	Engg. Physics and Chemistry Lab	0	3	2
R11CSE1201	Computer Programming Lab	0	3	2
Total		**21**	**11**	**25**

I YEAR II SEMESTER **COURSE STRUCTURE**

Subject Code	Subject Name	Lectures	T/P/D	Credits
R11MTH1102	Mathematics II	3	1	3
R11PHY1102	Engineering Physics II	3	0	3
R11CHE1101	Engineering Chemistry	3	0	3
R11HAS1101	English	3	0	3
R11CSE1102	Data Structures	3	0	3
R11MED1103	Engineering Mechanics II	4	1	4
R11MED1104	Engineering Graphics II	2	3	2
R11MED1201	Engineering Workshop	0	3	2
R11HAS1203	English Language and Communication Skills Lab	0	3	2
Total		**21**	**11**	**25**

* T/P/D: Tutorial/Practical/Drawing Practice

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

B. Tech. MECHANICAL ENGINEERING

II YEAR I SEMESTER **COURSE STRUCTURE**

Subject Code	Subject Name	Lectures	T/P/D	Credits
R11MTH1103	Mathematics III	3	1	3
R11MED1106	Mechanics of Solids I	4	1	4
R11MED1107	Thermodynamics	4	1	4
R11MED1108	Metallurgy and Material Science	3	0	3
R11EEE1132	Basic Electrical Engineering	3	0	3
R11MED1109	Machine Drawing	0	6	4
R11MED1203	Metallurgy and Mechanics of Solids Lab	0	3	2
R11EEE1203	Electrical Technology and Electric Circuits Lab	0	3	2
Total		17	15	25

II YEAR II SEMESTER **COURSE STRUCTURE**

Subject Code	Subject Name	Lectures	T/P/D	Credits
R11MED1110	Mechanics of Solids II	4	1	4
R11MED1111	Kinematics of Machinery	4	1	4
R11MED1112	Fluid Mechanics and TurboMachinery	3	1	3
R11MED1113	Applied Thermodynamics	4	1	4
R11MED1114	Production Technology	3	0	3
R11ECE1134	Basic Electronics	3	0	3
R11MED1204	Production Technology Lab and Applied Thermodynamics Lab	0	3	2
R11MED1205	Fluid Mechanics and TurboMachinery Lab	0	3	2
Total		**21**	**10**	**25**

* T/P/D: Tutorial/Practical/Drawing Practice

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

B. TECH MECHANICAL ENGINEERING

III YEAR I SEMESTER **COURSE STRUCTURE**

Subject Code	Subject Name	Lectures	T/P/D	Credits
R11MED1115	Dynamics of Machinery	4	1	4
R11MED1116	Mechanical Engineering Design I	4	1	4
R11MTH1104	Numerical Analysis and Linear Programming	3	1	3
R11MED1117	Machine Tools	3	0	3
R11MED1118	Metrology and Instrumentation	3	0	3
R11MED1119	Computer Aided Design	3	0	3
R11MED1206	Machine Tools Lab. and Metrology Lab.	0	5	3
R11MED1207	CAD Lab. and Instrumentation Lab.	0	3	2
Total		**20**	**11**	**25**

III YEAR II SEMESTER **COURSE STRUCTURE**

Subject Code	Subject Name	Lectures	T/P/D	Credits
R11MED1120	Mechanical Engineering Design II	4	1	4
R11AME1102	Structural Analysis	4	1	4
R11MED1121	Finite Element Method	3	1	3
R11MED1122	Heat and Mass Transfer	3	1	3
R11HAS1102	Business Economics and Financial Analysis	4	0	4
R11CED1109	Environmental Studies	3	0	3
R11MED1208	Heat and Mass Transfer Lab	0	3	2
R11HAS1204	Advanced English Language Communication Skills Laboratory	0	3	2
Total		**21**	**10**	**25**

* T/P/D: Tutorial/Practical/Drawing Practice

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

B. Tech. MECHANICAL ENGINEERING

IV YEAR I SEMESTER **COURSE STRUCTURE**

Subject Code	Subject Name	Lectures	T/P/D	Credits
R11HAS1103	Management Science	4	0	4
	Elective I	4	0	4
R11MED1123	Mechanical Vibrations			
R11MED1124	Automation in Manufacturing			
R11MED1125	Gas Dynamics			
R11MED1126	Advanced Mechanism Design			
R11EIE1127	Advanced Instrumentation and Control Systems			
R11MED1127	CNC Technology			
	Elective II	4	0	4
R11MED1128	Theory of Elasticity and Plasticity			
R11MED1129	Robotics			
R11MED1130	Composite Materials			
R11MED1131	Power Plant Engineering			
R11MED1132	Advanced Machine Design			
R11AME1110	Automobile Engineering			
	Elective III	4	0	4
R11MED1133	Mechatronics			
R11MED1134	Advanced Mechanics of Solids			
R11MED1135	Metal Forming			
R11MED1136	Tribology			
R11MED1137	Renewable Energy Sources: Solar Energy			
R11MED1138	Industrial Engineering			
	Elective IV	3	0	3
R11MED1139	Unconventional Machining Processes			
R11MED1140	Plant Layout and Material Handling			
R11MED1141	Computational Fluid Dynamics			
R11EIE1123	Fundamentals of Biomedical Instrumentation			
R11MED1142	Industrial Management			
R11MED1143	Theory of Metal Cutting			
R11MED1209	CAD/CAM Lab	0	3	2
R11EIE1210	Automation Systems Design Lab	0	3	2
R11MED1301	Industry Oriented Mini – Project	0	8	2
Total		**19**	**14**	**25**

* T/P/D: Tutorial/Practical/Drawing Practice

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

B. Tech. MECHANICAL ENGINEERING

IV YEAR II SEMESTER **COURSE STRUCTURE**

Subject Code	Subject Name	Lectures	T/P/D	Credits
R11MED1144	Computer Integrated Manufacturing	3	0	3
R11MED1145	Elective V NanoTechnology	3	0	3
R11MED1146	Theory of Plates and Shells			
R11MED1147	Production Planning and Control			
R11MED1148	Refrigeration and Air Conditioning			
R11MED1149	Operations Research			
R11MED1150	Tool Design			
R11MED1151	Elective VI BioMechanics and BioMaterials	3	0	3
R11MED1152	Precision Engineering			
R11MED1153	Principles of Entrepreneurship			
R11MED1154	Interactive Computer Graphics			
R11MED1155	Statistical Quality Control and TQM			
R11MED1156	Fracture Mechanics			
R11MED1302	Seminar	0	3	2
R11MED1303	Comprehensive Viva	0	0	2
R11MED1304	Major Project	6	12	12
Total		**15**	**15**	**25**

* T/P/D: Tutorial/Practical/Drawing Practice

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE I Sem	**L**	**T/P/D**	**C**
	3	**1**	**3**

(R11MTH1101) MATHEMATICS I
(Advanced Calculus)

Course Prerequisites: Differentiation, Integration

Course Objectives:

- Understand Taylor's theorem and its application to maxima and minima of f(x,y).
- Understand the process of curve sketching.
- Understand multiple integrals and its applications.
- Apply the integral theorems of vector calculus.

Course Outcomes:

Students will be able to:

- Compute maxima and minima of functions of two variables.
- Apply the curve tracing concepts to find arc length of curves, surface area and volume of solids of revolution.
- Evaluate the multiple integrals using appropriate change of variables.
- Apply the integral theorems proficiently in analysis and solution of engineering problems.

UNIT I

Elementary analysis

Sequences and series - convergence and divergence, ratio test, comparison test, integral test, Cauchy's root test, Raabe's test (statements only for the tests), and absolute and conditional convergence.

Mean value theorems (statements only) - Rolle's theorem, Lagrange's theorem, Cauchy's theorem, and generalized mean value theorem (Taylor's Theorem).

UNIT II

Functions of several variables

Partial differentiation; Functional dependence; Jacobian; Maxima and Minima of functions of two variables with constraints and without constraints.

Radius of curvature; Centre and circle of curvature – evolutes and envelopes.

UNIT III

Improper integrals and special functions

Improper Integrals; Beta, Gamma, and Error functions - Properties and simple applications.

UNIT IV

Curve tracing, applications of integration and multiple integrals

Curve tracing – Cartesian, polar, and parametric curves; Applications of integration to lengths, volumes and surface areas in cartesian and polar coordinates.

Multiple integrals - double and triple integrals, change of variables, and change of order of integration.

UNIT V

Vector calculus

Introduction to vector and scalar functions; Gradient, curl, divergence, and their related properties of sums and products; Laplacian and second order operators; Vector integration - line integral, work done, potential function; Area, surface, and volume integrals; Statements of Vector integral theorems and their verification (without proofs) - Green's theorem, Stoke's theorem, and Gauss divergence theorem.

TEXT BOOK

Calculus and Analytic Geometry *by* Thomas and Finney, 9th edition; *Publisher: Pearson Education*.

REFERENCE

1. Elementary Analysis: The Theory of Calculus *by* Kenneth Ross; *Publisher: Springer*
2. Principles of Mathematical Analysis by Walter Rudin (1976); 3rd edition; *Publisher: Paperback.*
3. Advanced Engineering Mathematics *by* Erwin Kreyszig, 8th edition; *Publisher: John Wiley*.
4. Calculus *by* Tom M. Apostol; Volume1 and Volume 2 (2003); 2nd edition; *Publisher: John Wiley*
5. Schaum's Outline of Vector Analysis *by* Murray R. Spiegel (2011); 2nd edition; *Publisher: Tata McGraw Hill*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE I Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11PHY1101) ENGINEERING PHYSICS I

Course prerequisites: General Physics

Course Objectives:

- To supplement and enhance the basic concepts in Physics essentially required in the study of materials as well as interaction of light with matter, interaction of light with matter through physical phenomena like interference, diffraction and polarization.
- To know and understand some important applications of lasers and optical fibers.
- To learn the importance of wave and particle nature of light and to understand the behavior of an electron in one dimensional potential box.
- To understand the effect of temperature on Fermi Dirac Distribution Function and also learn the behavior of an electron in a periodic potential, the new concept of Effective mass of an electron and to know the classification of materials into conductors, semiconductors and insulators.

Course Outcomes:

Students will be able to:

- Understand the Phenomenon of Interference, Diffraction& Polarization.
- Learn the principle, working, construction and energy mechanism of various lasers and their applications explain the light signal propagation and attenuation through optical fiber.
- Understand the differences between particle and wave nature, energy states in one dimensional potential box
- Understand the Consequences of Heisenberg‘s Uncertainty principle.
- Understand the one dimensional Schrodinger‘s wave equation and the effect of temperature on Fermi-Dirac Distribution, Kronig Penny model.

UNIT I

Interference and diffraction

Superposition principle; Resultant amplitude; Coherence - methods to obtain coherent sources; Interference; Young’s double slit experiment; Interference in thin films by reflection; Newton’s rings experiment; Distinction between Fraunhofer and Fresnel diffraction; Diffraction at single slit - Qualitative and Quantitative (Phasors approach); Diffraction at double slit - Circular aperture and multiple slits – grating (Qualitative Approach); Resolution of spectral lines; Rayleigh criterion; Resolving power of grating and telescope.

UNIT II

Polarization

Polarization phenomenon; Brewster's Law and Malus' law; Examples; Types of polarization; Double refraction; Nicol prism; Quarter and half wave plates.

Lasers

Characteristics of lasers – spontaneous and stimulated emission of radiation, meta stable state, population inversion, and lasing action; Einstein's coefficients and relation between them; Ruby laser; Helium-Neon laser; Carbon dioxide laser; Semiconductor Laser; Applications of lasers.

UNIT III

Fiber optics

Principle of optical fiber; Acceptance angle and acceptance cone; Numerical aperture; Types of fibers and refractive index profiles; Qualitative analysis of attenuation in optical fibers; Application of optical fibers.

Crystal structures

Space lattice; Unit cell; Lattice parameter; Crystal systems; Bravais lattices; Atomic radius; Co-ordination number; Structures and packing fractions of simple cubic – body centered cubic – face centered cubic crystals; Hexagonal closed packed crystals; Structures of diamond, NaCl.

UNIT IV

Directions, planes, and XRD

Miller Indices for Crystal planes and directions; Inter planar spacing of orthogonal crystal systems; Diffraction of X-rays by crystal planes and Bragg's law; Laue method; Powder method; Applications of X-ray diffraction.

Bonding in solids

Force and energy between two approaching atoms; Primary and secondary bonds; Binding energy and cohesive energy; Madelung constant; Cohesive energy and Madelung constant for NaCl crystal.

Defects in solids

Imperfections in crystals; Point defects (vacancies, interstitial and impurities); Schottky and Frenkel defects (with mathematical treatment); Line imperfections; Edge and screw dislocation; Burger vector; Surface defects and volume defects (qualitative treatment).

UNIT V

Surface physics

Surface electronic structure (work function - thermionic emission, surface states, and tangential surface transport); Electron microscope; Scanning tunneling microscope.

Science and technology of nanomaterials

Origin of nanotechnology – Basic principles of Nanoscience and Technology; Surface to volume ratio; Quantum confinement; Fabrication of nanomaterials - bottom up fabrication (sol-gel and combustion methods), top down fabrication (CVD and PVD methods); Characterization (XRD and TEM); Applications of nanotechnology.

TEXT BOOKS

1. Introduction to Solid State Physics *by* Charles Kittel; *Publisher: John Wiley*
2. Physics, Vol.2, *by* Halliday, Resnick and Krane; *Publisher: John Wiley*
3. Applied Physics *by* P.K.Mittal; *Publisher: IK International Publishing House*.
4. Optics *by* A. Ghatak; *Publisher: Tata Mc Graw Hill*

REFERENCE

1. Engineering Physics *by* R.K.Gaur and S.L.Gupta; *Publisher: Dhanpat Rai*.
2. Solid State Physics *by* S.O.Pillai; *Publisher: New Age International.*
3. Engineering Physics *by* M Chandra Shekar and P. Appala Naidu; *Publisher: VGS Book links*.
4. Solid State Physics *by* A.J.Dekker; *Publisher: Macmillan Publishers*.
5. Solid State Physics *by* N.W.Ashcroft and N.David Merwin; *Publisher: Thomson Learning.*
6. Engineering Physics *by* Jain, Sanjay D. and Sahasrabudhe, Girish G.; *Publisher: Universities Press.*
7. Elements of Solid State Physics *by* J.P.Srivatsva; *Publisher: Prentice Hall of India.*
8. Optical Fiber Communications *by* G. Keiser; *Publisher: McGraw Hill*.
9. Fundamentals of Molecular Spectroscopy *by* Banwell; *Publisher: Tata McGraw Hill.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE I Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11CHE1102) CHEMISTRY OF ENGINEERING MATERIALS

Course Prerequisites: General Chemistry

Course Objectives:

- A sustainable energy supply, is needed for promoting economic development as well as protecting the environment.
- Understanding the significance of various Engineering materials like cement abrasives, adhesives and composites in structural enhancement of materials.
- Exposure to refractories and ceramics in industries and most recently, aerospace technology.
- Familiarize lubricants as a basic and fundamental necessity for the maintenance of any machines.

Course outcomes:

Students will be able to:

- Acquire knowledge of the types of fuels, their sources and purification techniques.
- Understand the various purification techniques of various fuels
- Understand the manufacturing process of cement, its properties and usage of abrasives, adhesives and composites in various industrial processes.
- Benefits of refractories as heat-resistant materials and applications of ceramics in various fields.
- Knowledge of lubricants in regard to their applications in various machines.

UNIT I

Energy sources

Fuels - classification (solid, liquid, gaseous), calorific value of fuel (HCV, LCV), determination of calorific value by bomb calorimeter; Solid fuels – coal – analysis – proximate and ultimate analysis and their significance; Liquid fuels – petroleum, refining of petroleum, cracking, knocking, synthetic petrol – Bergius and Fischer- Tropsch's process, and biodiesel (properties and significance); Gaseous fuels – natural gas, LPG, CNG (composition and uses), analysis of flue gas by Orsat's method, determination of calorific value by Junker's gas calorimeter; Combustion – problems.

UNIT II

Cement

Types of cement**;** Chemical constituents and composition of Portland cement; Manufacturing methods of Portland cement (wet and dry processes); Properties of cement - Setting and Hardening of cement (reactions); Testing of cement; Decay of cement; Cement concrete - RCC.

UNIT III

Engineering materials

III a) Abrasives - Introduction, types of abrasives, working of abrasives, classification and chemical composition of abrasives, and their applications.

III b) Adhesives - Introduction, criteria of a good adhesive, classification of adhesives and their applications, advantages and disadvantages of adhesives.

UNIT IV

Refractories and Ceramics

Refractories: Definition; Classification with examples; Characteristics of a good refractory; Causes for the failure of a refractory material; Properties of refractories - refractoriness, RUL test, chemical inertness, dimensional stability, thermal expansion and contraction, thermal conductivity, porosity, electrical conductivity, heat capacity ,permeability, thermal spalling, and texture.

Ceramics: Introduction; Classification; Glazed ceramics; Applications of ceramics.

UNIT V

Lubricants

Criteria of a good lubricant; Classification of lubricants-lubricating oils; Greases or semisolid lubricants; Solid lubricants; Mechanism of lubrication-fluid film lubrication, boundary lubrication, and extreme pressure lubrication; Properties of lubricants - viscosity, cloudpoint, pour point, flash and fire point, mechanical stability, saponification number, neutralization number, aniline point, oiliness, and carbon residue.

TEXT BOOKS

1. Text book of Engineering Chemistry *by* Y.Bharathi Kumari and Jyotsna Cherukuri; *Publisher: VGS Book Links*.
2. Engineering Chemistry *by* P.C.Jain and Monica Jain; *Publisher: Dhanpatrai*.

REFERENCE

1. Text book of Engineering Chemistry *by* Balram Pani; *Publisher: Galgotia Publications.*
2. Text book of Engineering Chemistry *by* S.S. Dhara and Mukkanti; *Publisher: S.Chand.*
3. Text book of Engineering Chemistry *by* C.P.Murthy, C.V.Agrawal, and A.Naidu; *Publisher: B.S.Publications*.
4. Text book of Engineering Chemistry *by* R.Gopalan, D.Venkappayya, and Sulochana Nagarajan; *Publisher: Vikas Publishers*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE I Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11CSE1101) COMPUTER PROGRAMMING

Course Prerequisites: Knowledge on Computers and Mathematics

Course Objectives:

- Gain a working knowledge of C programming.
- Learn how to write modular, efficient and readable C.
- Utilize pointers to efficiently solve problems.
- Use functions from the portable C library.

Course Outcomes:

Students will be able to:

- Understand the fundamentals of computer programming.
- Choose the loops and decision making statements to solve the problems.
- Understand and relate different derived data types and also knowledge and skills of applying structured programming methods to solve the given problem.
- Trade-offs involved in choosing static versus dynamic memory allocation and identify appropriate file operation in c programming for a given application

UNIT I

Introduction to computers

Computer systems; Computing environments (DOS/Linux); Computer languages; Linux command for creating and running programs; Software development methods; Algorithms; Pseudo code; Flow charts; Applying the software development method.

UNIT II

Introduction to C language

History; Simple C programme; Identifiers; Basic data types; Variables; Constants; Type qualifiers; Input/ Output; Operators; Expressions - precedence and associativity, and expression evaluation; Type conversions; Bit wise operators; Statements; Simple C programming examples.

Selection statements – if and switch statements; Repetition statements – while, for, do-while statements, and loop examples; Other statements related to looping – break, continue, go to statements, and C Programming examples.

UNIT III

Designing structured programs

Functions – basics; user defined functions; inter-function communication, standard functions, and scope; Storage classes - auto, register, static, extern, and scope rules; Recursive functions; Example C programs.

Arrays – Basic concepts, one-dimensional arrays, two – dimensional arrays, multidimensional arrays, arrays to functions, C program examples.
Strings – Basic concepts, String input/ output functions, arrays of strings, string handling functions, strings to functions, C programme examples.

UNIT IV
Derived data types
Structures – basic concepts, nested structures, arrays of structures, structures and functions, unions, typedef, bit fields, enumerated types, and C programming examples.

Pointers
Basic concepts; Pointers and functions; Pointers and strings; Pointers and arrays; Pointers and structures; Self referential structures; Example C programs.

UNIT V
File I/O
Basic concepts; Text files and binary files; File input/ output operations; File status functions (error handling); Command-Line Arguments, C program examples.
Preprocessor directives.
Dynamic memory allocation.

TEXT BOOKS
1. C Programming: A Problem-Solving Approach *by* Behrouz A. Forouzan, Richard F.Gilberg, and E.V.Prasad; *Publisher: Cengage Learning.*
2. The C Programming Language *by* Brian W. Kernighan and Dennis M. Ritchie; *Publisher: Prentice Hall*.

REFERENCE
1. Let us C *by* Yashavant Kanetkar; *Publisher: BPB Publications*
2. C: How to Program *by* Paul Deitel and Harvey Deitel; *Publisher: Prentice Hall*
3. Absolute Beginner's Guide to C *by* Greg M. Perry, Edition 2; *Publisher: Sams Pub., 1994*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE I Sem	**L**	**T/P/D**	**C**
	4	**1**	**4**

(R11MED1101) ENGINEERING MECHANICS I

Course Prerequisites: Physics, Mathematics

Course Objectives:

- Understand particle, body, rigid body, concept of force, analysis of forces acting on a rigid body.
- Understand moment and the principle of moments.
- Understand friction and its implications.

Course Outcomes:

Students will be able to:

- Draw the free body diagram of a body acted upon by a system of forces.
- Analyze the forces acting on a body and write the equations of equilibrium.
- Write the moment equations of equilibrium.

UNIT I

Concurrent forces in a plane

Principles of statics; Composition and resolution of forces; Equilibrium of concurrent forces in a plane; Method of projections; Equilibrium of three forces in a plane; Method of moments; Friction.

UNIT II

Parallel forces in a plane

Two parallel forces; General case of parallel forces in a plane; Center of parallel forces and center of gravity; Centroids of composite plane figures and curves; Distributed force in a plane.

UNIT III

General case of forces in a plane

Composition of forces in a plane; Equilibrium of forces in a plane; Plane trusses: Method of joints; Plane trusses: Method of sections; Plane frames: Method of members; The funicular polygon; Maxwell diagrams; Distributed force in a plane; Flexible suspension cables.

UNIT IV

Force systems in space

Concurrent forces in space - method of projections, and method of moments; Couples in space; Parallel forces in space; Center of parallel forces and center of gravity; General case of forces in space.

UNIT V

Moments of inertia of a plane figure

Moment of inertia of a plane figure with respect to an axis in its plane; Moment of inertia of a plane figure with respect to an axis perpendicular to the plane of the figure; Parallel-axis theorem; Product of inertia and principal axes; Principal axes and principal moments of inertia.

Moments of inertia of material bodies

Moments of inertia of a rigid body; Moment of inertia of a lamina; Moment of inertia of three-dimensional bodies; Product of inertia and principal axes; Change of direction of axes of inertia.

TEXT BOOK

Engineering Mechanics *by* S.Timoshenko and D.H.Young; *Publisher: McGraw Hill*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE I Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11EEE1130) ELEMENTS OF ENGINEERING

Course Prerequisites: General Science, Mathematics

Course Objectives:

- Understand and acquire knowledge on different elements of Engineering.
- Gain knowledge on constructional materials and elements of civil engineering.
- Understand various power and energy generating Systems.
- Understand various transportation vehicles both air and surface.

Course Outcomes:

Students will be able to:

- Understand the basics of Electrical Engineering.
- Understand the basics of Civil Engineering.
- Understand the basics of power generating systems.
- Understand the basics of different types transportation systems

ELEMENTS OF CIVIL ENGINEERING

UNIT I

Construction and facilities

Introduction - Impact of Infrastructural development on the economy of a country, role of civil engineers, importance of planning, scheduling in construction management;

Surveying - linear measurements, elevation measurements, areas, volumes, modern tools of surveying like total station, GPS, and GIS;

Construction materials - Importance of civil engineering materials like stones, bricks, cement, timber, reinforcing steel, paints, glass in construction;

Soils and foundations - Types of soils, SBC of soils, suitable foundations for structures like buildings; bridges and towers;

Roads and highways - camber, stopping sight distance, overtaking sight distance, BOT projects;

Planning of buildings - building byelaws and regulations, planning of residential and commercial facilities like institutes, hospitals, shopping malls, and theatres;

Dams and Reservoir - water requirements and its conservation, hydraulic structures of storage and water conveyance systems.

ELEMENTS OF MECHANICAL ENGINEERING

UNIT II

Power (energy) systems

Block diagram of a power system; sources of energy; Conventional, non-conventional and renewable energy; Application; Resource availability; Power produced; Torque, Speed, and Efficiency; Materials used in turbine shafts; Blades; Nozzles; Diagnostics and condition monitoring; Commercial feasibility of power systems.
(Turbine)

UNIT III

Transport Vehicles (surface and air)

Road Vehicles - power plant in vehicles, transmission; steering, chassis, body, and wheels and axles
Rail vehicles - distinction of rail vehicles from road vehicles;
Air vehicles - aeroplane and its parts;
Space vehicles - rockets, 2 stage, 3 stage and 4 stage rockets, and solid and liquid fuels;
Sea Vehicles – power plant, transmission, steering, and hull.

ELEMENTS OF ELECTRICAL ENGINEERING

UNIT IV

Electrical power systems

Electrical power generation concept; A.C generator-principle; Steam power plant (thermal power plant); Hydel power plant (layouts only); Efficiency-transformer-principle-need-types; Fuse-Substation-simple problems.

UNIT V

Utilization of electrical energy

Electrical heating-advantages; Resistance heating; Illumination; Definitions; Laws of illumination; Working of Incandescent lamp and Fluorescent lamps; Electric Welding; Electric Traction-Block diagram; Simplified speed-time curve; Energy meter (principle only).

TEXT BOOKS

1. Electrical Engineering Fundamentals *by* Vincent Deltora, Prentice Hall of India, 2nd edition.
2. Art and Science of Utilization of Electrical Energy *by* H.Partab; *Publisher: Dhanpat Rai.*
3. Non-Conventional Energy Sources *by* G.D. Roy; *Publisher: Khanna Publishers.*
4. Automotive Mechanics *by* William Crouse and David Anglin; *Publisher: McGraw Hill*

REFERENCE

1. A Course in Utilization of Electrical Energy *by* S.K. Girdhar, G.C. Garg, and S.M. Dhir; *Publisher: Khanna Publishers.*
2. Electrical Power Systems *by* Soni, Gupta, and Batnagar; *Publisher: Dhanpat Rai.*
3. Generation, Distribution and Utilization of Electrical Energy *by* C.L. Wadhwa; *Publisher: New Age International.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE I Sem	**L**	**T/P/D**	**C**
	2	**3**	**2**

(R11MED1102) ENGINEERING GRAPHICS I

Course Prerequisites: Geometrical Construction

Course Objectives:

- Understand the usage of drawing instruments.
- Understand the construction methods for drawing conic sections.
- Identify the significance of curves in engineering practice like bridges, building, arches etc.
- Understand first and third angle projections and methods.

Course Outcomes:

Students will be able to

- Analyze and apply the concept of scales and curves and Solve the problems as per the drawing conventions
- Analyze and apply the concept of projections and solve the problems on Projections for lines, planes and solids
- Analyze and solve the problems on Auxiliary views of planes and solids
- Apply the knowledge of AutoCAD Solve all the problems

UNIT I

Introduction to AutoCAD.

Introduction to engineering drawing

Principles of engineering graphics and their significance; Drawing instruments and their uses; Conventions in drawing-lettering; BIS Convention; Different types of scales; Scale of chords.

UNIT II

Curves used in engineering practice and their construction

Ellipse; Parabola; Hyperbola and rectangular hyperbola; Cycloid; Epicycloids; Hypocycloid – involutes.

UNIT III

Orthographic projection

Points and straight lines inclined to both planes; True lengths and traces.

UNIT IV

Projection of planes

Projection of regular planes inclined to both planes; Auxiliary projections.

UNIT V

Projection of solids

Projection of regular solids-inclined to both planes; Auxiliary projections.

TEXT BOOK

Elementary Engineering Drawing *by* N.D. Bhat; *Publisher: Charotar Publishing House*

REFERENCE

Engineering Drawing *by* K.L. Narayana and P. Kannaiah; *Publisher: Scitech Publications.*

Engineering Graphics for degree *by* K.C. John; *Publisher: Prentice Hall of India*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE I Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11EPC1201) ENGINEERING PHYSICS AND CHEMISTRY LAB

Course Prerequisites: General Physics and Chemistry

Course Objectives:

- To practically learn interaction of light with matter through physical phenomena like interference, diffraction and dispersion.
- To expose to the principle of superposition and resonance.
- To demonstrate the formation of standing waves and to understand the mechanical wave behavior and to determine Rigidity Modulus of different materials of wires.
- To demonstrate basic discharge phenomenon in capacitors and to know the characteristics of the circuit elements, like resistors, capacitors and inductors.

Course Outcomes:

Students will be able to:

- Understand clearly the interference principle in wave theory of light and able to relate it to the formation of Newton Rings and Obtain a pure spectrum when light passes through prism.
- Understand the formation and propagation of mechanical waves.
- Study simple oscillations of a load attached to a string and relate it to nature of material of string.
- Understand the extent of hardness range present in a water sample and its consequences if used for various industrial operations.
- Determination of strength of solutions, pH of various solutions, lubricants usage in machinery to prevent wear and tear.
- Understanding the composition of soap used for washings.

ENGINEERING PHYSICS LABORATORY

Any eight experiments from the following:

1. Dispersive power of the material of a prism using spectrometer.
2. Diffraction grating (both with laser and non-laser source).
3. Single slit with laser light.
4. Newton's ring.
5. Finding thickness of a thin wire or sheet by forming a wedge-shaped film.
6. Energy gap of a semiconductor material.
7. Torsional pendulum expt. to determine the rigidity modulus of material of a wire.
8. Melde's experiment.
9. Sonometer experiment.

10. Numerical aperture and acceptance angle of an optical fiber cable.
11. Stewart Gee's experiment.
12. Characteristics of LED.
13. Photo cell/ solar cell.

Book: Essential Practical Lab Manual of Physics: by P.Raghavendra Rao

ENGINEERING CHEMISTRY: LIST OF EXPERIMENTS

Course Prerequisites: General Maths, General chemistry.

Course Objectives:

- Estimation of hardness of water is essential for drinking water and in industries to avoid boiler troubles.
- Knowledge of instrumentation in Colorimeter, Redwood viscometer, Conductivity meter and pH meter.
- Knowledge of preparation of soap.

Course Outcomes: Students will be able to

- Understand the extent of hardness range present in a water sample and its consequences if used for various industrial operations.
- Determination of strength of solutions, pH of various solutions, lubricants usage in machinery to prevent wear and tear.
- Understanding the composition of soap used for washings.

1. Titrimetry

a) Estimation of hardness of water by EDTA method.

2. Instrumental methods

(i) Conductometry

a) Conductometric titration of strong acid vs strong base

(ii) Colorimetry

a) Estimation of copper by colorimetric method

(iii) Potentiometry

a) Titration of strong acid vs strong base by potentiometry

3. Physical properties

a) Determination of viscosity of sample oil by Redwood viscometer.

4. Preparation of organic compounds

a) Preparation of aspirin or Thiokol rubber

TEXT BOOKS

1. Laboratory Manual on Engineering Chemistry *by* S.K.Bhasin and Sudha Rani; *Publisher: Dhanpat Rai.*
2. Laboratory Manual on Engineering Chemistry *by* Y.Bharathi Kumari and Jyotsna Cherukuri; *Publisher: VGS Book Links.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE I Sem.	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11CSE1201) COMPUTER PROGRAMMING LABORATORY

Course Prerequisites: Knowledge on Computers and Mathematics

Course Objectives:

- Learn how to write modular, efficient and readable C programs.
- Utilize pointers to efficiently solve problems.
- Utilize searching and sorting concepts to solve problem.
- Use functions from the portable C library.

Course Outcomes:

Students will be able to

- Implement basic command s in Linux.
- Able to write, compile and debug programs in c language.
- Implement appropriate decision making statements and derived data types to solve a given problem.
- Realize different file operations in c programming

Week 1

1. Write a program using C (WAP) that reads three different integers from the keyboard and prints – sum, average, product, smallest, and largest of the numbers.
2. WAP that reads two integers and prints – difference, quotient, and remainder.
3. WAP that reads two integers and determines whether the first is a multiple of the other.

Week 2

1. WAP to find the sum of individual digits of a positive integer.
2. WAP to generate Fibonacci sequence (1, 1, 2, 3, 5, 8,….).
3. WAP to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

Week 3

1. WAP to calculate the following sum:
   Sum=1-x2/2! +x4/4!-x6/6!+x8/8!-x10/10!
2. WAP to find the roots of a quadratic equation.

Week 4

1. WAP 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).
2. WAP to construct pyramids of numbers.

Week 5

1 WAP to print a given number [0-1000] in words. For example, 123 as "One Hundred and Twenty Three".
2 WAP to check whether a given number is an Armstrong, Palindrome, Perfect, Prime, or a Fibonacci prime number.
3 WAP to find both the largest and smallest number in a list of integers.

Week 6

1. Implementation of functions categories.
2. 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.

Week 7

1. WAP to calculate
   i) minimum and maximum of an 1-d array.
   ii) sorting and searching of 1-D array.
   iii) addition and multiplication of two matrices

Week 8

1. Programs on string handling functions-copying, reverse, substring, concatenation.
2. Programs on structure and unions.

Week 9

Midterm exam

Week 10

Programs using pointers - pointer basic operations, and pointers and functions.

Week 11

Program on pointers and structures, pointers and arrays, and pointers and strings.

Week 12

Implementation of file operations and error handling.

Week 13

Implementation of dynamic memory allocation.

Week 14

Programs using command line arguments.

Week 15

Implementation of preprocessor directives.

Week 16

Internal Lab Exam

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE II Sem	**L**	**T/P/D**	**C**
	3	**1**	**3**

(R11MTH1102) MATHEMATICS II
(Linear Algebra and Ordinary Differential Equations)

Course prerequisites: Matrices, Differentiation and Integration

Course Objectives:

- Understand the Echolen form and Normal form of a matrix and its applications in solving linear system of equations.
- Understand the methods of solving first order differential equations and learn about its applications to L-R and R-C circuits.
- Apply the convolution theorem to evaluate Laplace Transform of the functions.
- Apply Z-Transforms in solving the difference equations.

Course Outcomes:

Students will be able to:

- Find the rank using Echelon form and Normal form.
- Solve the problems in first order and second order differential equations.
- Learn Laplace Transform as a tool.
- Evaluate the Z-Transform of the given function.

LINEAR ALGEBRA

UNIT I

Solution of linear systems

Matrices and linear systems of equations - elementary row transformations, Rank Echelon form, and normal form; Solution of linear systems - direct methods - LU decomposition, LU decomposition from Gauss elimination, and solution of Tri-diagonal systems; Eigen values, eigen vectors, and their properties - Liner dependence and independence; Cayley-Hamilton theorem - inverse and powers of a matrix by Cayley-Hamilton theorem, diagonalization of a matrix, calculation of powers of a matrix; Modal and spectral matrices.

UNIT II

Linear transformations

Real matrices - symmetric, skew symmetric, and orthogonal linear transformation; Complex matrices - Hermitian, Skew-Hermitian and unitary matrices; Eigen values and eigen vectors of complex matrices and their properties; Quadratic forms - reduction of quadratic form to canonical form, rank, positive, negative definite, semi definite, index, signature, Sylvester law, and singular value decomposition.

ORDINARY DIFFERENTIAL EQUATIONS

UNIT III

Ordinary differential equations and their applications

Differential equations of first order and first degree - Linear, Bernoulli and exact differential equation; Applications of differential equations of first order and first degree - Newton's law of cooling, law of natural growth and decay, orthogonal trajectories, and basic circuits.

UNIT IV

Differential equations of higher order and their applications

Differential equations of higher order - homogeneous and non-homogenous type, differential equations of second order and higher order with constant coefficients with right hand side term of the type e^{ax}, sin (ax), cos (ax), polynomials in x, e^{ax} V(x), x V(x), and method of variation of parameters; Applications to bending of beams; Mechanical systems - simple harmonic motion.

UNIT V

Linear differential equations and qualitative methods

Cauchy's linear differential equation; Legendre's differential equations; Simultaneous linear differential equations; The phase plane; Phase portraits and direction fields; Critical points and stability.

TEXT BOOKS

1. Advanced Engineering Mathematics *by* R.K Jain and S.R.K Iyengar, 3rd edition; *Publisher: Narosa Publications*, 2011.
2. Differential Equations *by* Dennis G. Zill; *Publisher: Cengage learning*, 2011.

REFERENCE

1. Advanced Engineering Mathematics *by* Erwin Kreyszig, 8th edition; *Publisher: John Wiley*.
2. Advanced Engineering Mathematics *by* Peter V. O'Neil, 9th Edition; *Publisher: Cengage Learning.*
3. Elementary Differential Equations and Boundary Value Problems *by* William E. Boyce and Richard C. Diprima; *Publisher: Wiley.*
4. Linear Algebra and its applications by David C Clay; *Publisher: Pearson Education.*
5. Differential Equations, with Applications and Historical Notes *by* George F. Simmons and John S. Robertson (2008) 2nd Edition; *Publisher: Tata McGraw Hill*.
6. Advanced Engineering Mathematics *by* Dennis G. Zill, Warren S. Wright, and Michael R. Cullen, 4th edition; *Publisher: Jones and Bartlett Learning*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE II Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11PHY1102) ENGINEERING PHYSICS II

Course Prerequisites: General Physics

Course Objectives:

- To learn the structure of solids, crystal systems, packing and arrangement of particles in crystals, simple planes and directions in solids, defects in crystals.
- To learn the properties of magnetic materials and classification, Dielectric materials.
- To learn the concept and applications of superconductors.
- To introduce new concepts like surface phenomena and nano science.

Course Outcomes:

Students will be able to:

- Identify different crystal types various planes and directions in crystals and estimate one dimensional crystal defects.
- Learn the magnetic properties of materials classify the magnetic materials into Dia, Para and ferro.
- Learn the characteristics, properties and applications of superconductors and magnetic materials.
- Realize surface phenomena are different from bulk; learn methods to estimate work functions and Compare optical and electron microscopes
- Learn principles of SEM &TEM.

UNIT I

Elements of statistical mechanics

Maxwell-Boltzmann; Bose-Einstein and Fermi-Dirac statistics (non mathematical treatment); Photon gas; Planck's law of black body radiation; Deduction of Wein's law and Rayleigh-Jeans law from Plank's law.

Principles of quantum mechanics

Waves and particles; De Broglie hypothesis; Matter waves; Davisson and Germer experiment; Heisenberg's uncertainty principle; Schrodinger wave equation; Wave function and its physical significance - Particle in one dimensional potential box (wave functions, probability densities, and energy states).

UNIT II

Free electron Fermi gas

Energy levels in one dimension; Effect of temperature on the Fermi-Dirac distribution; Free electron gas in three dimensions; Electrical conductivity and Ohm's law; Electrical resistivity of metals (Qualitative); Thermal conductivity of metals.

Band theory of solids

Electron in a periodic potential - Bloch theorem - Kronig-Penney model (non mathematical treatment); Origin of energy band formation in solids; Classification of materials into conductors, semiconductors and insulators; Concept of effective mass of an electron.

UNIT III

Semiconductor physics

Fermi level in intrinsic and extrinsic semiconductors; Intrinsic semiconductor and carrier concentration; Extrinsic semiconductor and carrier concentration; Equation of continuity; Direct and indirect band gap semiconductors; Hall effect.

Physics of semiconductor devices

Formation of P-N junction; Open circuit P-N junction; Energy diagram of diode; I/ V characteristics of P-N junction diode; P-N diode as a rectifier; Diode equation; LED.

UNIT IV

Magnetic properties

Permeability; Field intensity, magnetic field induction, magnetization and magnetic susceptibility; Origin of magnetic moment - Bohr magneton; Classification of magnetic materials (Dia, Para, and Ferro); Domain theory of ferromagnetism - Hysteresis curve – soft and hard magnetic materials; Properties of anti ferro and ferri magnetic materials – ferrites and their applications.

UNIT V

Superconductors

Experimental survey and superconductivity phenomenon; Meissner effect; Critical fields and Persistent currents; Type I and Type II superconductors; London equations; Flux quantization; BCS theory; Josephson effect; High temperature superconductors; Applications of superconductors.

Dielectric properties

Electric dipole; Dipole moment; Dielectric constant; Electronic, ionic and orientation polarization; Calculation of Polarizibilities; Internal fields; Claussius; Mossotti equation; Piezo and ferro electricity.

TEXT BOOKS

1. Introduction to Solid State Physics *by* Charles Kittel; *Publisher: John Wiley* (for UNITS II to V)
2. Concepts of Modern Physics *by* Arthur Beiser; *Publisher: McGraw Hill Inc*.
3. Applied Physics *by* P.K.Mittal; *Publisher: IK International Publishing House.*

REFERENCE

1. Solid State Physics *by* S.O.Pillai; *Publisher: New Age International.*
2. Solid State Physics *by* A.J.Dekker; *Publisher: Macmillan Publishers.*
3. Engineering Physics *by* M. Chandra Shekar and P. Appala Naidu; *Publisher: VGS Book links*.
4. Solid State Physics *by* N.W. Ashcroft and N. David Merwin; *Publisher: Thomson Learning.*

5. Engineering Physics *by* Jain, Sanjay D. and Sahasrabudhe, Girish G.; *Publisher: Universities Press.*
6. Elements of Solid State Physics *by* J.P.Srivatsva; *Publisher: Prentice Hall of India*
7. Engineering Physics *by* M.R.Srinivasan; *Publisher: New Age International.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE II Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11CHE1101) ENGINEERING CHEMISTRY

Course Prerequisites: General Chemistry

Course Objectives:

- Understand electrochemistry which deals with the utilization of electrical energy of an external source for bringing about a physical or chemical change.
- Knowledge of "Corrosion engineering education" and Usage of polymers in modern world as an integral part of every human's life.
- Knowledge of purification techniques and various applications of soft water in industries.
- Usage of nanomaterials as emerging scientific components with amazing potential applications in various fields.

Course Outcomes:

Students will be able to:

- Visualize the chemical applications of electricity.
- Prevention of corrosion of metals
- Applications of polymers from domestic articles to sophisticated scientific and medical instruments.
- Benefits of treated water as source in steam generation and other fields like production of steel, paper, textiles, atomic energy etc.
- The applicability and greater efficiency of using a material at nanoscale in different Engineering fields

UNIT I

Electrochemical cells and batteries

Cell representation; Galvanic cells; Single electrode potential; Standard electrode potential; Electrochemical series; Nernst equation; Concentration cells; Reference electrodes – hydrogen, calomel, quinhydrone electrode; Ion selective electrodes (glass electrode and flouride electrode); Numerical problems.

Batteries

Primary and secondary cells (lead-acid cell; Ni-Cd cell; lithium cells); Applications of batteries; Fuel cells – hydrogen – oxygen fuel cells, advantages of fuel cells; Solar cells - working, principle, and applications.

UNIT II

Corrosion and its control

Introduction; Causes and effects of corrosion; Different types of corrosion; Theories of corrosion – chemical, electrochemical corrosion (reactions); Factors affecting corrosion – nature of metal (galvanic series; over voltage; purity of metal; nature of oxide film; nature of

corrosion product), and nature of environment (effect of temperature; effect of pH; humidity; effect of oxidant). Corrosion control methods – cathodic protection, sacrificial anode, and impressed current cathode;
Surface coatings – methods of application on metals (hot dipping; galvanizing; tinning; cladding; electroplating), organic surface coatings (paints - constituents and functions).

UNIT III

Polymers

Introduction**;** Types of polymerization; Plastics - thermoplastic resins, and thermoset resins; Compounding and fabrication of plastics; Preparation, properties, and engineering applications of polyethylene, PVC, PS, teflon, bakelite, nylon.

Rubber

Characteristics and uses of rubber - natural rubber, and vulcanization; Elastomers (Buna-s; Butyl rubber; thiokol rubbers); Fibers – polyester; Fiber reinforced plastics (FRP) and their applications.

UNIT IV

Water

Introduction; Hardness - causes, expression of hardness, units, types of hardness, estimation of temporary and permanent hardness of water, and numerical problems; Boiler troubles – scale and sludge formation, caustic embrittlement, corrosion, priming and foaming; Softening of water (Internal and external treatment - lime soda, zeolite, ion exchange process, and numerical problems); Reverse osmosis and Electro dialysis (desalination processes).

UNIT V

Nanomaterials

Introduction; Preparation and applications of nanomaterials with special reference to carbon nanotubes.

Insulators

Classification of insulators; characteristics of thermal and electrical insulators and their applications; Superconductors - Nb-Sn alloy, $YBa_2\ Cu_3\ O_{7-x}$; Applications of superconductors.

TEXT BOOKS

1. Text Book of Engineering Chemistry *by* Y.Bharathi Kumari and Jyotsna Cherukuri; *Publisher: VGS Book Links*.
2. Engineering Chemistry *by* P.C.Jain and Monica Jain, *Publisher: Dhanpatrai Publishing Company*.

REFERENCE

1. Text Book of Engineering Chemistry by S.S. Dhara and Mukkanti; *Publisher: S.Chand*.
2. Text Book of Engineering Chemistry by C.P.Murthy, C.V.Agrawal, and A.Naidu; *Publisher: B.S.Publications.*

3. Text Book of Engineering Chemistry *by* R.Gopalan, D.Venkappayya, and Sulochana Nagarajan; *Publisher: Vikas Publishers*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE II Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11HAS1101) ENGLISH

Course Prerequisites: General English

Course Objectives:

- To equip the students with all the LSRW skills for advanced writing and speaking.
- To equip the students with basic grammar, infrastructural patterns and grammatical constructions required in technical writing as well as oral presentation.
- To acquaint the students with the writing process in preparation for academic and workplace writing.

Course Outcomes:

Students will be able to:

- Comprehend technical communication produced in the engineering profession.
- Understand the writing process and create logical paragraphs.
- Use infrastructural patterns in writing and speaking.
- Communicate coherently orally and in writing.

Introduction

This is the age of information and communication technologies. Engineers and technical professionals need to convey technical information in English for various purposes.

Besides learning general English as an international language, engineering students need to be equipped with adequate writing ability so that they can communicate technical information clearly on at least a basic level. A good English writing proficiency can be a contributing factor to professional recognition and career prospects. This course teaches those writing strategies that scientists, engineers, and others will need in order to write successfully on the job. It initiates the students into Technical Writing. The purposes of technical writing are to inform and persuade. This program aims to train students in writing clear, concise and effective English.

This Syllabus is therefore, a Pragmatic English Writing Program for engineering students with intermediate proficiency. The program covers a syllabus outline and instructional approaches on basic writing skills with particular reference to technical writing.

Objectives

i) To equip the students with all the LSRW skills for advanced writing and speaking.
ii) To equip the students with basic grammar, infrastructural patterns and grammatical constructions required of in technical writing.

iii) To acquaint the students with the writing process, beginning with paragraph writing. This would prepare them for academic and workplace writing.
iv) Equip the students with Oral Communication Skills.

Methodology

A Task-based, process oriented methodology will be used by the teachers to give a practical orientation to the teaching of language. An inductive approach will be used to demonstrate the use of language in context. This should enable the students to internalize the language structures and vocabulary used in context. Students will be exposed to numerous examples and ample practice will be given in the contextual use of language structures.

Syllabus Outline

UNIT I

Prose:

1. Heaven's Gate by Pico Iyer
2. The Connoisseur by Nergis Dalal

UNIT II

Basic grammar

i) Common errors
ii) Subject-Verb agreement
iii) Adverbs
iv) Transitional elements
v) Use of articles and prepositions
vi) Conjunctions
vii) Pronoun reference

UNIT III

Reading and writing skills

i) Reading comprehension
ii) Paragraph writing
iii) Letter writing
iv) Memo writing
v) Words often confused
vi) Synonyms and antonyms
vii) One word substitutes
viii) Prefixes and suffixes
ix) Idioms and phrases

UNIT IV

Prose

1. The Cuddalore Experience by Anu George
2. The Odds Against Us by Satyajit Ray

UNIT V

Technical writing component

A. Definition of a Technical Term
B. Description of a Mechanism
C. Description of a Technical Process
D. Classification
E. Cause and Effect
F. Comparison and Contrast

G. Analogy

TEXT BOOKS

1. Effective Technical Communication *by* M. Ashraf Rizvi; Publisher: Tata McGraw Hill.
2. Technical Communication: Principles and Practices *by* M. Raman and S. Sharma; *Publisher: Oxford University Press, 2004 (Indian Edition).*

REFERENCE

1. Technical Writing Process and Product *by* Gerson Sharon J. and Steven Gerson, 3rd edition; *Publisher: Prentice Hall* 1999
2. Blanton, L.L. 1993; Composition Practice, Book 4 ,Second Edition; *Publisher: Heinle and Heinle Publishers*, pp. 54
3. Georges, T.M. 1996; A course in Analytical Writing for Science and Technology, http://www.mspiggy.etl.noaa.gov/write/
4. Oxford English for Electrical and Mechanical Engineering *by* E.H.Glendinning, and N.Glendinning, 1995, pp.28,68,83; *Publisher: Oxford University Press*.
5. Greaney, G.L. 1997; Less is More: Summary Writing and Sentence Structure in the Advanced ESL Classroom, The Internet TESL Journal, Vol.III, No.9; http://iteslj.org/Techniques/Greaney-Writing.html
6. A Handbook for Technical Communication *by* J.K. Neufeld, 1987; *Publisher: Prentice Hall*.
7. Principles of Course Design for Language Teaching, *by* J. Yalden, 1987; *Publisher: Cambridge University Press.*
8. A Guide to Writing as an Engineer *by* David F. Beer and David McMurrey; 2nd / 3rd edition, *Publisher: Wiley.*
9. Applied Writing for Technicians *by* Dale Jungk; *Publisher: McGraw Hill*.
10. A Pocket Style Manual *by* Diane Hacker, 2003; *Publisher: Bedford/ St. Martin's*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE II Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11CSE1102) DATA STRUCTURES

Course Prerequisites: C, Mathematics

Course Objectives:

- Gain a working knowledge of C data structure programming.
- Learn how to write modular, efficient and readable data structure programs.
- Utilize searching and sorting concepts to solve problem.
- Understand and define Trees and Graphs.

Course Outcomes:

Students will be able to:

- Explore and analyze the working of linear data structures like list, stack and variation of queues in both static and dynamic implementation.
- Relate and demonstrate the application of linear data structures
- Illustrate and implement basic non linear data structures like trees, graphs and their operations.
- I identify and implement basic and advanced comparison based sorting and searching techniques

UNIT I

Introduction to data structures.

Abstract data types.

Linear lists

Singly linked list implementation - insertion, deletion, and searching operations on linear list; Circular linked list implementation; Double linked list implementation - insertion, deletion and searching operations; Applications of linked lists.

UNIT II

Stacks

Operations; Array and linked representations of stacks; Stack applications - infix to postfix conversion, postfix expression evaluation, and recursion implementation.

UNIT III

Queues

Operations; Array and linked representations; Circular queue operations; Dequeues; Applications of queues.

UNIT IV

Trees

Definitions; Binary tree representation; Binary search tree; Binary tree traversals.

Graphs
Definitions; Graph representations; Graph traversals.

UNIT V
Searching and sorting
Big O notation;
Searching - linear and binary search methods;
Sorting - selection sort, bubble sort, insertion sort, quick sort, and merge sort.
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TEXT BOOKS

1. C Programming and Data Structures *by* B.A.Forouzan and R.F. Gilberg, Third Edition, *Publisher: Cengage Learning*.
2. Data Structures Using C (Paperback) *by* Aaron M. Tenenbaum; *Publisher: Pearson Education.*

REFERENCE

1. C and Data structures *by* P. Padmanabham, Third Edition; *Publisher: B.S. Publications*.
2. Data Structures using C and C++ *by* A.M.Tanenbaum, Y.Langsam, and M.J. Augenstein; *Publisher: Pearson Education/ Prentice Hall*
3. C Programming and Data Structures *by* E. Balagurusamy; *Publisher: Tata McGraw Hill.*
4. Computer Programming and Data Structures *by* P. Dey, M. Ghosh R. Thareja; *Publisher: Oxford University Press.*
5. C and Data structures *by* E V Prasad and N.B. Venkateswarlu; *Publisher: S. Chand*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE II Sem	**L**	**T/P/D**	**C**
	4	**1**	**4**

(R11MED002) ENGINEERING MECHANICS – II

Course Prerequisite: Physics, Mathematics, Engineering Mechanics – I

Course Objectives:

- Understand trusses and their analysis using various methods.
- Understanding principle of virtual work and its applications.
- Understanding kinematics and kinetics parts of machines.

Course Outcomes:

Students will be able to:

- Draw and analyze the free body diagram of a truss acted upon by a system of forces
- Understand the principle of virtual work and its applications.
- Understand the difference between kinematics and kinetics parts of mechanics
- Apply the principles of work-energy and impulse-momentum for problem solving

UNIT I

Principle of virtual work

Equilibrium of ideal systems; Efficiency of simple machines; Stable and unstable equilibrium.

UNIT II

Rectilinear translation

Kinematics of rectilinear motion; Principles of dynamics; Differential equation of rectilinear motion; Motion of a particle acted upon by a constant force; Force as a function of time; Force proportional to displacement - free vibrations; D' Alembert's principle; Momentum and impulse; Work and energy; Ideal systems; Conservation of Energy; Impact.

UNIT III

Curvilinear translation

Kinematics of curvilinear motion; Differential equations of curvilinear motion; Motion of a projectile; D' Alembert's principle in curvilinear motion; Moment of momentum; Work and energy in curvilinear motion.

UNIT IV

Rotation of a rigid body about a fixed axis

Kinematics of rotation; Equation of motion for a rigid body rotating about a fixed axis; Rotation under the action of a constant moment; Torsional vibration; The compound pendulum; General case of moment proportional to angle of rotation; D' Alembert's principle in rotation; Resultant inertia force in rotation; The principle of angular momentum in rotation; Energy equation for rotating bodies; Gyroscopes.

UNIT V

Plane motion of a rigid body

Kinematics of plane motion; Instantaneous center; Equations of plane motion; D' Alembert's principle in plane motion; The principle of angular momentum in plane motion; Energy equation for plane motion.

TEXT BOOK

Engineering Mechanics *by* S.Timoshenko and D.H.Young; *Publisher: McGraw Hill.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE II Sem	**L**	**T/P/D**	**C**
	2	**3**	**2**

(R11MED1104) ENGINEERING GRAPHICS II

Course Prerequisites: Engineering Graphics -I

Course Objectives:

- Understand the concept of section of solids, development of surfaces, intersection of surfaces.
- Learn the various types of projections- orthographic and pictorial.
- Understand the importance and the principles of perspective projections.

Course Outcomes:

Students will be able to

- Construct the true shape of section and also obtain the development of surfaces of various solids using AutoCAD.
- Obtain the intersection of surfaces of solids like prism, cylinder and cone, using AutoCAD.
- Visualize the objects and convert them in different projections – orthographic & isometric using AutoCAD.
- Convert the given orientation of the object into perspective view.

UNIT I

Sections and sectional views

Sections of right regular solids-prisms, pyramids, cylinders and cones – auxiliary views

Development of surfaces

Development of surfaces of right regular solids prisms, pyramids, cylinders and cones.

UNIT II

Intersection of solids

Intersection of prism Vs prism, cylinder Vs prism, cylinder Vs cylinder, and cylinder Vs cone

UNIT III

Isometric projections

Principles of isometric projections, Isometric scale, isometric views, conventions, isometric views of lines, planes, simple and compound solids, isometric views of objects having spherical parts.

UNIT IV

Tranformation of projections

Conversion of isometric views to orthographic views-conventions and vice versa.

UNIT V

Perspective projections

Perspective view of points, lines, plane figures and simple solids, vanishing point method and visual ray method

TEXT BOOK

Elementary Engineering Drawing *by* N.D.Bhat; *Publisher: Charotar Publishing House*

REFERENCE

Engineering Drawing *by* K.L. Narayana and P. Kannaiah; *Publisher: Scitech Publications.*

Engineering Graphics for degree *by* K.C. John; *Publisher: Prentice Hall of India*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE II Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11MED1201) ENGINEERING WORKSHOP

Course Prerequisites: basic knowledge about different Trades, computer hardware, Operating System, different trades in mechanical engineering

Course Objectives:

- To study/demonstrate the concepts of computer w.r.t. its hardware, operating system, assembling and disassembling.
- To conduct the experiments related to production engineering technology.
- To demonstrate the usage of power tools, CNC lathe and machine shop for different exercises.

Course Outcomes:

Students will be able to

- To identify, assemble, dissemble, install and write commands for a given configuration of a computer.
- To create components using the techniques of Carpentry, Tin Smithy, Welding and Fitting etc. listed in trades for exercises.
- To evaluate the jobs prepared in different trades with the models prepared using various machine tools.
- To evaluate the performance of different Power Tools.

Mechanical Part (12 weeks)

TRADES FOR EXCERCISES

At least two exercises from each trade:

1. Carpentry
2. Tin-Smithy
3. Fitting
4. Welding
5. Electrical Wiring

TRADES FOR DEMONSTRATION and EXPOSURE:

1. Power tools in construction, wood working, electrical engineering and mechanical engineering.
2. Machine shop.

IT Workshop (4 weeks)

Computer hardware: identification of parts, assembling, and disassembling.

Installation of operating system: windows, linux – basic commands.

TEXT BOOKS

1. Workshop Manual *by* P.Kannaiah and K.L.Narayana; *Publisher: Scitech*.
2. IT Essentials: PC Hardware and Software Companion Guide, Third Edition *by* David Anfinson and Kenneth Quamme; *Publisher: CISCO Press/ Pearson Education*.
3. PC Hardware and A+ Handbook *by* Kate J. Chase; *Publisher: Microsoft press.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

I Year B.Tech ME/ AE II Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11HAS1203) ENGLISH LANGUAGE COMMUNICATION SKILLS LABORATORY

Course Prerequisites: General English

Course Objectives

- Provide ample practice in LSRW skills.
- Provide practice in grammatical construction, structural patterns, word usage and improve comprehension abilities in the students.
- Train students to use neutral pronunciation through phonetic sounds, symbols, stress and intonation.
- Enable students to transfer information from verbal to graphic representation and vice versa.
- Train students to use effective language for oral presentations, public speaking, role play and situational dialogue.

Course Outcomes

Students will be able to

- Comprehend spoken and written discourse.
- Speak fluently with neutral pronunciation and exhibit interpersonal skills.
- Write accurately, coherently and lucidly making appropriate use of words depending on context and present data clearly.
- Introduce oneself to people and be able to speak extempore.

The English Language Communication Skills Lab. aims to provide practice in all the four skills of LSRW, and provide ample practice in listening and speaking skills.

Syllabus for Lab. Sessions

UNIT I

Multimedia Lab

1. Phonetics
2. Listening comprehension
3. Vocabulary Lesson 1

Oral Communication Skills Lab: Self Introduction; E-mail

UNIT II

Multimedia Lab

1. Grammar ---Nouns and Pronouns; The Present Tense
2. Vocabulary Lesson 2
3. Listening Skills

Oral Communication Skills Lab: Role Play/ Situational Dialogues

UNIT III

Multimedia Lab

1. Telephoning Skills
2. Grammar --- Articles; The Past Tense
3. Vocabulary Lesson 3

Oral Communication Skills Lab: JAM/ Short Talk

UNIT IV

Multimedia Lab

1. Grammar ---- Concord; The Future Tense
2. Vocabulary Lesson 4
3. Listening Comprehension

Oral Communication Skills Lab: Information Transfer

UNIT V

Multimedia Lab

1. Grammar --- Adjectives, adverbs, conjunctions & Vocabulary -- Lesson 5

Oral Communication Skills Lab: Presentation Skills

MULTIMEDIA LAB REQUIREMENTS

Minimum Requirement

The English Language Lab shall have two parts:

i) **The Computer aided Language Lab** for 60 students with 60 systems, one master console,LAN facility and English language software for self- study by learners.

ii) **The Communication Skills Lab** with movable chairs and audio-visual aids with a P.A System, & iii) a T. V., a digital stereo –audio and video system and camcorder etc.

System Requirement (Hardware component)

Computer network with LAN with minimum 60 multimedia systems with the following specifications:

iv) **P – IV Processor**

a) Speed – 2.8 GHZ
b) RAM – 512 MB Minimum
c) Hard Disk – 80 GB

v) Headphones of High quality

Suggested Software

vi) The software consisting of the prescribed topics elaborated above should be procured and used.

- Clarity Pronunciation Power – part II
- Oxford Advanced Learner's Compass, 7th Edition
- DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.
- Lingua TOEFL CBT Insider, by Dreamtech
- TOEFL and GRE (KAPLAN, AARCO and BARRONS, USA, Cracking GRE by CLIFFS)

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	3	**1**	**3**

(R11MTH1103) MATHEMATICS III
(Partial Differential Equations and Integral Transforms)

Course prerequisites: Differentiation and Integration

Course Objectives:

- Derive the Fourier coefficients for the sine and cosine series.
- Apply Separation of Variables to solve elementary examples of linear second order Partial Differential Equations (heat, Laplace and wave equations).
- Understand the properties of Fourier transforms.
- Apply Cauchy theorem

Course Outcomes:

Students will be able to:

- Solve the second order linear partial differential equations by using separation of variables method.
- Solve problems in Fourier sine and cosine series.
- Evaluate simple problems of finite Fourier sine and cosine transforms, Inverse Fourier sine and cosine transform problems and apply to heat, wave and Laplace equations.
- Evaluate the line integrals using residue theorem, Cauchy's theorem and Cauchy's integral formula

UNIT I

Partial differential equations

Introduction and formation of partial differential equations by elimination of arbitrary constants and arbitrary functions; Solutions of first order linear (Lagrange's) equation and non-linear (standard type) equations; Method of separation of variables for second order equations; Particular integrals; Monge's method for solving Rr+ Ss+ Tt = V

INTEGRAL TRANSFROMS

UNIT II

Laplace transform

Laplace transform of standard functions; Inverse transform-first shifting theorem; Dirac's delta function; Convolution theorem; Periodic function; Differentiation and integration of transforms; Application of Laplace transforms to ordinary differential equations.

UNIT III

Fourier series

Determination of Fourier coefficients; Fourier series - even and odd functions; Fourier series in an arbitrary interval; Even and odd periodic continuation; Half range Fourier series sine and cosine expansions; Fourier integral theorem (only statement); Fourier sine and cosine integrals; Fourier transforms; Fourier sine and cosine transforms; Properties; Inverse transforms-finite Fourier transforms.

UNIT IV

Application of transform (Laplace and Fourier)

Solutions of wave equation, heat equation and Laplace equation and their use in problems of vibrating string; One dimensional unsteady heat flow; Two dimensional steady heat flow.

UNIT V

Z-Transform

Z-transform; Inverse z-transform; Properties, initial, and final value theorems; Convolution theorem; Difference equations; Solutions of difference equations using z-transform.

TEXT BOOKS

1. Advanced Engineering Mathematics *by* R.K Jain and S.R.K Iyengar, 3rd edition; *Publisher: Narosa Publications*, 2011.
2. Elements of Partial Differential Equations *by* Ian Naismith Sneddon; *Publisher: Dover Publications.*

REFERENCE

1. Advanced Engineering Mathematics *by* Erwin Kreyszig, 8th Edition; *Publisher: John Wiley.*
2. Advanced Engineering Mathematics *by* Peter V. O'Neil, 9th Edition; *Publisher: Cengage Learning.*
3. Advanced Engineering Mathematics *by* Dennis G. Zill and Warren S. Wright; 4th edition; *Publisher: Jones and Bartlett Learning*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	4	**1**	**4**

(R11MED1106) MECHANICS OF SOLIDS I

Course prerequisites: Maths, Physics and Engineering Mechanics

Course Objectives:

- Understand the stress-strain diagrams for various materials
- Evaluate the shear force and bending moment diagrams for different beams
- Understand the stresses developed in beams.
- Analyze the stress and strain using Mohr's circle

Learning Outcomes:

Students will be able to:

- how basic stress strain equations with appropriate assumptions.
- Interpret model and analyze solid mechanics problems on bars, beams and shafts..
- Apply the concepts of principal stresses in real life design issues
- Analyze and develop beams, shafts for various applications

UNIT I

Tension, compression, and shear

Introduction; Normal Stress and Strain; Stress-strain diagrams; Elasticity and plasticity; Linear elasticity and Hooke's law; Allowable stress and allowable loads.

Axially loaded members

Introduction; Deflections of axially loaded members; Displacement diagrams; Statically indeterminate structures (flexibility method and stiffness method); Temperature and prestrain effects; Stresses on inclined sections; Strain energy; Dynamic loading; Overview of nonlinear behavior.

UNIT II

Torsion

Introduction; Torsion of circular bars; Nonuniform torsion; Pure shear; Relationship between moduli of elasticity E and G; Transmission of power by circular shafts; Statically indeterminate torsional members; Strain energy in pure shear and torsion.

Shear force and bending moment diagrams

Types of beams; Types of loading; Shear force and bending moment; Relationship between load, shear force and bending moment; Shear force and bending moment diagrams.

UNIT III

Area moment of inertia of composite sections.

Stresses in beams

Introduction; Normal strains in beams; Normal stresses in beams; Cross-sectional shapes of beams; Shear stresses in rectangular beams; Shear stress in webs of beams with flanges; Shear stress in circular beams (solid and hollow sections); Built-up beams; Overview of stresses in nonprismatic beams.

UNIT IV

Analysis of stress and strain

Introduction; Plane stress; Principal stresses and maximum shear stresses; Mohr's circle for plane stress; Hooke's law for plane stress; Spherical and cylindrical pressure vessels (biaxial stress; Hoop and longitudinal stresses); Combined loadings (plane stress); Principal stresses in beams; Triaxial stress; Volumetric strain; Three dimensional stress; Overview of plane strain.

UNIT V

Deflections of beams

Introduction; Differential equations of the deflection curve; Deflections by integration of the bending moment equation; Deflections by integration of the shear-force and load equations; Macaulay's method; Moment area method; Method of superposition; Nonprismatic beams; Strain energy in bending; Overview of discontinuity functions.

TEXT BOOK

Mechanics of Materials (SI units) *by* J.M.Gere and S.P.Timoshenko; *Publisher: CBS Publishers.*

REFERENCE

Engineering Mechanics of Solids *by* Popov; *Publisher: Pearson Education.*

Strength of Materials *Schaum's Series.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	4	**1**	**4**

(R11MED 1107) THERMODYNAMICS

Course prerequisites: Physics

Course Objectives:

- To understand the basic concepts of thermodynamics and Thermodynamic Laws.
- To apply the thermodynamic laws and principles in the fields of energy technology.
- To understand real world thermal engineering applications.
- To understand the working principle and analysis of gas power cycles

Course Outcomes:

Students will be able to:

- To apply the basic concepts of thermodynamics and Thermodynamic Laws for various thermodynamic systems
- To Evaluate the properties of pure substance and to analyse the concept of irreversibility and availability.
- To apply the basic concept of power cycles and refrigeration systems for Heat Engines and Refrigerators
- Evaluate the behaviour of ideal gas mixtures and Thermodynamic properties of the given mixture of gases.

UNIT I

Introduction

Various applications of thermodynamics.

Control volumes and units (concepts and definitions)

A thermodynamic system and the control volume; Macroscopic versus microscopic point of view; Properties and state of a substance; Processes and cycles, units for mass, length, time, and force; Energy; Specific volume and density; Pressure; Equality of temperature; The Zeroth law of thermodynamics; Temperature scales; Engineering applications.

Properties of a pure substance

The pure substance; Vapor- liquid- solid- phase equilibrium in a pure substance; Independent properties of a pure substance; Tables of thermodynamic properties; Thermodynamic surfaces; The P-V-T behavior of low- and moderate- density gases; The compressibility factor; Equations of state; Introduction to computerized tables; Engineering applications.

Work and heat

Definition of work; Units for work; Work done at the moving boundary of a simple compressible system; Other systems that involve work; Remarks regarding work; Definition of heat; Heat transfer modes; Comparison of heat and work; Engineering applications.

UNIT II

Energy equation for a control mass (The first law of thermodynamics)

The first law of thermodynamics for a control mass undergoing a cycle; The first law of thermodynamics for a change in state of a control mass; Internal energy-a thermodynamic property; Problem analysis and solution technique; The thermodynamic property enthalpy; The constant-volume and constant-pressure specific heats; The internal energy, enthalpy, and specific heat of ideal gases; The first law as a rate equation; Conversion of mass; Engineering applications.

Energy equation for a control volume (First law analysis for a control volume)

Conversion of mass and the control volume; The first law of thermodynamics for a control volume; The steady-state process; Examples of steady-state processes; Engineering applications.

UNIT III

The (classical) second law of thermodynamics

Heat engines and refrigerators; The second law of thermodynamics; The reversible process; Factors that render processes irreversible; The Carnot cycle; Two propositions regarding the efficiency of a Carnot cycle; The thermodynamic temperature scale; The ideal-gas temperature scale; Ideal versus real machines; Engineering applications.

Entropy for a control mass

The inequality of Clausius; Entropy – a property of a system; The entropy of a pure substance; Entropy of a pure substance, Entropy change in reversible processes; The thermodnamic property relation; Entropy change of an ideal gas; The reversible polytropic process for an ideal gas; Entropy change of a control mass during an irreversible process; Entropy generation; Principle of the increase of entropy; Entropy as ya rate equation; Some general comments about entropy and chaos.

Entropy equation for a control volume (Second law analysis for a control volume)

The second law of thermodynamics for a control volume; The stead–state process; The steady-state single flow process; Principle of the increase of entropy; Engineering applications; Efficiency.

UNIT IV

Irreversibility and Availability

Available energy; Reversible work, and irreversibility; Availability and second-law efficiency; Energy balance equation; Engineering applications.

Power and refrigeration systems-with phase change (Cycles)

Introduction to power systems; The Rankine cycle; Effect of pressure and temperature on the Rankine cycle; Introduction to refrigeration systems; The vapour-compression refrigeration cycle.

Power and refrigeration systems-gaseous working fluids

Air-standard power cycles; The Brayton cycle; The simple gas-turbine cycle with a regenerator; The air-standard cycle for jet propulsion; Reciprocating engine power cycles; The Otto cycle; The diesel cycle; The Stirling cycle; The Atkinson and Miller cycles; Combined cycle power and refrigeration systems.

UNIT V

(Ideal) Gas mixtures

General consideration and mixtures of ideal gases; A simplified model of a mixture involving gases and a vapor; The first law applied to gas-vapor mixtures; The adiabatic saturation process; Engineering applications: Wet-bulb and dry- bulb temperatures and overview of psychrometric chart.

Thermodynamic (property) relations

The Clapeyron equation; Mathematical relations for a homogeneous phase; The Maxwell relations; Thermodynamic relations involving enthalpy, internal energy, and entropy; Volume expansivity, and isothermal and adiabatic compressibility; Real gas behavior and equations of state; The generalized chart for changes of enthalpy at constant temperature; The generalized chart for changes of entropy at constant temperature; The property relation for mixtures; Pseudopure substance models for real-gas mixtures; Tables of thermodynamic properties.

TEXT BOOK

Fundamentals of Thermodynamics *by* C. Borgnakke and R.E. Sonntag; *Publisher: John Wiley*.

REFERENCE

1. Fundamentals of Thermodynamics *by* C. Borgnakke, R.E. Sonntag, and G.J. Van Wylen; *Publisher: John Wiley*.
2. Engineering Thermodynamics by P.K.Nag.
3. Thermodynamics – An engineering approach by Yunus Cengel and Boles; *Publisher: TMH*.

II Year B.Tech ME I Sem	L	T/P/D	C
	3	0	3

(R11MED1108) METALLURGY AND MATERIAL SCIENCE

Course prerequisites: Maths, Physics and Chemistry

Course Objectives:

- Understand the microstructures of different types of metal and alloys –cast iron, steels, non ferrous metal and alloys.
- Understand the heat treatment principles-annealing, normalizing and hardening.
- Understand the different types of tools.
- Understand the different types of Alloy steels

Course Outcomes:

Students will be able to:

- Analyze different types of metals and alloys.
- Evaluate a heat treatment process to change the properties-hardness, ductility, etc.
- Analyze the failure of metals and alloys.
- Apply the knowledge to use the right materials for right components

UNIT I

Metal structure and crystallization

Introduction - atom binding, ionic bond, covalent bond, metallic bond, and Vander Waals forces;

Overview of metal structure and crystallization.

Constitution of alloys

Introduction; Classification of alloys or compounds; Pure metal; Intermediate alloy phase or compound - intermetallic compounds or valency compounds, interstitial compounds, and electron compounds; Solid solutions; Substitutional solid solution - factors that control the range of solubility in alloy system; Interstitial solid solutions.

UNIT II

Phase diagrams

Introduction; Coordinates of phase diagrams; Experimental methods - construction of equilibrium diagrams by thermal analysis, metallographic methods, and X-ray diffraction;

Type-I-Two metals completely soluble in the liquid and solid states; Chemical composition of phases; relative amounts of each phase; Equilibrium cooling of a solid solution alloy; Diffusion; Nonequilibrium cooling; Homogenization; Properties of solid-solution alloys;

Variation of Type I; Type II-Two metals completely soluble in the liquid state and completely insoluble in the solid state; Type III-Two metals completely soluble in the liquid state but only partly soluble in the solid state; Properties of eutectic alloy systems; Age hardening – solution treatment, and aging process; Type IV-The congruent-melting intermediate phase; Type V-The peritectic reaction; Type VI-Two liquids partly soluble in the liquid state: the monotectic reaction; Type VII-two metals insoluble in the liquid and solid states; Interrelation of basic types;

Transformations in the solid state - allotropy, order-disorder transformation, the eutectoid reaction, the peritectoid reaction, and complex diagrams;

Study of important binary phase diagrams of Cu-Ni, Al-Si,Sb-Pb,Pt-Ag,Bi-Cd,Cu-Pb,Cu-Sn,and Fe-Fe3C.

UNIT III

The heat treatment of steel

Introduction; Full Annealing; Spheroidizing; Stress-relief annealing; Process annealing; Normalizing; Hardening; The isothermal transformation diagram; Transformation to Pearlite and Bainite; Cooling curves and I-T Diagram; Transformation on continuous cooling; Position of the I-T curves; Hardening or austenitizing temperature; Homogeneity of austenite; Mechanism of heat removal during quenching - vapor-blanket cooling state (stage A), vapor transport cooling stage (stage B), Liquid cooling stage (stage C); Quenching medium; Temperature of quenching medium; Surface condition - methods to minimize the formation of scale - copper plating, protective atmosphere, liquid-salt pots, and cast-iron chips; Size and Mass; Hardenability; Use of Hardenability data; Tempering; Austempering; Surface heat treatment or case hardening; Carburizing; Heat treatment after carburizing; Cyaniding and Carbonitriding; Nitriding; Flame hardening; Induction Hardening; Residual Stresses; Hardenable carbon steels.

UNIT IV

Alloy steels

Introduction; Purpose of alloying; Effect of alloying elements upon Ferrite; Effect of alloying elements upon carbide; Influence of alloying elements on the iron-iron carbide diagram; Effect of alloying elements in tampering; Classification of steels - nickel steel, chromium steel, nickel-chromium steels, manganese steels, molybdinum steels, tungsten steels, venedium steels, silicon steels, stainless steels, martensitic stainless steels, ferritic stainless steels, austenitic stainless steels, precipitation-hardening stainless steels, maraging steels, and ausforming.

Tool steels

Classification of tool steels; Selection of tool steels; Comparative properties; Non-deforming properties; Depth of hardening; Toughness; Wear resistance; Red-hardness; Machinability; Resistance to decarburization; Brand names; Water-hardening tool steels (Group W); Shock resisting tool steels (Group S); Cold-work tool steels; Hot-work tool steels (Group H); High speed tool steels; Mold Steels (Group P); Special purpose tool steels; Heat treatment of tool steels; Overview of tool failures;

Special cutting materials – satellites, cemented carbides, and ceramic tools.

UNIT V

Cast iron

Introduction; Types of cast iron; White cast iron; Malleable cast iron; Pearlitic malleable iron; Gray cast iron; Silicon in cast iron; Sulfur in cast iron; Manganese in cast iron; Phosphorus in cast iron; Heat treatment of grey iron, Size and distribution of graphite flakes; Mechanical properties and applications of grey cast iron; Chilled cast iron; Nodular cast iron; Alloy cast irons.

Non-ferrous metals and alloys

Introduction; Copper and its alloys - Copper, temper designation of copper and copper alloys, and copper alloys; Aluminum and its alloys - Aluminum, Alloy designation system, and temper designation; Titanium and Titanium alloys.

Overview of solidification of metals

TEXT BOOK

Introduction to Physical Metallurgy by Sidney H. Avner; *Publisher: McGrawHill*.

REFERENCE

1. Essentials of Materials Science and Engineering *by* Donald R. Askeland and Thomson.
2. Materials Science and Engineering *by* William and Collister.
3. Elements of Materials Science *by* V.Raghavan

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11EEE1132) BASIC ELECTRICAL ENGINEERING

Course prerequisites: Physics, Electrical Engineering

Course Objectives:

- To get awareness of using mechanical energy for electrical energy generation.
- To understand the working basic operation of circuits used for automobile control.
- To know about working of different electrical machines used for propulsion of vehicles.

Course Outcomes:

Students will be able to:

- Design and conduct experiments, as well as to analyze and interpret data.
- Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- Function on multi-disciplinary teams.
- Identify, formulate, and solve engineering problems

UNIT I

Introduction to Electrical Circuits

Basic definitions; Types of elements; Types of sources; Ohm's law; Kirchhoff's laws; Resistive networks; Source transformation; Series parallel circuits; Star delta and delta star transformation; Inductive networks; Capacitive networks;
Superposition; Thevenin's; Norton's and maximum power transfer theorems.

UNIT II

Singel Phase AC circuits

Principle of AC voltages; Waveforms and basic definitions; Root mean square and average values of alternating current and voltage; Form factor and peak factor; Phasor representation of alternating quantities; The J operator and phasor algebra; Analysis of AC circuits with single basic network element; Single phase series circuits; Parallel Circuits; Series Resonance

UNIT III

D.C Machines

D.C.Generator

Principle; Construction; EMF Equation; Types; Self excitation; Magentization characteristics;

D.C.Motor

Principle; Mechanical power developed; Torque equation; Speed control of DC shunt motor; Efficiency;
Swinburne's Test.

UNIT IV

Transformers and Three Phase Induction Motors

Transformer

Principle; Construction; Types-EMF Equation; Transformer on NoLoad, and Load; Phasor Diagrams; OC and SC Tests; Efficiency.

3-Phase Induction Motor

Principle; Types; Slip-Rotor Frequency; Torque equation; Torque-Slip characteristics.

UNIT V

Synchronous Machines & Measuring Instruments

Synchronous Generator

Principle; Types; EMF Equation; Voltage regulation using synchronous impedance method; Synchronous motor principle;
Basic principles of indicating instruments; Permanent magnet moving coil and moving iron instruments.

TEXT BOOKS

1. Basic Electrical Engineering by M.S. Naidu and S. Kamakshiah; *Publisher: TMH.*

2. Theory and Problems of Basic Electrical Engineering by D.P. Kothari & J. Nagrath*; Publisher: Prentice Hall of India.*

REFERENCES

1. Electrical Technology by Harry Cotton*; Publisher: Pitman*.
2. Electrical and Electronic Technology by Edwards Hughes, Ian McKenzie Smith, John Hiley, and Keith Brown; *Publisher: Pearson Education.*
3. A Text Book of Electrical Technology by B.L. Theraja and A.K. Theraja Volume I and II; *Publisher: S Chand*.
4. Essentials of Electrical and Computer Engineering by David V. Kerns and J. David Irwin; *Publisher: Pearson Education*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	0	**6**	**4**

(R11MED1109) MACHINE DRAWING

Course prerequisites: Engineering Graphics

Course Objectives:

- Understand the Principles of Machine Drawing Conventions.
- Familiarize the Machine Elements like Screw Threads, Nuts, Bolts, Keys and riveted joins.
- Impart the knowledge on Machine Elements and simple parts like Shaft couplings, Journal, pivot, and collar bearings.
- Understand the different views of Part Drawings and based on that, draw the Assembled Parts of Engine & Machine parts

Course Outcomes:

Students will be able to:

- Apply the Knowledge of Machine Drawing Conventions.
- Apply the knowledge of AutoCAD Software and draw the Machine Elements like Screw Threads, Nuts, Bolts, Keys and riveted joins.
- Apply the knowledge of AutoCAD Software and draw the Machine Elements and simple parts like Shaft couplings, Journal, pivot, and collar bearings.
- Design all the parts & assemble them in AutoCAD with section views.

Machine drawing conventions

Need for drawing conventions – introduction to IS conventions

a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, and ribs.
b) Types of sections – selection of section planes, and drawing of sections and auxiliary sectional views. Parts not usually sectioned.
c) Methods of dimensioning, general rules for sizes, and placement of dimensions for holes, centers, and curved and tapered features.
d) Title boxes, their size, location, and other details - common abbreviations and their liberal usage
e) Types of drawings – working drawings for machine parts.
f) Production drawings

I. Drawing of machine elements and simple parts

Selection of orthogonal views, and additional views for the following machine elements and parts with every drawing proportion.

a) Popular forms of screw threads, bolts, nuts, stud bolts.
b) Keys, cottered joints, and knuckle joint.
c) Riveted joints for plates.
d) Shaft coupling and spigot joint.
e) Journal, pivot, and collar bearings.

II. Part and assembly drawings

Assembly drawings for the following, using conventions and easy drawing proportions:

a) Engine parts – stuffing boxes, eccentrics, I.C. engine connecting rod, and piston assembly.
b) Other parts - screws jacks, machine vices, and tailstock.
c) Valves - steam stop valve.

III. Production drawings

a) Overview of limits, fits, tolerances, geometrical accuracy, surface roughness symbols, welding symbols etc.
b) Production drawings of piston assembly and tailstock.

NOTE

1. To adopt first angle of projection.
2. The student should be able to provide working drawings of actual parts.

TEXT BOOK

Machine Drawing *by* K.L. Narayana, P. Kannaiah and K. Venkata Reddy; *Publisher: New Age/ Publishers.*

REFERENCE

Machine Drawing *by* Siddheswar, Kannaiah and Sastry.
Machine Drawing by N.D.Bhat.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11MED1203) METALLURGY AND MECHANICS OF SOLIDS LAB

Course prerequisites: Mechanics of solids, Engineering Mechanics, Metallurgy and Material Science

Course Objectives:

- Understand the need of proper simplification for different materials and various tests to be conducted on engineering materials.
- Understand the significance microstructure of different materials under microscopic testing and the significance of tests on evaluating the corresponding mechanical properties.
- Understand the changes in microstructures after different treatments and the importance of technical parameters used during tests.
- Understand the phase related changes after the subsequent treatment process and the experimental parameters used during tests.

Course Outcomes:

Students will be able to:

- Evaluate the properties of given materials for the study of micro structure. & applying the theoretical concepts by conducting the tests on different materials.
- Analyze the microstructure of any given material and predict properties&: Evaluate the result of test and comment on the mechanical properties of materials
- Analyze the obtained structure through metallurgical microscope by doing Polishing operations & decide a material and an appropriate test suitable for given application.
- Create different microstructures by doing appropriate heat treatment for given material by checking its microstructure Analyze the significance of the tests in different fields of engineering.

Metallurgy lab. (Six experiments)

1. Preparation and study of the microstructure of pure metals like Iron, Cu and Al.
2. Preparation and study of the microstructure of mild steels, low carbon steels, and high carbon steels.
3. Study of the microstructures of cast irons.
4. Study of the microstructures of non-ferrous alloys.
5. Study of the microstructures of heat treated steels.
6. Hardeneability of steels by Jominy end quench test.

7. To find out the hardness of various treated and untreated steels.

Mechanics of solids lab. (Six experiments)

1. Direct tension test
2. Bending tests:
   a) Simple supported beam
   b) Cantilever beam
3. Torsion test
4. Hardness test
   a) Brinell hardness test
   b) Rockwell hardness test
5. Test on springs
6. Compression test on a cube
7. Impact test
8. Punch shear test

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11EEE1203) ELECTRICAL TECHNOLOGY AND ELECTRIC CIRCUITS LAB

Course prerequisites: Maths, Physics and Basic Electrical Engineering

Course Objectives:

- Build circuits and take measurements of circuit variables using tools such as oscilloscopes, multimeters, and signal generators.
- Understand the basic electrical engineering principles and abstractions on which the design of electronic systems is based
- Understand the relationship between the mathematical representation of circuit behavior and corresponding real-life effects.
- Appreciate the practical significance of the systems developed in the course

Course Outcomes:

Students will be able to:

- Apply Kirchhoff's voltage and current laws to the analysis of electric circuits.
- Analyze first and second order AC and DC circuits for steady-state and transient response in the time domain and frequency domain.
- Derive relations for and calculate the gain and input impedance of a given operational amplifier circuit for both DC and frequency domain AC circuits using an ideal operational amplifier model.

PART – A (six experiments)

1. Verification of Kirchhoff's laws.
2. Series Resonance-Timing, Resonant Frequency, Bandwidth and Q factor determination for RLC network
3. Verification of superposition theorem.
4. Verification of maximum power transfer theorem.
5. Experimental verification of Thevenin's theorem.
6. Experimental verification of Norton's theorem.
7. Design of electric circuits for practical applications
8. Elementary design specifications (ratings - power, voltage, and current; guage calculations; number of turns) for machines

PART – B (six experiments)

9. Magnetization characteristics of D.C. shunt generator. Determination of critical field resistance and critical speed.
10. Swinburne's test on DC shunt machine (predetermination of efficiency of a given DC shunt machine working as motor and generator).
11. Speed Control of DC Shunt Motor

12. OC & SC tests on a single-phase transformer (Determination of equivalent circuit parameters, predetermination of efficiency and regulation at given power factors).
13. Brake test on 3-phase induction motor. Determination of performance characteristics.
14. Load test on a Single Phase Transformer
15. Regulation of three phase alternator by synchronous impedance method.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	4	**1**	**4**

(R11MED1110) MECHANICS OF SOLIDS II

Course prerequisites: Maths, Physics and Engineering Mechanics

Course Objectives:

- Analyze the statically indeterminate beams using superposition method
- Evaluate the unsymmetric bending beams with generalized theory and energy methods to find the deflections in the beams
- Understand the equations of inelastic bending, plastic bending, plastic hinges etc.
- Analyze the columns with pinned ends, with other support conditions etc.,

Course Outcomes:

Students will be able to:

- Quote procedures for designing statically determinate and indeterminate structures.
- Interpret model and analyze symmetric and unsymmetrical bending and torsion problems.
- Apply the concepts of principal stresses in real life design issues
- Analyze and develop procedures for solving real life problems using strain energy methods.

UNIT I

Statically indeterminate beams

Statically indeterminate beams; Analysis by differential equations of the deflection curve; Moment-area method; Method of superposition (flexibility method); Continuous beams; Temperature effects; Horizontal displacements at the ends of a beam.

UNIT II

Unsymmetric bending

Introduction; Doubly symmetric beams with skew loads; Pure bending of unsymmetric beams; Generalized theory of pure bending; Bending of beams by lateral loads; Shear centre; Shear stresses in beams of thin-walled open cross sections; Shear centers of thin-walled open sections; General theory for shear stresses.

UNIT III

Inelastic bending

Introduction; Equations of inelastic bending; Plastic bending; Plastic hinges; Plastic analysis of beams; Deflections; Inelastic bending; Residual stresses.

UNIT IV

Columns

Buckling and stability; Columns with pinned ends; Columns with other support conditions; Columns with eccentric axial loads; Secant formula; Imperfections in columns; Elastic and inelastic column behavior; Inelastic buckling; Column design formulas.

UNIT V

Energy methods

Introduction; Principal of virtual work; Unit-load method for calculating displacements; Reciprocal theorems; Strain-energy and complementary energy; Strain-energy methods; Complementary energy methods; Castigliano's second theorem; Shear deflections of beams.

TEXT BOOK

Mechanics of Materials *by* J.M.Gere and S.Timoshenko; *Publisher: CBS*

REFERENCE

Engineering Mechanics of Solids *by* E.P.Popov; *Publisher: Pearson Education.*

Strength of Materials *Schaum's Series.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	4	**1**	**4**

(R11MED1111) KINEMATICS OF MACHINERY

Course prerequisites: Geometrical Construction, Engineering Mechanics

Course Objectives:

- Develop an ability to apply knowledge of mathematics, science, and engineering
- Understand mechanisms for motion transmission.
- Study of displacements, velocities, accelerations of mechanical linkages.
- Design engineering applications involving in selection, sizing of mechanism to accomplish motion objectives.

Course Outcomes:

Students will be able to:

- Develop the ability to analyze and understand the dynamic (position, velocity, acceleration, force and torque) characteristics of mechanisms such as linkages and cams.
- Develop the ability to systematically design and optimize mechanisms to perform a specified task.
- Increase the ability of students to effectively present written, oral, and graphical solutions to design problems.
- Increase the ability of students to work cooperatively on teams in the development of mechanism designs.

UNIT I

About mechanisms

Introduction; introduction to analysis and synthesis; The science of mechanics; Terminology, definitions, and assumptions; Introduction to planar, spherical, and spatial mechanisms; Mobility; Classification of mechanisms; Kinematic inversion; Grashof's law; Mechanical advantage.

Position and displacement

Locus of a moving point; Position of a point; Position difference between two points; Apparent position of a point; Absolute position of a point; Graphic position analysis; Algebraic position analysis; Complex-algebra solutions of planar vector equations; Overview of Complex polar algebra; Position analysis techniques.

UNIT II

Velocity

Definition of velocity, Rotation of a rigid body; Velocity difference between points of a rigid body; Graphic methods-velocity polygons; Apparent velocity of a point in a moving coordinate system; Apparent angular velocity; Direct contact and rolling contact; Systematic strategy for velocity analysis; Analytic methods; Overview of complex-algebra methods; The method of kinematic coefficients; The vector method; Instantaneous center of velocity; The aronhold-kennedy theorem of three centers; Locating instant centers of velocity; Velocity analysis using instant centers; Mechanical advantage; Centrodes.

Acceleration

Definition of acceleration; Angular acceleration; Acceleration difference between points of a rigid body; Acceleration polygons; Apparent angular acceleration; Direct contact and rolling contact; Systematic strategy for acceleration analysis; Analytic methods; Overview of Complex algebra methods; Overview of the method of kinematic coefficients.

DESIGN OF MECHANISMS

UNIT III

Cam design

Introduction; Classification of cams and followers; Displacement diagrams; Graphical layout of cam profiles; Kinematic coefficients of the follower motion; Overview of high speed cams; Standard cam motions; matching derivatives of the displacement diagrams; Plate cam with reciprocating flat-face follower; Plate cam with reciprocating roller follower.

UNIT IV

Spur gears

Terminology and definitions; Fundamental law of toothed gearing; Involute properties; Interchangeable gears; AGMA standards; Fundamentals of gear tooth action; The manufacture of gear teeth; Interference and undercutting; Contact ratio, Varying the center distance; Involutometry; Nonstandard gear teeth.

Helical gears

Parallel-axis helical gears; Helical-gear-tooth relations; Herringbone gears;

Bevel gears

Straight-tooth bevel gears.

Overview of worm gears.

UNIT V

Mechanism trains

Parallel-axis gear trains and definitions; Examples of gear trains; Determining tooth numbers; Epicyclic gear trains; Bevel-gear epicyclic trains; Analysis of planetary trains by formula; Tabular analysis of planetary gear trains; Overview of adders and differentials; All-wheel drive train.

TEXT BOOK

Theory of Machines and Mechanisms *by* J.J. Uicker Jr., G.R. Pennock, and J.E.Shigley; *Publisher: McGraw Hill.*

REFERENCE

1. Mechanism Design (Vol 1) by A.G.Erdman and G.N.Sandor; *Publisher: Prentice Hall of India.*
2. Theory of Machines by Thomas Bevan; *Publisher: CBS*
3. Design of Machinery by R.L.Norton; Publisher: *McGraw Hill.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	3	**1**	**3**

(R11MED1112) FLUID MECHANICS AND TURBOMACHINERY

Course prerequisites: Maths, Physics and Engineering Mechanics

Course Objectives:

- Understand the properties of fluids, principles of buoyancy, flow, force and head calculations.
- Understand boundary layer principles applied to aerofoils.
- Understand various energy conversations that take place in a turbo machines.
- Understand the principles of turbo machines. .

Course Outcomes:

Students will be able to:

- To apply fundamental equations of fluid mechanics for turbines and pumps
- Model and analyze fluid flow problems in mechanical engineering.
- To create a model of fluid flow equipments.
- Evaluate the experimental results with theoretical concepts.

UNIT I

Fluid properties

Definitions: Definition of a fluid, force, mass, length, and time units; Viscosity; Continuum; Density, specific volume, unit gravity force, relative density, pressure, and perfect gas; Bulk modulus of elasticity; Vapor pressure; Surface tension.

Fluid statics

Pressure at a point; Basic equation of fluid statics; Units and scales of pressure measurement; Manometers; Forces on plane areas; Force components on curved surfaces; Buoyant force; Stability of floating and submerged bodies; Relative equilibrium.

Fluid-flow concepts and basic equations

Flow characteristics – definitions; the concepts of system and control volume; Application of the control volume to continuity, energy and momentum; Continuity equation; Euler's equation of motion along a streamline; The Bernoulli equation.

UNIT II

Fluid-flow concepts and basic equations (contd)

The steady state energy equation; Application of the energy equation to steady fluid flow situations; Applications of the linear momentum equation; The moment-of-momentum equation.

Dimensional analysis and dynamic similitude

Dimensional homogeneity and dimensionless ratios; Dimensions and units; The π-theorem; Discussion of dimensionless parameters; Similitude – model studies.

Viscous effects – fluid resistance

Laminar, incompressible, steady flow between parallel plates; Laminar flow through circular tubes and circular annuli; the Reynolds number; Prandtl mixing length - velocity distribution in turbulent flow; Transport phenomina; Boundary-layer concepts; Drag on immersed bodies.

UNIT III

Fluid measurement

Pressure measurement; Velocity measurement; positive-displacement meters; Orifices; Venturimeter, nozzle, and other rate devices; Overview of measurement of turbulence; Measurement of viscosity.

UNIT IV

Turbo machinery

Introduction to turbomachinery; Homologous units; Specific speed; Elementary cascade theory; Theory of turbomachines.

UNIT IV

Turbo machinery

Reaction turbines; Pumps and blowers; Impulse turbines; Cavitation.

UNIT V

Viscous effects – fluid resistance (Contd)

Resistance to turbulent flow in open and closed conduits; Overview of steady uniform flow in open channels; Overview of Steady incompressible flow through simple pipe systems

Steady closed conduit flow

Exponential pipe friction formulas; Hydraulic and energy grade lines; The siphon; Pipes in series; Pipes in parallel; Branching pipes; Networks of pipes.

Introduction to compressible flow, perfect gas relationships, speed of sound wave, Mach number

TEXT BOOK

1. Fluid Mechanics (First SI Metric Edition) *by* V.L. Streeter and E.B. Wylie, *Publisher: McGraw Hill*.
2. Fluid Mechanics (Third edition; International Student Edition) *by* V.L. Streeter; *Publisher: McGraw Hill and Kogakusha*.

REFERENCE

1. Schaum's outline of Fluid Mechanics; *Publisher: TMH.*
2. Fluid Mechanics *by* F.M.White; *Publisher: McGraw Hill*.
3. Fluid Mechanics and Fluid Power Engineering *by* D.S. Kumar
4. Fundamentals of Compressible Flow *by* S.M.Yahya; *Publisher: New Age International.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	4	**1**	**4**

(R11MED1113) APPLIED THERMODYNAMICS

Course prerequisites: Physics

Course Objectives:

- To apply the basic concept of Rankine cycles for External combustion engines and evaluate the efficiency with modifications in the cycle and will also be able to design the nozzle and its thermodynamic properties
- To design the rotodynamic machinery for steam and gas turbines.
- To evaluate the performance characteristics of reciprocating internal combustion engine.
- To Measure psychometric properties.

Course Outcomes:

Students will be able to:

- Develop the ability to analyze and understand the dynamic (position, velocity, acceleration, force and torque) characteristics of mechanisms such as linkages and cams.
- Develop the ability to systematically design and optimize mechanisms to perform a specified task
- Increase the ability of students to effectively present written, oral, and graphical solutions to design problems.
- Increase the ability of students to work cooperatively on teams in the development of mechanism designs.

UNIT I

Steam cycles

Rankine cycle; Rankine cycle with superheat; The enthalpy-entropy chart; The reheat cycle; The regenerative cycle; Further considerations of plant efficiency; Steam for heating and process use.

Gas turbine cycles

The practical gas turbine cycle; Modifications to the basic cycle; Additional factors.

UNIT II

Nozzles and jet propulsion

Nozzle shape; Critical pressure ratio; Maximum mass flow; Nozzles off design pressure ratio, Nozzle efficiency; The steam nozzle; Stagnation conditions; Jet propulsion; The turbojet; The turboprop.

Positive displacement machines

Reciprocating compressors; Reciprocating compressors including clearance; Multi-stage compression; Steady-flow analysis; Rotary machines; Vacuum pumps; Air motors.

UNIT III

Rotodynamic machinery

Rotodynamic machines for steam and gas turbine plant; The impulse steam turbine; Pressure and velocity compounded impulse steam turbines; Axial-flow reaction turbines; Losses in turbines; Axial-flow compressors; Overall efficiency, stage efficiency, and reheat factor; Polytropic efficiency; Centrifugal compressors; Radial-flow turbines.

UNIT IV

Reciprocating internal-combustion engines

Four-stroke cycle; Two-stroke cycle; Other types of engine; Criteria of performance; Engine output and efficiency; Performance characteristics; Factors influencing performance; Real cycles and the air standard cycles; Properties of fuels for IC engines.

UNIT V

Reciprocating internal-combustion engines (contd)

Fuel systems; Measurement of air and fuel flow rates; Supercharging; Engine emissions and legal requirements; Alternative forms of IC engines; Developments in IC engines.

Overview of refrigeration and heat pumps

Psychrometry and air conditioning

Psychrometric mixtures; Specific humidity, relative humidity and percentage saturation; Specific enthalpy; Specific heat capacity; Specific volume of moist air; Overview of air-conditioning systems.

TEXT BOOK

Applied Thermodynamics *by* T.D.Eastop and A.McConkey; *Publisher: Addison Wesley*..

REFERENCE

1. Basic and Applied Thermodynamics *by* P.K.Nag; *Publisher: TMH.*
2. Engineering Fundamentals of IC Engine *by* Pulkrabek; *Publisher: Perason/PHI*.
3. Internal Combustion Engine Fundamentals *by* Heywood; *Publisher: McGraw Hill*.
4. I.C.Engines *by* V.Ganeshan; *Publisher: TMH.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11MED1114) PRODUCTION TECHNOLOGY

Course prerequisites: Material science, Manufacturing Science.

Course Objectives:

- Understand metal joining techniques.
- Understand the principles involved in ferrous and non-ferrous casting design
- Understand cold and hot working of metals and processing of non-metals like plastics.
- Understand the joining processes with solid state welding, cold weklding etc.

Course Outcomes:

Students will be able to:

- Design castings taking into considerations of different moulds and their preparations.
- Design different welded joints applying it to different welding processes and able to conduct different types of tests on weldments.
- Produce various components from cutting and shaping operations.
- Design concepts of various press tools.

UNIT I

Materials in manufacturing

Major classes of engineering materials - metals, ceramics, plastics, composite structures, and joining.

Metal casting

Structure and properties of castings - solidification of melts, and macro segregation;
Casting properties - viscosity, surface effects, and fluidity;
Casting alloys - ferrous materials, and non ferrous materials;
Melting and pouring: melting, pouring, and quality assurance;
Casting processes – classification, ingot casting, casting of shapes, expendable-mold and expendable-pattern casting, permanent-mold casting, and centrifugal casting;
Finishing processes - cleaning and finishing, and changing properties after casting;
Quality assurance – inspection, and casting defects;
Process capabilities and design aspects - process capabilities, and part design.

UNIT II

Plastic deformation of metals

Material properties - flow stress in cold working, discontinuous yielding, textures (anisotropy), effects of cold working, annealing, hot working, and interactions between deformation and structure;

Overview of Mechanics of deformation processing;

Wrought alloys - carbon steels, alloy steels, and nonferrous materials.

Bulk deformation process

Classification - temperature of deformation, purpose of deformation, and analysis;

Open die forging – axial upsetting of a cylinder, forging of rectangular workpieces, and open die forging;

Overview of Impression-die and closed-die forging;

Extrusion - the extrusion process, hot extrusion, cold extrusion, and extrusion force;

Forging and extrusion equipment - tools and dies, hammers, and presses;

Drawing: the drawing process, and overview of forces.

Rolling - flat rolling, shape rolling, ring rolling, transverse rolling, and overview of forces and power requirements.

UNIT III

Sheet metalworking processes

Sheet materials - steels, nonferrous materials, surface topography;

Classification;

Shearing - the shearing process, forces, improving the quality of cut, and processes;

Bending - the bending process, bending limits, stresses and springback, and bending methods;

Overview of Stretch forming;

Deep drawing - drawing processes, limiting draw ratio, and further drawing;

UNIT IV

Processing of plastics

Classification; Casting;

Melt processing (molding) - principles of melt processing, extrusion, injection moulding, other moulding techniques;

Processing in the rubbery state - blow moulding, thermoforming, cold drawing, matched-die forming;

Particulate processing techniques; Cellular or foam plastics; Processing of elastomers.

UNIT V

Joining processes

Classification; Mechanical joining;

Solid state welding - cold welding, diffusion welding, hot welding, and friction welding (FRW);

Fusion welding - the fusion joint, weldability and weld quality, and weldable materials;

Resistance welding;

Electric arc welding - nonconsumable electrode welding, consumable-electrode welding, and consumable-work piece welding;

Overview of liquid solid state bonding

Overview of Adhesive bonding;

Joining of plastics, and joining of ceramics.

TEXT BOOK

Introduction to Manufacturing Processes *by* John A. Schey; *Publisher: McGraw Hill*.

REFERENCE

1. Manufacturing Processes for Engineering Materials *by* Serope Kalpakjian
2. Manufacturing Technology (Volume 1) *by* P.N.Rao; *Publisher: TMH***.**
3. Process and Materials of Manufacturing by Lindberg; *Publisher: Pearson Education***.**

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11ECE1134) BASIC ELECTRONICS

Course prerequisites: Physics and Electronics

Course Objectives:

- To get the knowledge on operational principle, analysis, design and application of the bipolar junction transistor (BJT),
- understanding of the concepts, know-how and tools of Electronic Design Automation (EDA) for circuit analysis and design
- Ability on preparing professional report.

Course Outcomes:

Students will be able to:

- To learn the basics of semiconductor diodes, BJTs and their small signal and high frequency analysis.
- To learn the basics of tuned amplifiers such as single tuned, double tuned, stagger tuned & power amplifiers
- Foster ability to work using Fourier series & z-transform.
- Acquired knowledge about Microprocessors and its need.

UNIT I

Semiconductors: P-N junction diode and its applications, and BJT

Review of Semi Conductor Materials; Theory of p-n Junction; P-N Junction as a Diode; Diode Equation; Volt-Ampere Characteristics; The P-N Junction as a rectifier; Half wave Rectifier; Full wave rectifier; Bridge Rectifier; Breakdown mechanisms in semiconductor diodes; Zener diode characteristics; Shunt voltage regulation using Zener diode; Principle of series voltage regulators; The junction transistor; Transistor as an amplifier; Transistor construction; BJT Operation; Common base; Common emitter and common collector configurations.

UNIT II

Feedback amplifiers and oscillators

Concepts of feedback; Classification of feedback amplifiers; General characteristics of negative feedback amplifiers; Effect of feedback on amplifier characteristics; Classification of oscillators; Conditions for oscillations, RC phase shift oscillators.

UNIT III

Electronic components

Principle of operation of cathode ray tube and CRO; Simple applications; Principle of operation and characteristics of varactor diode; UJT, SCR, Diac and Triac; Principle of operation of semiconductor photo diode and phototransistor - LED and LCD; IC 555 Timer Circuits.

UNITIV

Instrumentation components

Flip-flops; Moving Iron and moving coil meters; Transformers - pulse transformers, and Relays and Switches; Potentiometers; Synchros - magnetic amplifiers, AC and DC servomotors, and stepper motors.

UNITV

Introduction to microprocessors; Architecture of 8086 microprocessor; Programming model of 8086; Addressing modes of 8086; 8086 Instruction set; Analog to Digital and Digital to Analog Converters.

TEXT BOOKS

1. Integrated Electronics *by* Jackob MilIliman, C Halkias, and Satyabratha Jit, 2nd edition (2007); *Publisher: Tata McGraw Hill.*
2. Modern Electronic Instrumentation and Measurement Techniques *by* Helfrick, Albert D. and Cooper, William D.; 3rd edition; Publisher: Prentice Hall of India.
3. Micro Processors and Interfacing by Douglas V. Hall, 2nd edition, 1999; *Publisher: Tata McGraw Hill/ McGraw Hill.*

REFERENCE

1. Electronic Devices and Circuits *by* S. S Salivahanan, N. Sursh Kumar, A. Vallava Raju, 2nd Edition (2007, 2010); *Publisher: Tata McGraw Hill*
2. Industrial and Power Electronics *by* G.K. Mithal; *Publisher: Khanna*.
3. Control System Components by John E. Gibson and Franz B. Tuteur; *Publisher: McGraw Hill (McGraw Hill Series in Control Systems Engineering)*.
4. Mechanical Details for Product Design *by* Douglas C. Greenwood; *Publisher: McGraw Hill*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

II Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11MED1204) PRODUCTION TECHNOLOGY LAB and APPLIED THERMODYNAMICS LAB

Course prerequisites: Production Technology, Thermodynamics and Engineering Mechanics

Course Objectives:

- Understand and evaluate casting techniques and sand properties & valves and port timing diagrams of I.C.Engines.
- Understand different welding processes and their use & performance curves of the I.C. Engines.
- Understand various processing of plastics & find friction power and sir fuel ratio of the given engine.
- Understand different press working operations and plastic moulding & find the flash and fire point of the given oil

Course Outcomes:

Students will be able to:

- Summarize the knowledge of molding techniques and be in a position to prepare moulds for casting
- Summarize the knowledge of joining techniques and can able to perform welding
- Classify various types of press working operations and can able to perform the press working operations
- Interpret the knowledge in processing of plastics and can able to perform the experiments

PRODUCTION TECHNOLOGY: Six experiments

Metal casting lab

1. Pattern design and making - for one casting drawing.
2. Sand properties testing - exercise -for strengths, and permeability – 1
3. Moulding melting and casting - 1 exercise

Welding lab

1. ARC welding lap and butt joint - 2 exercises
2. Spot welding - 1 exercise
3. TIG welding - 1 exercise
4. Plasma welding and brazing - 2 exercises

Mechanical press working

1. Blanking and piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic press: deep drawing and extrusion operation.
3. Bending and other operations

Processing of plastics

1. Injection moulding
2. Blow moulding

APPLIED THERMODYNAMICS LAB: Six experiments

1. I.C. Engines - valve/ port timing diagrams.
2. I.C. Engines - performance test (4-stroke diesel engines).
3. I.C. Engines - performance test on 2-stroke petrol engine.
4. Evaluation of engine friction by conducting motoring test on 2-stroke petrol engine.
5. I.C.Engines - air/fuel ratio and volumetric efficiency.
6. Flash and fire points.

II Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11MED1205) FLUID MECHANICS AND TURBOMACHINERY LAB

Course prerequisites: Fluid Mechanics& Hydraulic Machines

Course Objectives:

- Conduct the experiments to understand the concept, find the values and obtain the result of experiments.
- Apply fundamental principles of fluid mechanics for the solution of practical mechanical engineering problems of water conveyance in pipes, orifices, mouth pieces, notches & weirs.
- Understand various pumps, water turbines, pipes and pressure measurement devices.

Course Outcomes:

Students will be able to:

- To apply fundamental equations of fluid mechanics for turbines and pumps
- Model and analyze fluid flow problems in mechanical engineering.
- To create a model of fluid flow equipments.
- Evaluate the experimental results with theoretical concepts.

1. Impact of jets on vanes.
2. Performance test on Pelton wheel.
3. Performance test on Francis turbine.
4. Performance test on Kaplan turbine.
5. Performance test on single stage centrifugal pump.
6. Performance test on multi stage centrifugal pump.
7. Performance test on reciprocating pump.
8. Calibration of venturimeter.
9. Calibration of orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Turbine flow meter.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	4	**1**	**4**

(R11MED1115) DYNAMICS OF MACHINERY

Course Prerequisites: Engineering mechanics, Kinematics of Machinery

Course Objectives:

- Study the construction methods like Klien's, velocity polygons, acceleration diagrams etc for drawing various mechanisms.
- Identify the significance of the principles of equilibrium, super position, virtual work& D'Alembert's principle.
- Familiarize with the methods of static &dynamic stability.

Course Outcomes:

Students will be able to

- Apply the engineering methods involving the selection and design of machine components with respect to the forces developed.
- Evaluate whether the proposed design is satisfactory or not.
- Analyze and design flywheels, governors and gyroscopes to withstand forces.
- Understand the impact of vibrations and balancing in practical applications

UNIT I

Static force analysis

Introduction; Applied and constraint forces; Free-body diagrams; Conditions for equilibrium; Two- and three- force members; Four-force members; Friction-force models; Static force analysis with friction; Spur-and helical-gear force analysis; Straight-bevel-gear force analysis; The method of virtual work.

UNIT II

Dynamic force analysis (Planar)

Introduction; Centroid and center of mass; Mass moments and products of inertia; Inertia forces and D' Alembert's principle; The principle of superposition; Planar rotation about a fixed center; Shaking forces and moments; Complex algebra approach; equation of motion.

Dynamic force analysis (Spatial)

Introduction; Measuring mass moment of inertia; Transformation of Inertia axes; Euler's equations of motion; Impulse and momentum; Angular impulse and angular momentum.

UNIT III

Dynamics of reciprocating engines

Engine types; Indicator diagrams; Dynamic analysis-general; Gas forces; Equivalent masses; Inertia forces; Bearing loads in a single-cylinder engine; Crankshaft torque; Engine shaking forces; Computation overview.

UNIT IV

Balancing

Static unbalance; Equations of motion; Static balancing machines; Dynamic unbalance; Analysis of unbalance; Dynamic balancing; Balancing machines; Field balancing with a programmable calculator; Balancing a single-cylinder engine; Balancing multicylinder engines; Analytical technique for balancing multicylinder reciprocating engines; Balancing linkages; Balancing of machines.

UNIT V

Overview of cam dynamics

Flywheels

Dynamic theory; Integration technique; Multicylinder engine torque summation.

Governors

Classification**;** Centrifugal governors; Inertia governors; Mechanical control systems; Standard input functions; Solution of linear differential equations; Analysis of proportional–error feedback systems.

Gyroscopes

Introduction; The motion of a gyroscope; Steady or regular precession; Forced procession.

TEXT BOOK

Theory of Machines and Mechanisms *by* J.J. Uicker Jr., G.R. Pennock, and J.E.Shigley; *Publisher: McGraw Hill.*

REFERENCE

1. Mechanism Design (Vol 1) by A.G.Erdman and G.N.Sandor; *Publisher: Prentice Hall of India.*
2. Theory of Machines by Thomas Bevan; *Publisher: CBS*
3. Design of Machinery by R.L.Norton; *Publisher: McGraw Hill*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	4	**1**	**4**

(R11MED1116) MECHANICAL ENGINEERING DESIGN I

Course Prerequisites: Maths, Physics, Engineering Mechanics, Solid Mechanics, Metallurgy & Materials Science, Kinematics of Machinery

Course Objectives:

- Understand different properties of Materials and relationship between them.
- Understand the principles of stress, strain and Principal stresses as applied to Solid bodies or structural and machine elements under loads.
- Understand to form mathematical equation and analyze problems by making appropriate assumptions and learn systematic engineering method to solve practical Design engineering problems.

Course Outcomes:

Students will be able to

- Apply the knowledge of stress-strain relations design considerations for the new design.
- Apply the knowledge of standard elements and their technical information available in the data bases and in designing machine elements.
- Analyze the bolted and riveted joints for their strength.
- Evaluate the welded joints and springs for the safety.

FUNDAMENTALS OF MECHANICAL DESIGN

UNIT I

Introduction

The meaning of design; Mechanical engineering design; The phases of design; Recognition and identification; Evaluation and presentation; Design considerations; Factor of safety; Codes and standards; Economics; Reliability; Safety and product liability; Units.

Stress analysis

Stress; Mohr's circle; Triaxial stress states; Uniformly distributed stresses; Elastic strain; Stress strain relations; Shear and moment; Singularity functions.

Normal stresses in bending; Vector programming; Beams with unsymmetrical sections; Shear stresses in beams; Shear stresses in rectangular-section beams; Flexural shear for other shapes; Shear center; Torsion; Stresses in cylinders; Press and shrink fits;

Strain energy

Concepts, The theorem of Castigliano; Overview of columns;

UNIT II

Design for static strength

Static strength; Static loads and factor of safety; Failure theories; The maximum-normal-stress theory; The maximum-shear-stress theory; The distortion–energy theory; Failure of ductile materials; Failure of brittle materials; Stress concentration; Determination of stress concentration factors; Stress-concentration charts; Stress concentration and static loads.

Design for fatigue strength

Introduction; The S-N diagram, Low-cycle fatigue; High-cycle fatigue; Endurance-limit modifying factors; Surface finish; Size effects; Reliability; Temperature effects; Stress concentration effects; Fluctuating stresses; Fatigue strength under fluctuating stresses.

DESIGN OF MECHANICAL ELEMENTS

UNIT III

The design of screws, fasteners, and connections

Thread standard and definitions; The mechanics of power screws; Thread stresses; Threaded fasteners; Bolted joints in tension; Compression of bolted members; Torque requirements; Strength specifications; Bolt preload; Selecting the nut; Fatigue loading; Gasketed joints; Bolted and riveted joints loaded in shear; Centroids of bolt groups; Shear of bolts and rivets due to eccentric loading; Keys, pins, and retainers.

UNIT IV

Welded, brazed, and bonded joints

Welding; Butt and fillet welds; Torsion in welded joints; Bending in welded joints; The strength of welded joints.

Mechanical springs

Stresses in helical springs; Deflection of helical springs; Extension springs; Compression springs; Spring materials; Design of helical springs; Critical frequency of helical springs; Overview of Fatigue loading.

UNIT V

Rolling contact bearings

Bearing types; Bearing life; Bearing load; Selection of ball and straight roller bearings; Selection of tapered roller bearings; Lubrication; Mounting and enclosure.

TEXT BOOK

1. Mechanical Engineering Design (SI edition) *by* J.E. Shigley; *Publisher: McGraw Hill.*
2. Mechanical Engineering Design (SI edition) *by* J.E.Shigley and Mischke.
3. Mechanical Engineering Design (International edition) *by* J.E.Shigley, Mischke, and Budynas; *Publisher: McGraw Hill.*

4. Mechanical Engineering Design (International edition) *by* J.E.Shigley, Mischke, R.G.Budynas, and K.J.Nisbett; *Publisher: TMH.*

REFERENCE

1. Machine Design *by* R.L.Norton; *Publisher: McGraw Hill*.
2. *Schaum's Outline* of Machine Design; *Publisher: TMH*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	3	**1**	**3**

(R11MTH1104) NUMERICAL ANALYSIS AND LINEAR PROGRAMMING

Course prerequisites: Elementary Row Transformations of Matrices, Differentiation and Integration

Course Objectives:

- Understand the numerical methods for non linear systems, evaluating definite integrals and ordinary differential equations.
- Understand various methods of interpolation.
- Understand the simplex method and methods to solve the transportation problem.

Course Outcomes:

Student will be able to:

- Apply the numerical methods to find a root of algebraic and transcendental equations.
- Apply the numerical methods to find the solutions of ordinary differential equations.
- Use simplex method procedure to optimize a linear function.
- Solve transportation problems

NUMERICAL ANALYSIS

UNIT I

Solutions of nonlinear systems

Introduction; Mathematical preliminaries; Solution of algebraic and transcendental equations – the bisection method, the method of false position, the iteration method, Newton - Raphson method, and their order of convergence.

UNIT II

Interpolation

Introduction; Errors in polynomial interpolation; Finite differences; Forward differences; Backward differences; Central differences; Symbolic relations and separation of symbols; Differences of a polynomial; Newton's formulae for interpolation; Central difference interpolation formulae; Gauss's central difference formulae; Lagrange and Hermite interpolation formulae; Cubic spline interpolation.

UNIT III

Numerical differentiation and Integration

Introduction; Differentiation of equally and unequally spaced data, and finite difference approximations; Trapezoidal rule, Simpson's 1/3 rule, and Simpson's 3/8 rule.

Numerical solutions of ordinary differential equations

Solution of initial value problems by Taylor's series - Picard's method of successive approximations, Euler's method, and Runge - Kutta methods; Predictor Corrector methods – Adams-Bashforth-Moulton method.

UNIT IV

Numerical solutions of partial differential equations (PDE)

Introduction; Classification of second order PDE; finite difference approximations to derivatives; Solution of Laplace and Poisson equation - Jacobi's method, Gauss-Seidal method (by Leibmann's), Solution of parabolic equations (heat equation) by explicit and Crank Nicolson implicit scheme method; Solution of hyperbolic equations (wave equation).

LINEAR PROGRAMMING

UNIT V

Linear programming

Basic concepts; formulation of linear programming problem; constrained optimization-linear programming - simplex method, dual simplex method, and transportation problems.

TEXT BOOKS

1. Introduction to Numerical Analysis *by* S.S.Sastr;*, Publisher: PHI , 2010.*
2. Operations Research *by* Prem Kumar Gupta and D.S.Hira (2003); *Publisher: S.Chand.*

REFERENCE

1. Advanced Engineering Mathematics *by* Erwin Kreyszig, 8th Edition; *Publisher: John Wiley and Sons.*
2. Advanced Engineering Mathematics *by* Peter V. O'Neil, 9th Edition; *Publisher: Cengage Learning.*
3. Elementary Numerical Analysis: An algorithmic approach *by* Samuel D. Conte and Carl De Boor (2006); 3rd edition; *Publisher: Tata McGraw Hill.*
4. Numerical Analysis *by* R.L Burden and J.D Faires; 7th edition; *Publisher: Thomson, 2007.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME I sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11MED1117) MACHINE TOOLS

Course Prerequisites: Production Technology, Engineering Materials

Course Objectives:

- Understand Material removal processes, classification of machine tools and types of cutting tools used for performing different operations.
- Understand the principle of working of lathe machine, special purpose lathe & construction, working of reciprocating machine tools, milling operations, grinding & finishing operations.
- Understanding the Need for going to Non-Traditional Machining process & necessity of jigs & fixtures.

Course Outcomes:

Students will be able to:

- Understand the knowledge on metal cutting and be in a position to adopt the suitable machining process that is suitable for different materials.
- Know the operations performed on lathe, Special purpose lathes and reciprocating machine tools
- Get the knowledge on various milling, hole making and abrasive operations and aware of all work holding and tool holding devices.
- Know the importance of jigs and fixtures for clamping and performing the different machining operations.

UNIT I

Introduction

Introduction to material removal processes; Variety of machine tools.

Metal cutting

Introduction; Chip formation; Shear zone; Orthogonal cutting; Shear angle and its relevance; Cutting tool materials; Thermal aspects; Tool wear and tool life; Surface finish; Cutting fluids; Empirical and analytical determination of cutting forces; Economics.

Machine tools

Introduction; Classification of machine tools; Generating and forming; Methods of generating surfaces; Accuracy and finish achievable; Basic elements of machine tools; Support structures; Power transmission; Actuation systems; Guideways; General work holding methods.

UNIT II

Centre lathe

Introduction; Constructional features of a centre lathe; Aids for support and location; Cutting tools; Operations performed in a centre lathe; Taper turning methods; Thread-cutting methods; Special attachments; Machining time and power estimation; Typical setups.

Special purpose lathes

Limitations of a centre lathe; Capstan and turret lathes; Automatic lathes; Tooling layout.

Reciprocating Machine Tools

Introduction; Shaper; Planing machine; Slotter.

UNIT III

Milling

Introduction; Types of milling machines; Milling cutters; Milling operations; Dividing head; Milling Mechanics; Milling time and power estimation; Special setups.

Hole-making operations

Introduction; Drilling; Reaming; Boring; Tapping; Other hole-making operations.

Abrasive processes

Introduction; Grinding wheel designation and selection; Types of grinding machines; Grinding process; Grinding process parameters; Creep feed grinding; Honing; Lapping; Other finishing processes.

UNIT IV

Other machine tools

Sawing; Overview of Broaching; Gear cutting.

Overview of Machine tool testing

Designing for machining

Introduction; General guidelines for “design for machining”.

UNIT V

Jigs and fixtures

Introduction; Functional surfaces; Location principles; Locating devices; Clamping devices; Jigs; Designing a Jig; Fixtures.

TEXT BOOK

Manufacturing Technology (Volume 2): Metal Cutting and Machine Tools *by* P.N. Rao; *Publisher: McGraw Hill.*

REFERENCE

1. Technology of Machine Tools *by* Steve F Krar, Arthur R Gill, and Peter Smid; *Publisher: McGraw Hill.*

2. Production Technology; *Publisher: HMT and McGraw Hill.*
3. Manufacturing Engineering and Technology by Serope Kalpakjian and Steven R. Schmid; *Publisher: Pearson.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11MED1118) METROLOGY AND INSTRUMENTATION

Course Prerequisites: Mathematics, Elements of Engineering

Course Objectives:

- Understand about the knowledge of limits and fits
- Impart the knowledge on various measuring instruments
- Understand about the knowledge on instrument transducers
- Impart the knowledge on installation and commissioning

Course Outcomes:

Students will be able to:

- To understand the knowledge of limits, fits and tolerances
- To understand the use of various measuring instruments
- To understand the better knowledge about instrument transducers and their design and construction
- To learn about instrument installation and commissioning

METROLOGY FOR WORKSHOP/ MACHINE SHOP

UNIT I

Accuracy – interchangeability – gauging

Conditions and synthesis of accuracy; Interchangeability and limit systems; BS system; Selective assembly gauging; Limit gauges; Indicating gauges; Special and first operation gauges.

Checking and measurement of surfaces

Surface relationships and accuracy; Tests for accuracy; Flatness; Squareness; Parallelism; Roundness; Concentricity; Angle measurement; Vernier protractor; Length measurement; The rule; Calipers; Micrometer; Vernier caliper; Use of gauges; Metric system; Metric and english micrometer and vernier.

UNIT II

Measurement and precision work

Slip gauges; Comparator; Vernier height guage; Marking out; Vernier micrometer; Examples of measurement; Sine bar; Angular testing; Use of rollers; Tapers; Projection.

Measurement and inspection

The standard of length; Measurement and comparison of length; Plane, angular, and linear examination; Comparison of heights and parallelism; Angular and division testing; The tool maker's microscope; Inspection and control on the machine.

Screw thread and spur gear measurement

Screw thread shapes and accuracy; Screw thread inspection; Screw thread limits and tolerances; Measurements and testing of gears.

UNIT III

Surface roughness measurements

Surface roughness vs. surface waviness; Numerical assessment of surface finish; Methods of measurements of surface finish; ISI symbols for indication of finish.

INSTRUMENTATION: MECHANICAL MEASUREMENTS

Measurement of flow

Introduction; Basic principles of flow measurement; Fluid flow in closed pipes; Flow in open channels; Point velocity measurement; Flow meter calibration methods.

Overview of measurement of viscosity

INSTRUMENTATION SYSTEMS

UNIT IV

Classification of instrument transducers

Primary quantities – input characteristics; Secondary quantities – output characteristics; Electromechanical coupling characteristics – electromechanical analogies, and Unified theory of bilateral electromechanical transducers (basic two port equations; ideal transducers; real transducers); Feedback systems.

Design and construction of instruments

Introduction; Instrument design; Elements of construction; Construction of electronic instruments; Mechanical instruments;

Instrument installation and commissioning

Introduction; General requirements; Storage and protection; Mounting and accessibility; Piping systems. Cabling; Earthing; Overview of testing and precommissioning; Plant commissioning.

UNIT V

Overview of pneumatic instrumentation

Display and recording

Introduction; Indicating devices; Light-emitting diodes (LEDs); Liquid crystal displays (LCDs); Plasma displays; Cathode ray tubes (CRTs); Graphical recorders; Magnetic recording; Transient/waveform recorders; Data loggers.

Interface and backplane bus standards for instrumentation systems

Introduction; Principles of interface; Data-link control protocol; Parallel interface and buses; Parallel bus; backplane bus; parallel bus; Black plane bus standards.

TEXT BOOK

For Metrology part:

1. Workshop Technology - Part I (3rd edition) by W.A.J. Chapman; pp. 194 to 228; *Publisher: Viva Books.*
2. Workshop Technology - Part II (3rd edition) by W.A.J. Chapman; pp. 1 to 68; *Publisher: Viva Books.*
3. Workshop Technology - Part III (3rd edition) by W.A.J. Chapman and S.J. Martin; pp. 481 to 506 and 531 to 545; *Publisher: Viva Books.*

For Instrumentation part:

INSTRUMENTATION *by* B.E. Noltingk (Part Numbers 1, and 4); *Publisher: Butterworth-Heinemann* 1995

(Alternatively available as separate books, Jones' Instrument Technology - Volume 1: Mechanical Measurements; Jones' Instrument Technology - Volume 4: Instrumentation Systems *by* Ernest Beachcroft Jones, and B.E.Noltingk; *Publisher: Butterworths* 1985/1987).

REFERENCE

1. Instrument Transducers: An Introduction to Theory *by* Neubert Herman; *Publisher: Oxford - Harper Collins*
2. Engineering Metrology by Hume
3. Metrology by R.K. Jain

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B. Tech ME I Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11MED1119) COMPUTER AIDED DESIGN

Course Prerequisites: Mathematics, Engineering Graphics

Course Objectives:

- Impart the knowledge of terminology involved in CAD
- Understand about the parametric representation of curves and surfaces
- Understand about the creation of various solid models
- Know about the fundamentals involved in data exchange formats

Course Outcomes:

Students will be able to:

- Identify the database management terminology, interpret and use CAD/CAM software efficiently.
- Realize and solve the parametric representation of curves and surfaces.
- Validate the solid models through various representation schemes
- Relate to the various data exchange formats and demonstrate part programming knowledge.

OVERVIEW OF CAD/CAM SYSTEMS

UNIT I

CAD/CAM software

Introduction; Graphics standards; Basic definitions - data structure, database, database management system (DBMS), database coordinate system, working coordinate system, and screen coordinate system; Modes of graphics operations; User interface, Software modules - operating system (OS) module, graphics module, applications module, programming module, and communications module; Modeling and viewing; Software documentation; Software development; Efficient use of CAD/CAM software; Software trends.

GEOMETRIC MODELING

UNIT II

Types and mathematical representations of curves

Introduction; wireframe models; Wireframe entities; Curve representation; Parametric representation of analytic curves - review of vector algebra, lines, circles, ellipses, parabolas, hyperbolas, and conics; Parametric representation of synthetic curves - hermite cubic splines, Bezier curves, B-spline curves, and rational curves; Curve manipulations - displaying, evaluating points on curves, blending, segmentation, trimming, intersection, and transformation; Design and engineering applications; Graphics aids, graphics manipulations, and editings;

Practice of flow charts on the above topics to aid in the development of CAD software.

UNIT III

Types and mathematical representations of surfaces

Introduction; Surface models; Surface entities; Surface representation; Parametric representation of analytic surfaces - plane surface, ruled surface, surface of revolution, and tabulated cylinder; Parametric representation of synthetic surfaces - hermite bicubic surface, Bezier surface, B-spline surface, Coons surface, blending surface, offset surface, triangular patches, sculptured surface, and rational parametric surface; Surface manipulations – displaying, evaluating points and curves on surfaces, segmentation, trimming, intersection, projection, and transformation; Design and engineering applications; Practice of flow charts on the above topics to aid in the development of CAD software.

UNIT IV

Types and mathematical representations of solids

Introduction; Solid models; Solid entities; Solid representation; Fundamentals of solid modeling - set theory, regularized set operations, and set membership classification; Boundary representation - basic elements, building operations, and remarks; Constructive solid geometry (CSG) – basic elements, building operations, and remarks; Sweep representation - basic elements, building operations, and remarks; Overview of analytical solid modeling; Solid manipulations - displaying, evaluating points, curves and surfaces on solids, segmentation, trimming and intersection, transformation, and editing; Overview of solid modeling- based applications.

UNIT V

CAD/CAM data exchange

Introduction; Evolution of data exchange format - shape-based format, product data-based format, and ISO standard; IGES - description, data representation, file structure and format, processors, and remarks; Overview of PDES

NC and CNC Programming

Types of part programming; Basic CNC structure; CNC programming using G and M codes.

TEXT BOOK

CAD/ CAM – THEORY and PRACTICE *by* Ibrahim Zeid; *Publisher: McGraw Hill*.

REFERENCE

1. CAD/ CAM *by* Zimmer and Groover; *Publisher: Pearson 56Education.*
2. Computer Graphics *by* Harrington; *Publisher: McGraw Hill*.
3. CAD/CAM/CIM by Radhakrishnan and Subramanyam; *Publisher: New Age Publishers.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	0	**5**	**3**

(R11MED1206) MACHINE TOOLS LAB AND METROLOGY LAB

Course Prerequisite: Machine tools, Metrology and Engineering Materials

Course Objectives:

- Remember the working principles of lathe and its accessories.
- Remember the significance of operating parameters and selection of cutting tools for performing machining operations on drilling, milling, shaping, slotting and grinding machines
- Familiarize the measurement techniques by using metrology instruments.
- Impart the knowledge on characteristics of measuring instruments.

Course Outcomes:

Students will be able to:

- Understand the working principles of various machine tools and accessories and the significance of operating parameters and tooling of machine tools.
- Understand the safety precautions to be taken while working on machine tools.
- Understand working principles of various instruments and their applications.
- Understand the significance of calibration and the working procedure of conducting various tests.

MACHINE TOOLS LAB: Ten experiments

1. Introduction to general purpose machines - lathe, drilling machine, milling machine, shaper, planing machine, slotting machine, cylindrical grinder, surface grinder, and tool and cutter grinder.
2. Step turning and taper turning on lathe machine.
3. Thread cutting and knurling on lathe machine.
4. Drilling and tapping.
5. Shaping.
6. Slotting.
7. Milling.
8. Cylindrical grinding
9. Surface grinding.
10. Grinding of tool angles.

METROLOGY: Ten experiments

1. Measurement of lengths, heights, diameters by vernier calipers micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.

3. Use of gear teeth, Vernier calipers and checking the chordal addendum and chordal height of spur gear.
4. Machine tool alignment test on a lathe.
5. Machine tool alignment test on a milling machine.
6. Tool makers microscope and its application
7. Angle and taper measurements by bevel protractor, sine bars, etc.
8. Use of spirit level in finding the flatness of surface plate.
9. Thread measurement by two wire/ three wire method or tool makers' microscope.
10. Surface roughness measurement by Taly Surf.
11. Surface wear resistances test using electro spark coating device.

REFERENCE

1. Workshop Technology *by* W.A.J. Chapman (Parts I, II, and III); *Publisher: Viva Books.*
2. The Principles of Metallographic Laboratory Practice *by* George L. Kehl; *Publisher: McGraw Hill.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11MED1207) CAD LAB AND INSTRUMENTATION LAB

Course Prerequisites: CAD and Basic Electronics

Course Objectives:

- Understand the ways in which 2D sketches and 3D models –solid and surface are made using appropriate CAD packages
- Know the procedure of building the models and obtain drafted views from it
- Know the calibration of pressure gauges
- Understand the calibration of transducer and thermocouple

Course Outcomes:

Students will be able to:

- Summarize the skills learnt in sketching using CAD packages
- Design the solid models and obtain the drafted views
- Assess and measure the calibration of pressure gauges
- Assess and measure the calibration of transducer and thermocouple

CAD LAB: Six exercises

1) Write a program that draws a line and an arc of desired dimensions by accepting user-input of the relevant geometric description.

2) Program written for experiment # 1 should be enhanced to show a menu of draw-commands (line and arc) and to accept the user-choice. Upon choosing a command, the program should be able to draw an entity as per the user-choice by accepting the user-input of the relevant geometric description by mouse–clicks.

3) Improve the program written for experiments 1 and 2 in order to make a thorough validation of the input data and to facilitate generating all possible cases of in-plane arcs between two points.

4) Enhance the program written for experiments 1 to 3 in order to enable the user to input the geometric description for line and arc by picking the start/end/mid points of an existing line, by means of a mouse.

5) Enhance the program written for experiments 1 to 4 in order to enable the user to input the geometric description for a line and an arc by picking the center/quarter points of an existing circle or end points of an existing arc, by means of a mouse.

6) Improve the program written for experiments 1 to 5 to perform the edit-commands for erasing, copying, chamfering, and filleting.

or

7) Practicing of advanced CAD models.

INSTRUMENTATION LAB: Six experiments

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

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	4	**1**	**4**

(R11MED1120) MECHANICAL ENGINEERING DESIGN II

Course Prerequisites: Mathematics, Mechanics, Strength of Materials, Kinematics of Machinery and Dynamics of Machinery

Course Objectives:

- Understand different types of bearing and their design, center cranks, crank pins, crank shafts.
- Understand stresses in curved beams, expression for radius of neutral axis for rectangular, circular, trapezoidal and T-section, transmission of power by belt and rope drives, transmission efficiencies.
- Understand the overview of different types of gears and their applications, force analysis, friction in worm gears etc.

Course Outcomes:

Students will be able to:

- Analyze different types of bearings.
- Evaluate different types of gears.
- Analyze the clutches, brakes, couplings and flywheels.
- Apply the design concepts for the design of flexible power transmission drives.

UNIT I

Lubrication and journal bearings

Types of lubrication; Viscosity; Petroff's law; Stable lubrication; Thick-film lubrication; Hydrodynamic theory; Design considerations; Bearing performance; Optimization techniques; Pressure–fed bearings; Heat balance; Bearing design; Bearing types; Thrust bearings; Bearing materials; Boundary- lubricated bearings.

UNIT II

Spur gears

Nomenclature; Conjugate action; Involute properties; Fundamentals; Contact ratio; Interference; The forming of gear teeth; Basic tooth dimensions; Gear trains; Force analysis; Tooth stresses; Dynamic effects; Estimating gear size; Fatigue strength; Factor of safety; Surface durability; Surface fatigue strength; Heat dissipation; Gear materials; Gear- blank design.

Helical, worm, and bevel gears

Parallel helical gears-kinematics; Helical gears-tooth proportions; Helical gears- force analysis; Helical gears-strength analysis; Crossed helical gears; Worm gearing–kinematics;

Worm gearing-force analysis; An observation and some REFERENCE; Straight bevel gears- kinematics; Bevel gears- force analysis; Spiral bevel gears.

UNIT III

Shafts Power screws

Introduction; Design for static loads; A historical approach; Reversed bending and steady torsion; The Soderberg approach; The Goodman approach; A general approach; The Sines approach, Suggestions for computer solution.

Power Screws

UNIT IV

Clutches, brakes, couplings, and flywheels

Statics; Internal–expanding rim clutches and brakes; External–contracting rim clutches and brakes; Band-type clutches and brakes; Band type clutches and brakes; Frictional-contact axial clutches; Cone clutches and brakes; Energy considerations; Temperature rise; Friction materials; Miscellaneous clutches and couplings; Flywheels.

UNIT V

Flexible, mechanical elements

Belts; Flat- belt drives; V belts; Roller chain; Rope drives; Wire rope.

TEXT BOOKS

1. Mechanical Engineering Design (SI edition) *by* J.E. Shigley; *Publisher: McGraw Hill.*
2. Mechanical Engineering Design (SI edition) *by* J.E.Shigley and Mischke.
3. Mechanical Engineering Design (International edition) *by* J.E.Shigley, Mischke, and Budynas; *Publisher: McGraw Hill.*
4. Mechanical Engineering Design (International edition) *by* J.E.Shigley, Mischke, R.G.Budynas, and K.J.Nisbett; *Publisher: TMH.*

REFERENCE

1. Machine Design by R.L.Norton; *Publisher: McGraw Hill*.
2. *Schaum's Outline* of Machine Design; *Publisher: TMH.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	4	**1**	**4**

(R11AME1102) STRUCTURAL ANALYSIS

Course Prerequisites: Engineering Mechanics, Solid Mechanics

Course Objectives:

- Define types of loads and analyse statically determinate structures & trusses
- Describe principals of shear and moment for a beam & Frame
- Demonstrate design of cables under concentrated loads & uniform distributed loads
- Analyse beams, trusses, grinders under influences lines.

Course Outcomes:

Students will be able to:

- Determine the deflections of simple trusses and beams.
- Differentiate between determinate and indeterminate structures.
- Qualitatively understand the way structures deform under loads.
- Analyze statically determinate structures.

UNIT I

Types of structures and loads

Introduction; Classification of structures; Loads; Structural Design.

Analysis of statically determinate structures

Idealized structures; Principle of superposition; Equations of equilibrium; Analysis of simple diaphragm and shear wall systems; Maximum influence at a point due to a series of concentrated loads.

UNIT II

Analysis of statically determinate trusses

Common types of trusses; Classification of coplanar trusses; The method of joints; Zero-force members; The method of sections; Compound trusses; Complex trusses; Space trusses.

UNIT III

Internal loading developed in structural members

Internal loading at a specified point; Shear and moment functions; Shear and moment diagrams for a beam; Shear and moment diagrams for a frame; Moment diagrams constructed by the method of superposition.

UNIT IV

Cables and Arches

Cables; cable subjected to concentrated loads; Cable subjected to a uniform distributed load; Arches; Three-hinged arch.

UNIT V

Influence lines for statically determinate structures

Influence lines; Influence lines for beams; Qualitative influence lines; Influence lines for floor girders; Influence lines for trusses; Live loads for bridges; Maximum influence at a point due to a series of concentrated loads; Absolute maximum shear and moment; Overview of applications for influence lines.

Deflections

Deflections of trusses by virtual work method

Overview of analysis of statically indeterminate structures

TEXT BOOK

Structural Analysis *by* R.C.Hibbeler; *Publisher: Pearson Education*

REFERENCE

1. Fundamentals of Structural Analysis by Kenneth M. Leet and Chia – Ming Uang; *TMH*
2. Structural Analysis *by* Prakash Rao.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	3	**1**	**3**

(R11MED1121) FINITE ELEMENT METHOD

Course Prerequisites: Maths, Strength of Materials, Mechancal Vibrations

Course Objectives:

- Understand different concepts of FEM.
- To study the boundary conditions, formulations and other functional approaches of FEM.
- To perform simulations using FEM software.

Course Outcomes:

Students will be able to:

- Name and tabulate various approaches leads to FEM to solve a given problem.
- Describe the given problem for finding solution using finite element technique.
- Apply the concept of FEM to solve different field problems.
- Assess real life problems using dynamic analysis

UNIT I

Fundamental concepts

Introduction; Historical background; Stresses and equilibrium; Boundary conditions; Strain-displacement relations; Stress-strain relations; Temperature effects; Potential energy and equilibrium - the Rayleigh-Ritz method; Galerkin's method; Saint Venant's principle; Von Mises stress.

Matrix algebra and Gaussian elimination

Matrix algebra; Gaussian elimination; Conjugate gradient method for equation solving.

One-dimensional problems

Introduction; Finite element modeling; Co-ordinates and shape functions; The potential energy approach; The Galerkin approach; Assembly of the global stiffness matrix (**K**) and load vector; Properties of **K**; The finite element equations; Treatment of boundary conditions; Quadratic shape functions; Temperature effects.

UNIT II

Trusses

Introduction; Plane trusses; Three-dimensional trusses; Assembly of global stiffness matrix for the banded and skyline solutions.

Two-dimensional problems using constant strain triangles

Introduction; Finite element modeling; Constant strain triangle (CST); Problem modeling and boundary conditions.

UNIT III

Axisymmetric solids subjected to axisymmetric loading

Introduction; Axisymmetric formulation; Finite element modeling - triangular element; Problem modeling and boundary conditions.

UNIT IV

Two-dimensional is parametric elements and numerical integration

Introduction; The four-node quadrilateral; Numerical integration; Higher-order-elements.

UNIT V

Beams and frames

Introduction; Finite element formulation; Load vector; Boundary considerations; Shear force and bending moment; Beams on elastic supports; Plane frames; Three-dimensional frames.

Overview of Three-dimensional problems in stress analysis

TEXT BOOK

Introduction to Finite Elements in Engineering, 2E, *by* Tirupathi R. Chandrupatla, Ashok D. Belegundu; *Publisher: Prentice Hall of India.*

REFERENCE

1. Finite Element Method *by* Zienkiewicz.
2. An Introduction to Finite Element Methods *by* J.N.Reddy.
3. Finite Element Method *by* S.S.Rao.

III Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	3	**1**	**3**

(R11MED1122) HEAT AND MASS TRANSFER

Course Prerequisites: Basic integral and differential calculus, thermodynamics

Course Objectives:

- To understand different modes of heat transfer in physical environment under various conditions.
- To develop the equations governing the phenomena of heat transfer.
- To apply these equations to analyze problems by making good assumptions and solve practical heat transfer problems.

Course Outcomes:

Students will be able to:

- Understanding of different modes of heat transfer in physical environment under various conditions.
- Developing of equations governing the phenomena of heat transfer as well as approach to numerical estimation of heat flow.
- Apply governing equations to analyze problems with proper assumptions and solve practical heat transfer problems.
- Design of various heat equipments on the basis of physical conditions and improve the efficiency.

UNIT I

Introduction

Conduction heat transfer; Thermal conductivity; Convection heat transfer; Radiation heat transfer; Dimensions and units.

Steady-state conduction – one dimension

Introduction; The plane wall; Insulation and *R* values; Radial systems; The overall heat–transfer coefficient; Critical thickness of insulation; Heat-source systems; Cylinder with heat sources; Conduction-convection systems; Fins; Thermal contact resistance.

UNIT II

Steady-state conduction

Introduction; Mathematical analysis of two-dimensional heat conduction; Graphical analysis; The conduction shape factor; Numerical method of analysis; Overview of Numerical formulation in terms of resistance elements.

Unsteady-state conduction

Introduction; Lumped-heat-capacity system; Transient heat flow in a semi-infinite solid; Convection boundary conditions; Overview of transient numerical method; Overview of thermal resistance and capacity formulation.

UNIT III

Principles of convection

Introduction; Viscous flow; Inviscid flow; Laminar boundary layer on a flat plate; Energy equation of the boundary layer; The thermal boundary layer; The relation between fluid friction and heat transfer; Turbulent-boundary-layer heat transfer; Overview of turbulent-boundary layer Thickness; Overview of heat transfer in laminar tube flow, turbulent flow in a tube, and heat transfer in high-speed flow. Overview of empirical and practical relations for forced convection heat transfer.

Natural convection systems

Introduction; Free convection heat transfer on a vertical flat plate; Overview of empirical relations for free convection; Free convection from vertical plates and cylinders; Free convection from horizontal cylinders; Overview of free convection from horizontal plates; Overview of free convection from inclined surfaces; Introduction to non-newtonian fluids.

UNIT IV

Radiation heat transfer

Introduction; Physical mechanism; Radiation properties; Radiation shape factor; Relations between shape factors; Heat exchange between nonblack bodies; Infinite parallel surfaces; Radiation shields; Gas radiation.

UNIT V

Condensation and boiling heat transfer

Introduction; Condensation heat-transfer phenomena; The condensation number; Overview of film condensation inside horizontal tubes; Overview of boiling heat transfer; Simplified relations for boiling heat transfer with water.

Heat exchangers

Introduction; The overall heat-transfer coefficient; Fouling factors; Types of heat exchangers; The log mean temperature difference; Effectiveness-NTU method, Overview of compact heat exchangers, and heat exchanger design considerations.

Mass transfer

Introduction; Fick's law of diffusion; Diffusion in gases; Diffusion in liquids and solids; The mass-transfer coefficient; Evaporation processes in the atmosphere.

TEXT BOOK

Heat Transfer *by* J.P. Holman; *Publisher: McGraw Hill.*

REFERENCE

1. Heat Transfer *by* P.K. Nag.
2. Heat and Mass Transfer by Cengel; *Publisher: McGraw Hill.*
3. Schaum's Outline of Heat Transfer; *Publisher; TMH*

III Year B. Tech ME II Sem	**L**	**T/P/D**	**C**
	4	**0**	**4**

(R11HAS1102) BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

Course Prerequisites: Basic knowledge about Economics, Finance and Business

Course Objectives:

- To explain the features, merits, limitations and suitability of different forms of organizing private and public business enterprises and to analyze the significance of Managerial Economics and how it helps business managers in performing decision – making function.
- To define Demand, Elasticity of Demand and Demand Forecasting and to explain and analyze the factors of Demand, Elasticity of Demand and Demand Forecasting.
- To analyze the nature of various costs and how they influence the total cost, to determine the level of output at which there is neither profit nor loss and to identify the volume of sales at which desired amount of profit can be earned.
- To estimate capital requirements, to describe the sources of mobilizing capital and to evaluate the investment opportunities. To explain input – output relationship in short and long period and to identify least cost combinations of inputs to produce desired quantity of output.
- To describe the features of different market structure and different pricing strategies.
- To explain the basic accounting concepts and conventions. To elaborate the importance of finance function for evaluating the economics status of a business unit.

Course Outcomes:

Students will be able to:

- Select the suitable form of business organization which meets the requirement of selected business also perform decision – making function effectively in an uncertain frame work by applying concepts of Managerial Economics. Meet and manipulate the demand efficiently and plan the future course of action.
- Apply right kind cost to reduce cost by paying attention towards the costs which can be reduced. Take decision whether to buy or produce? Reduce the cost of capital by selecting best source of fund mobilization and select best investment opportunity which yields higher rate of return.
- Fix the right price which can best meets the predetermined objectives of the business firm under different market conditions. Able to select best combination of inputs to produce required quantity of output.

- Prepare books of accounts and know over all financial position of the business enterprise which enables the concerned to take appropriate measures to improve the situation. Also interpret the financial position from difference angles and initiates the measures/ efforts in that direction.

UNIT I

Business and new economic environment

Characteristic features of business; Features and evaluation of sole proprietorship; Partnership; Joint stock company; Public enterprises and their types; Changing business environment in post- liberalization scenario.

UNIT II

Introduction to business economics, and demand analysis

Definition; Nature and scope of managerial economics - demand analysis determinants; Law of demand and its exceptions.

Elasticity of demand and demand forecasting

Definition; Types; Measurement and significance of elasticity of demand; Demand forecasting; Factors governing demand forecasting; Methods of demand forecasting - survey methods, statistical methods, expert opinion method, test marketing, controlled experiments, and judgmental approach to demand forecasting.

UNIT III

Cost analysis

Cost concepts - opportunity cost, fixed vs. variable costs, explicit costs vs. implicit costs, and out of pocket costs vs. imputed costs; Break-even analysis (BEA) - determination of break-even point (simple problems), managerial significance, and limitations of BEA.

Capital and capital budgeting

Capital and its significance; Types of capital; Estimation of fixed and working capital requirements; Methods and sources of raising finance.

Nature and scope of capital budgeting; Features of capital budgeting proposals; Methods of capital budgeting - payback method, accounting rate of return (ARR), and net present value method (simple problems)

UNIT IV

Theory of production

Production function - isoquants and isocosts, least cost combination of inputs, and laws of returns; Internal and external economics of scale.

Market structures

Types of competition; Features of perfect competition, monopoly, and monopolistic competition; Price-output determination in case of perfect competition and monopoly.

Pricing policies and methods

Cost plus pricing; Marginal cost pricing; Sealed bid pricing; Going rate pricing, Limit pricing, Market skimming pricing, Penetration pricing, Two-part pricing, Block pricing, Bundling pricing, Peak load pricing, Cross subsidization.

UNIT V

Introduction to financial accounting

Double-entry book keeping; Journal; Ledger; Trial balance; Final accounts - trading account, profit and loss account, and balance sheet with simple adjustments.

Financial analysis through ratios

Computation; Analysis and interpretation of liquidity ratios - current ratio, and quick ratio; Activity ratios - inventory turnover ratio, and debtor turnover ratio; Capital structure ratios – debt-equity ratio, and interest coverage ratio; Profitability ratios - gross profit ratio, net profit ratio, operating ratio, P/E ratio, and EPs.

TEXT BOOKS

1. Managerial Economics and Financial Analysis *by* Aryasri, 2009; *Publisher: Tata McGraw Hill*.
2. Managerial Economics *by* Varshney and Maheswari, 2009; *Publisher: Sultan Chand*.

REFERENCE

1. Financial Accounting for Management: An analytical perspective *by* Ambrish Gupta, 2010; *Publisher: Pearson Education*.
2. Managerial Economics *by* H. Craig Peterson and W. Cris Lewis; *Publisher: Prentice Hall of India*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11CED1109) ENVIRONMENTAL STUDIES

Course Prerequisites: General Science

Learning Objectives:

- Develop an understanding of the necessity of protection of environment.
- Develop an understanding of Natural resources.
- Develop an understanding of Biodiversity.
- Develop an understanding of Global Environmental problems.
- Develop an understanding of Environmental pollution.

Course Outcomes:

Students will be able to:

- Acquire the knowledge on environment.
- List and distinguish between different Natural Resources.
- Develop skills in understanding of various environmental problems.
- Find the solution and strategies to protect the Environment

UNIT I

Introduction; Definition, scope, and Importance

Ecosystems - Introduction, types, Classification of Eco system, AND structure and functions of ecosystems.

Bio-diversity and its conservation; Value of bio-diversity; Bio-geographical classification of India – India as a mega diversity habitat; Threats to bio-diversity –Hot-spots of Bio Diversity; Conservation of bio-diversity.

UNIT II

Natural Resources

Classification of Resources; Land resources; Land degradation; Soil erosion and desertification; Food resources; Effects of modern agriculture; Fertilizer pesticide problems; Food miles; Organic farming; Forest resources; Use and over-exploitation; Water resources; Dams–benefits; Conflicts over Water; Energy resources-sustainable Development; Energy Audit

UNIT III

Environmental pollution and its control

Classification of pollution and pollutants; Air pollution, causes; Effects; Control measures; Ambient air quality standards; Water pollution causes; Effects; Control measures; Water and waste water treatment methods; Water quality standards; Noise pollution causes; Effects; Control measures; Land pollution causes, effects, and control measures; Solid waste disposal methods; Characteristics of e-waste and management.

UNIT IV

Global Environmental problems and global Efforts

Nuclear hazards; Global warming; Acid rain; Hurricanes; Hazardous Waste; Overpopulation; Ozone layer depletion; Clean development mechanism; Green computing; Green Building; Carbon credits; Carbon trading.

International conventions/protocols

Earth summit; Kyoto protocol and Montreal protocol; Stockholm Declaration

UNIT V

Environmental Impact Assessment and Environmental Management plan

Definition of impact; Classification of Impacts; Prediction of impacts and impact assessment methodologies; Environmental impact statement; Environmental management plan - Technological Solutions.

TEXT BOOKS

1. Introduction to Environmental Science *by* Y.Anjaneyulu; *Publisher: BS Publications.*
2. Text book of Environmental Studies *by* Deeksha Dave; *Publisher: Cengage Learning.*
3. Textbook of Environmental Science and Technology by M.Anji Reddy; *Publisher: BS Publications*

REFERENCE

1. Environmental Science *by* Anubha Kaushik and C P Kaushik; *Publisher: New Age International*
2. Environmental Studies *by* S V S Rana; *Publisher: Rastogi Publications*
3. Text book of Environmental Studies *by* Dr. K Raghavan Nambiar; *Publisher: Scitech Publishers*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11MED1208) HEAT AND MASS TRANSFER LAB

Course Prerequisites: Heat and Mass Transfer, Thermodynamics

Course Objectives:

- Understand various modes of heat transfer experimentally.
- Understand calculations of heat transfer co-efficient in difference systems.
- Understand factors affecting the heat transfer rate.

Course Outcomes:

Students will be able to:

- Evaluate critical thickness of insulation to minimize heat lost.
- Evaluate thermal conductivity of lagged pipe , metal bar and insulating powder
- Evaluate Heat transfer coefficient for natural and forced convection
- Evaluate emissivity of the given metal

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. Experiment on transient heat conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan boltzman apparatus.
12. Heat transfer in drop and film wise condensation.
13. Critical heat flux apparatus.
14. Study of heat pipe and its demonstration.
15. Study of two – phase flow.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

III Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11HAS1204) ADVANCED ENGLISH LANGUAGE COMMUNICATION SKILLS LABORATORY

Introduction

This course aims to offer students a practical approach to Technical Writing, and provide a relevant, contemporary and authoritative introduction to the dynamic field of technical communication that prepares them for Workplace Communication. Each unit in the syllabus is devised so as to include a writing component as well as an oral component.

Course objectives:

- enable the students to create clear, accurate, and succinct content to write business letters, resume, SOP, Proposals and Technical Reports for academics as well as for workplace.
- enable students to adjust technical content to meet the needs of a specific target audience.
- groom students to speak accurately and fluently and prepare them for real world activities through behavioral skills.

Course Outcomes:

Students will be able to:

- Summarize and synthesize information and produce technical writing that is required in academics as well as in the engineering profession.
- write covering letters, resume, SOP, Project Proposals and Technical Reports.
- speak fluently and address a large group of audience and participate in debates and discussions
- Negotiate terms, manage complex situations through interpersonal skills, persuade people and make quick decisions

Methodology

Writing Component

A Process- Genre methodology will be used in teaching the technical genres. This method would enable students to understand the use of particular lexico-grammatical patterns required of in the context of technical writing. They would learn to use language to express the particular communicative intent that is required of in the context of writing these genres.

Oral Communication Component

The objective of including Oral Communication is to impart behavioral skills and prepare students to speak to a large group or team, keeping in mind the audience, context and purpose of communication. This Oral Communication component must enable students to speak in an organized and mature way, without any inhibitions. They will be groomed to relate their speech to their audience.

Objectives of Oral Communication Component

i) equip students with Behavioral skills
ii) prepare them for Oral presentations, and Group Discussions
iii) equip them with Interview skills

Syllabus Outline

UNIT I

1. Applications and Covering letters
2. Resume Writing
3. Oral Communication :Self Introduction

UNIT II

1. Introduction to Technical Writing

- Defining Technical Writing
- Distinguishing it from other types of writing
- Determining audience, purpose and context

2. Summarizing and Synthesizing Information

3. Behavioral Skills and Personality Development

(a) Building a positive attitude, building a positive personality, Motivation, goal setting, values and vision
(b) Problem Solving and Decision Making; Negotiation Skills through Role Play
(c) Team Building and Leadership Abilities

UNIT III

1. Verbal Ability : language, reasoning skills, analytical ability, reading and listening skills
2. Oral Communication: Presentation Skills (Oral and Visual)

UNIT IV

1. Writing Research Abstracts

2. Oral Communication: Group Discussions

UNIT V

1. Writing Project Proposals
2. Writing Project Reports
3. Oral Communication: Interview Skills

REQUIRED TEXT BOOKS AND MATERIALS

1. Technical Writing: Process and Product *by* Sharon J. Gerson and Steven M. Gerson (1999); *Publisher: Prentice Hall.*
2. Effective Technical Communication *by* Ashraf Rizvi, M., (2005); Publisher: *Tata Mc Graw Hill*.
3. Anderson, Paul V. (2003). Reports. In Paul V. Anderson's Technical Communication: A Reader-Centered Approach (5th ed.) (pp. 457-473). Boston: Heinle.

REFERENCE

1. Technical Communication *by* Rebecca E. Burnett, 5th edition (2001); *Publisher: Thomson/Wadsworth*
2. Technical Communication: A Practical Approach (7th ed.) *by* William S. Pfeiffer; *Publisher: Person education*
3. Technical Communication: Situations and Strategies *by* Mike Markel (2006-2007); *Publisher: Bedford/ St. Martins*.
4. Anderson, Paul V. (2003). Three Types of Special Reports. In Paul V. Anderson's Technical Communication: A Reader-Centered Approach (5th ed..) (pp. 474-513). Boston:Heinle.
5. Bolter, Jay David (2001), "The Late Age of Print" in Robert P. Yagelski's Literacies and Technologies: A Reader for Contemporary Writers (135-145); *Publisher: Longman*.
6. Brandt, Deborah. (1998) Sponsors of literacy. College Composition and Communication 49.2, 165-185.
7. Burnett, Rebecca, E. (2001) "Locating and Recording Information" in Rebecca E. Burnett's Technical Communication (pp. 164-195).
8. Johnson-Sheehan, Richard (2007). "Starting Your Career" in Richard Johnson-Sheehan's Technical Communication Today (2nd ed.) (pp. 388-402). New York: Longman.
9. Business Correspondence and Report Writing by R. C. Sharma and K. Mohan, Third Edition (2002); *Publisher: Tata McGraw Hill*.
10. Technical Communication: Principles and Practices by M. Raman and S. Sharma (Indian edition; 2004); *Publisher: Oxford University Press*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	4	**0**	**4**

(R11HAS1103) MANAGEMENT SCIENCE

Course Prerequisites: Economics and Financial Accounting

Course Objectives:

- Understand the principles, functions, theories and practices of different management areas and to provide them with practical exposure to cases of success/failure in business
- Expose with a systematic and critical understanding of organizational theory, structures and design
- Comprehend conceptual models of strategic management and to familiarize with the tools of operations and project management
- Understand the role of human relations in the management of operations and to provide basic insights into contemporary management practices

Course Outcomes:

Students will be able to

- Function effectively in multidisciplinary teams to accomplish a common goal of organizations.
- Apply theories to improve the practice of management.
- Appreciate the management challenges associated with high levels of change in the organizations.
- Develop global vision and management skills at both a strategic level and interpersonal level.

UNIT I

Introduction to management

Concepts of management - nature, importance, and functions of management; Taylor's scientific management theory; Fayol's principles of management; Mayo's Hawthorne experiments; Maslow's theory of human needs; Douglas McGregor's theory X and theory Y; Herzberg's two-factor theory of motivation; System and contingency approach to management; Planning – meaning, significance, and types of plans; Decision making and steps in decision making process; Leadership styles; Social responsibilities of management.

Organizing - Meaning, and features; Process of organization; Principles of organization; Elements of organization; Organization chart; Span of control - Graicunas formulae; Centralisation and decentralization; Types of mechanistic and organic structures of organisation - line organization, line and staff organization, functional organization,

committee organization, matrix organization, virtual organisation, cellular organisation, team structure, boundaryless organization, inverted pyramid structure, and lean and flat organization structure; Their merits, demerits and suitability.

UNIT II

Human resources management

Concepts of HRM;

Basic functions of HR manager - human resource planning (definition; objectives; process), recruitment (definition; sources; techniques), selection (definition; process), induction and orientation, training and development (definition; need; methods), employee exit process, employee relations management, employee compensation and benefits administration, job evaluation (objectives; process; methods), and performance appraisals (objectives; process; methods).

UNIT III

Strategic management

Mission; Goals; Objectives; Policy; Strategy; Programmes; Elements of corporate planning process - environmental scanning; value chain analysis, BCG matrix, generic strategy alternatives, SWOT analysis, and steps in strategy formulation and implementation; Balance score card; Capability maturity model (CMM)/ People capability maturity model (PCMM).

UNIT IV

Operations management

Plant location; Types of plant layout; Methods of production – job, batch, and mass production; Work study-basic procedure involved in method study and work measurement.

Materials management

Objectives; Need for inventory control; EOQ, ABC Analysis; Purchase procedure; Value analysis; JIT, Six sigma; TQM; Supply chain management; Stores management and stores records.

Marketing

Functions of marketing; Marketing mix, and marketing strategies based on product life cycle; Channels of distribution.

UNIT V

Project management – network analysis

Network analysis; Programme evaluation review technique - PERT (probability of completing the project within given time); Critical path method - CPM (Identifying critical path); Project cost analysis; Project crashing; Simple problems.

TEXT BOOKS

1. Management Science *by* Aryasri; *Publisher: Tata McGraw Hill, 2009.*
2. Management *by* James Arthur, Finch Stoner, R. Edward Freeman, and Daniel R. Gilbert 6th Ed; *Publisher: Pearson Education/ Prentice Hall.*
3. Principles and Practice of Management - L.M. Prasad; *Publisher: Sultan Chand Publications, New Delhi.*

REFERENCE

1. Principles of Marketing: A South Asian Perspective *by* Kotler Philip, Gary Armstrong, Prafulla Y. Agnihotri, and Eshan ul Haque , 2010, 13th Edition, *Publisher: Pearson Education/ Prentice Hall of India*.
2. A Handbook of Human Resource Management Practice *by* Michael Armstrong, 2010; *Publisher: Kogan Page Publishers*.
3. Quantitative Techniques in Management *by* N.D. Vohra, 4th edition, 2010; *Publisher: Tata McGraw Hill*.
4. Operations Management: Theory and Practice *by* B. Mahadevan, 2010; *Publisher: Pearson Education*.
5. Strategic Management *by* V.S.P.Rao and V.Hari Krishna, 2010; *Publisher: Excel Books*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective I	**4**	**0**	**4**

(R11MED1123) MECHANICAL VIBRATIONS

Course Prerequisites: Design of Machine Members, Engineering Mechanics, Maths

Course Objectives:

- Understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions.
- Develop linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF).
- Formulate the differential equations of motion of vibratory systems.

Course Outcomes:

Students will be able to:

- Apply vibration analysis in mechanical design of machine parts that operate in vibratory conditions.
- Evaluate at linear mathematical models of real life engineering systems.
- Analyze the mathematical model of linear vibratory system to determine its response.
- Analyze vibration of continuous system under various conditions.

UNIT I

Introduction to vibrations;

Concepts from vibrations

Review of Mechanics fundamentals; Moment of a force and angular momentum; Work and energy; Dynamics of systems of particles; Dynamics of rigid bodies – pure translation relative to the inertial space, pure rotation about a fixed point, and general planar motion referred to the mass center; Kinetic energy of rigid bodies in planar motion – pure translation relative to the inertial space, pure rotation about a fixed point, and general planar motion referred to the mass center; Characteristics of discrete system components; Equivalent springs; Dampers and masses; Modeling of mechanical systems; System differential equations of motion; Nature of excitations; System and response characteristics - the superposition principle; Vibration about equilibrium points.

UNIT II

Response of single-degree-of-freedom systems to initial excitations

Undamped single-degree-of-freedom systems - harmonic oscillator; Viscously damped single-degree-of-freedom systems; Measurement of damping; Coulomb damping - dry friction; Introduction to plotting the response to initial excitations by MATLAB.

UNIT III

Response of single-degree-of- freedom systems to harmonic and periodic excitations

Response of single-degree-of- freedom systems to harmonic excitations; Frequency response plots; Systems with rotating unbalanced masses; Whirling of rotating shafts; Harmonic motion of the base; Vibration isolation; Vibration measuring instruments – accelerometers - high frequency instruments, and Seismometers-low frequency instruments; Energy dissipation - structural damping.

UNIT IV

Response of single-degree-of-freedom systems to nonperiodic excitations

The unit impulse - impulse response; The unit step function - step response; The unit ramp function - ramp response; Response to arbitrary excitations - the convolution integral; Shock spectrum; System response by the Laplace transformation method - transfer function; General system response; Response by the state transition matrix.

UNIT V

Two – degree – of - freedom systems

System configuration; The equation of motion of two – degree – of - freedom systems; Free vibration of undamped systems - natural modes; Response to initial excitations; Coordinate transformations - coupling; Orthogonality of modes - natural coordinates; Beat phenomenon; Response of two–degree–of-freedom systems to harmonic excitations; Undamped vibration absorbers.

TEXT BOOK

Fundamentals of Vibrations *by* Leonard Meirovitch; *Publisher: McGraw Hill*

REFERENCE

1. Mechanical Vibrations *by* Tse and Morse
2. Vibration problems in Engineering *by* S.P.Timoshenko
3. Mechanical Vibrations *by* S.Graham Kelly; *Publisher: Schaum's Outline, TMH.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective I	**4**	**0**	**4**

(R11MED1124) AUTOMATION IN MANUFACTURING

Course Prerequisites: Manufacturing Technology

Course Objectives:

- To understand the characteristics, phases in different types of automation technologies
- To assess the importance of several components needed to build automated industries
- To analyze the performance of material handling systems used in automation
- To understand different kinds of assembly models in automation and make effective line balancing solutions

Course Outcomes:

Students will be able to:

- Evaluate the product and process facilities in Fixed, Programmable and Flexible Automation Technologies
- Evaluate the essential components in industries and their usage in their respective functionality.
- Apply the measures of performance of Automated Guided Vehicle's, Conveyor's and Storage Systems for real time scenarios.
- Apply the heuristics of Line Balancing Algorithms to single model and mixed model assembly lines and thereby finding the solutions of several automated lines.

UNIT I

Introduction

Production systems; Automation in production systems; Manual labor in production systems; Automation principles and strategies.

Manufacturing operations

Manufacturing industries and products; Manufacturing operations; Product facilities; Product/production relationships; Lean production.

Manufacturing models and metrics

Mathematical models of production performance; Manufacturing costs.

AUTOMATION AND CONTROL TECHNOLOGIES

UNIT II

Introduction to automation

Basic elements of an automated system; Advanced automation functions; Levels of automation.

Industrial control systems
Process industries versus discrete manufacturing industries; Continuous versus discrete control; Computer process control.
Hardware components for automation and process control
Sensors; Actuators; Analog-to-digital converters; Digital-to-Analog converters; Input / Output devices for discrete data.

MATERIAL HANDLING AND IDENTIFICATION TECHNOLOGIES
UNIT III
Material transport systems
Introduction to material handling equipment; Material transport equipment; Analysis of material transport systems.
Storage systems
Storage system performance and storage location strategies; Conventional storage methods and equipment; Automated storage systems; Engineering analysis of storage systems.
Automatic identification and data capture
Overview of automatic identification methods; Bar code technology; Radio frequency identification; Other AIDC Technologies

MANUFACTURING SYSTEMS
UNIT IV
Introduction to manufacturing systems
Components of a manufacturing system; Classification of manufacturing systems; Overview of the classification scheme;
Single-station manufacturing cells
Single station manned workstations; Single station automated cells; Applications single station cells; Analysis of single station cells.
Manual assembly lines
Fundamentals of manual assembly lines; Analysis of single model assembly lines; Line balancing algorithms; Mixed model assembly lines; Workstation considerations.
Other considerations in assembly line design
Alternative assembly systems.

UNIT V
Automated production lines
Fundamentals of automated production lines; Applications of automated production lines; Analysis of transfer lines.
Automated assembly systems
Fundamentals of automated assembly systems; Quantitative analysis of assembly systems.

TEXT BOOK
Automation, Production Systems and Computer-Integrated Manufacturing *by* Mikell P. Groover; *Publisher: Pearson/ Prentice Hall*.

REFERENCE

1. Computer Aided Manufacturing by Tien-Chien Chang, Richard A.Wysk and Hsu-Pin Wang; *Publisher: Pearson Education.*
2. Automation *by* W.Buekinsham.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective I	**4**	**0**	**4**

(R11MED1125) GAS DYNAMICS

Course Prerequisites: Thermodynamics, Fluid Mechanics

Course Objectives:

- Impart the knowledge on supersonic flow and compressible flow
- Understand about nozzles and diffusers
- Impart the basic knowledge on shock waves
- Understand about one dimensional and two dimensional compressible flows

Course Outcomes:

Students will be able to:

- Able to understand the supersonic flow and compressible flow.
- Correlate the fundamentals equations in nozzles and diffusers.
- Develop correlations in normal shock waves and understand the basic concept in oblique shock waves.
- understand one dimensional and two dimensional compressible flows.

UNIT I

Some Preliminary Thoughts

Introduction to gas dynamics, Compressibility; Supersonic flow; Speed of sound; Temperature rise; Mach angle;

Basic equations of compressible flow

Thermodynamics of fluid flow; First law of thermodynamics (entropy equation); The second law of thermodynamics; Thermal and calorical properties; The perfect gas;

Wave propagation

Introduction; Wave propagation; Velocity of sound; Subsonic and supersonic flow.

UNIT II

Steady one-dimensional flow

Introduction; Fundamental equations; Discharge from a reservoir; Streamtube area-Velocity relation; De Laval nozzle; Diffusers; Dynamic head measurement in compressible flow; Pressure coefficient.

UNIT III

Normal shock waves

Introduction; Equations of motion for a normal shock wave; The normal shock relations for a perfect gas; Change of stagnation or total pressure across the shock; Hugoniot equation; The propagating shock wave; Reflected shock wave; Centred expansion wave; Shock tube.

Oblique shock and expansion waves

Introduction; Oblique shock relations; Relation between *b* and *q*; Shock polar; Supersonic flow over a wedge; Weak oblique shocks; Supersonic compression; Supersonic expansion by turning; The prandtl-meyer function; Simple and nonsimple regions; Overview of Reflection and intersection of shocks and expansion waves;

UNIT IV

Potential equation for compressible flows

Introduction; Crocco's theorem; The general potential equation for Three-Dimensional flow; Linearisation of the potential equation; Potential equation for bodies of revolution; Boundary conditions; Pressure coefficient.

Overview of similarity rule

UNIT V

Two-dimensional compressible flows

Introduction; General linear solution of supersonic flow; Flow along a wave-shaped wall.

Prandtl-Meyer flow

Introduction; Thermodynamic considerations; Prandtl-Meyer expansion fan; Reflections.

Flow with friction and heat transfer

Introduction; Flow in Constant Area Duct with Friction; Adiabatic, Constant-area flow of a perfect gas; Flow with heating or cooling in ducts.

TEXT BOOK

Gas Dynamics *by* Rathakrishnan; *Publisher: Prentice Hall of India.*

REFERENCE

1. Fundamentals of Compressible Flow *by* S.M.Yahya; *Publisher: New Age International.*
2. Gas Dynamics *by* Cambell and Jennings; *Publisher: McGraw Hill.*
3. Gas Dynamics *by* H.W.Lipman and A.Rashkho; *Publisher: John Wiley.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective I	**4**	**0**	**4**

(R11MED1126) ADVANCED MECHANISM DESIGN

Course Prerequisites: Kinematics of Machinery

Course Objectives:

- Impart the knowledge on four bar mechanisms and degrees of freedom
- Understand about kinematic synthesis
- Understand about Freudenstein's equation for three-point function generation and Loop-closure-equation technique
- Impart the knowledge on motion generation procedure

Course Outcomes:

Students will be able to:

- To understand four bar mechanisms and degrees of freedom.
- understand and apply the various tasks of kinematic synthesis
- To apply Freudenstein's equation for three-point function generation and Loop-closure-equation technique;
- Motion generation with four and five prescribed positions; and knows the Solution procedure, Computer program for four prescribed precision points

UNIT I

Introduction to kinematics and mechanisms

Introduction; Motion; The four-bar linkage; The science of relative motion; Kinematic diagrams; Six-bar chains; Degrees of freedom; Analysis versus synthesis.

UNIT II

Introduction to kinematic synthesis: graphical and linear analytical methods

Introduction; Tasks of kinematic synthesis; Number synthesis - the associated linkage concept; Tools of dimensional synthesis; Graphical synthesis-motion generation - two prescribed positions; Graphical synthesis - motion generation - three prescribed positions; Graphical synthesis for path generation - three prescribed positions; Path generation with prescribed timing - three prescribed positions.

UNIT III

(Contd…) **Introduction to kinematic synthesis: graphical and linear analytical methods**

Graphical synthesis for path generation (without prescribed timing) - four positions; Function generator - three precision points; The overlay method; Analytical synthesis techniques; Complex number modeling in kinematic synthesis; The dyad or standard form; Number of prescribed positions versus number of free choices; Three prescribed positions for motion, path and function generation.

UNIT IV

(Contd…) **Introduction to kinematic synthesis: graphical and linear analytical methods**

Three–precision-point synthesis program for four–bar linkages; Three–precision-point synthesis - analytical versus graphical; Extension of three-precision-point synthesis to multiloop mechanisms; Circle-point and center–point circles; Ground-pivot specification; Freudenstein's equation for three-point function generation; Loop-closure-equation technique; Order synthesis - four-bar function generation.

UNIT V

Kinematic synthesis of linkages - advanced topics

Introduction; Motion generation with four prescribed positions; Solution procedure for four prescribed positions; Computer program for four prescribed precision points; Four prescribed motion-generation positions - superposition of two three-precision-point cases; Special cases of four-position synthesis; Motion generation - five positions; Solution procedure for five prescribed positions.

TEXT BOOK

Advanced Mechanism Design: Analysis and Synthesis (Volume 2) *by* George N. Sandor and Arthur G. Erdman; *Publisher: Prentice Hall of India.*

REFERENCE

1. Machines and Mechanisms *by* Pennock, Uickker, and Shigley
2. Design of Machinery *by* R.L.Norton

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective I	**4**	**0**	**4**

(R11EIE1127) ADVANCED INSTRUMENTATION AND CONTROL SYSTEMS

Course Prerequisites: Metrology, Instrumentation

Course Objectives:

- To impart the knowledge on strain gauges
- Understand about vibration and virtual instrumentation
- Impart the knowledge on control systems
- Understand about signal flow graphs and physical systems

Course Outcomes:

Students will be able to:

- Apply the knowledge on strain gauges
- Apply the knowledge on vibration and virtual instrumentation
- Apply the knowledge on control systems
- Apply the knowledge on signal graphs and physical systems

INSTRUMENTATION PART- MECHANICAL MEASUREMENTS

UNIT I

Measurement of length

Introduction; The nature of length; Derived measurements; Standards and calibration of length; Practice of length measurement for industrial use; Automatic gauging systems.

Measurement of strain

Strain; Bonded resistance strain gauges; Gauge characteristics; Installation; Circuits for strain gauges; Vibrating wire strain gauge; Capacitive strain gauges; Overview of survey of whole surfaces; Photo-elasticity.

Measurement of level and volume

Introduction; Practice of level measurement; Calibration of level-measuring systems; Overview of methods providing full-range level measurement; Overview of methods providing short-range detection.

UNIT II

Vibration

Introduction; Amplitude calibration; Sensor practice; Literature.

Measurement of force

Basic concepts; Force measurement methods; Lever-balance methods; Force-balance methods; Hydraulic pressure measurement; Acceleration measurement; Elastic elements; Further developments.

Brief introduction to measurements of density, pressure, and vacuum.

INSTRUMENTATION PART - ELECTRICAL AND RADIATION MEASUREMENTS

Non-destructive testing

Introduction; Visual examination; Surface-inspection methods; Ultrasonics; Radiography; Underwater non-destructive testing; Developments; Certification of personnel.

Electrical, optical and nucleonic measurements

Brief introduction to electrical, optical, and noise measurements and nucleonic instrument technology.

INSTRUMENTATION PART- INSTRUMENTATION SYSTEMS

UNIT III

Virtual instrumentation

Definition; Parts of the system; Microsoft windows; Traditional and graphical programming languages; Personal computers for data acquisition and instrument control; Register-and message-based programming and SCPI; Instrument drivers; The VXI bus; DSP hardware; Features of DSP hardware and software; Overview of joint-time frequency analysis.

CONTROL SYSTEMS

Introduction to control systems

Introduction - basic components of a control system, control-system applications, open-loop control systems (nonfeed-back systems), and closed-loop control systems (feedback control systems); Feedback and its effects - effect of feedback on overall gain, effect of feedback on stability, and effect of feedback on external disturbance or noise; Types of feedback control systems - linear versus nonlinear control systems, and time-invariant versus time-varying systems; Overview of mathematical foundation.

UNIT IV

Block diagrams and signal-flow-graphs

Block diagram - block diagrams of control systems, and block diagrams and transfer functions of multivariable systems; Signal-flow graphs (SFGs) - basic elements of an SFG, summary of the basic properties of SFG, definitions of SFG terms, SFG algebra, SFG of a feedback control system, gain formula for SFG, application of the gain formula between output nodes and noninput nodes, and application of the gain formula to block diagrams; State diagram - from differential equations to state diagram, from state diagram to transfer function, and "from state diagram to state and output equations"; MATLAB tools and case studies.

UNIT V

Modeling of physical systems

Introduction; Modeling of electrical networks; Modeling of mechanical systems elements - translational motion, rotational motion, conversion between translational and rotational motions, gear trains, and backlash and dead zone (nonlinear characteristics); Equations of mechanical systems; Sensors and encoders in control systems – potentiometer, tachometers, and incremental encoder; DC motors in control systems - basic operational principles of DC motors, basic classifications of PM DC motors, and mathematical modeling of PM DC motors; Linearization of nonlinear systems; Systems with transportation lags (time

delays) - approximation of the time-delay function by rational functions; A sun-seeker system - coordinate system, error discriminator, Op-Amp, servoamplifier, tachometer, and DC motor; MATLAB tools and case studies.

TEXT BOOK

For instrumentation part:

1. INSTRUMENTATION *by* B.E. Noltingk (Part Numbers 1, 3, and 4); *Publisher: Butterworth-Heinemann* 1995

(Alternatively available as separate books, Jones' Instrument Technology - Volume 1: Mechanical Measurements; Jones' Instrument Technology - Volume 3: Electrical and Radiation Measurements; Jones' Instrument Technology - Volume 4: Instrumentation Systems *by* Ernest Beachcroft Jones, and B.E.Noltingk; *Publisher: Butterworths* 1985/1987).

For control systems part:

2. Automatic Control Systems *by* Benzamin C. Kuo; *Publisher: Wiley*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective I	**4**	**0**	**4**

(R11MED1127) CNC TECHNOLOGY

Course Prerequisites: Machine Tools and Computer Integrated Manufacturing

Course Objectives:

- To able to write NC Part Programming by using the concepts of NC & CNC process
- To identity and select the equipment necessary for CNC machines
- To understand the various systems used in CNC machines
- To understand the integration of Industrial robots with CNC machines in Computer Integrated Manufacturing

Course Outcomes:

Students will be able to:

- Understand the concept of NC and CNC machines and NC part programming.
- Able to know about system devices and control loops of CNC machines
- know about the adaptive systems in CNC machines
- understand the concepts of Industrial robots and CIM

UNIT I

Introduction

Basic concepts in manufacturing systems; Fundamentals of numerical control; Advantages of NC systems; Classification of NC systems – point-to-point and contouring, NC and CNC, incremental and absolute systems, and open – loop and closed-loop systems; The punched tape.

Features of NC machine tools

Fundamentals of machining; Design considerations of NC machine tools; Methods of improving machine accuracy – tool deflection and chatter, leadscrews, and thermal deformations; Increasing productivity with NC machines; Machining centers; MCU functions – mode selections, compensations and override, readout displays, and CNC controllers.

NC part programming

Introduction; Manual programming – basic concepts, tape format, contour programming; Computer aided programming – general information, and postprocessors; APT programming – general description, geometric expressions, motion statements, additional APT statements, an example of APT programming; Other programming systems – Description of compact II, and additional languages.

UNIT II

System devices

Drives – hydraulic systems, direct-current motors, stepping motors, and alternate-current motors; Feedback devices – encoders, resolvers, inductosyn, and tachometers; Counting

devices – flip-flops, counters, decoders; Digital-to-analog converters – weighted resistor network, and resistor ladder network.

UNIT III

Interpolators for manufacturing systems

DDA integrator – principal of operation, and exponential deceleration; DDA hardware interpolator – linear interpolator, circular interpolator, and complete interpolator; CNC software interpolator; Software DDA interpolator; Reference-word CNC interpolators – the concept of reference-word interpolators, Tustin method, and improved Tustin method.

Control loops of NC systems

Introduction; Control point-to-point systems – incremental open-loop control, incremental closed-loop control, and absolute closed-loop circuit; Control loops in contouring systems – principal operation, mathematical analysis, design for constant input frequency, position control, and operation of a two axis system.

UNIT IV

Computerized numerical control

CNC concepts; Advantages of CNC; The digital computer – principal structure, computer memory, and input and output; The reference-pulse technique; Sampled-data technique – design principles, optimization for circular motion, and summary of design considerations, Microcomputers in CNC – the microprocessor, and microprocessors in CNC systems,

UNIT V

Adaptive control systems

Introduction; Adaptive control with optimization; Adaptive control with constraints – basic concepts, and ACC system for turning; Variable-gain AC systems – the stability problem, the estimator algorithm, and variable-gain algorithm; Adaptive control of grinding – grinding model, optimization strategy, and design of adaptive control for grinding; Cost analysis in machining.

Overview of Industrial robots

Overview of Computer-integrated manufacturing systems

TEXT BOOK

Computer Control of Manufacturing Systems *by* Yoram Koren; *Publisher: Tata McGraw Hill/ McGraw Hill.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective II	**4**	**0**	**4**

(R11MED1128) THEORY OF ELASTICITY AND PLASTICTY

Course Prerequisites: Engineering Mechanics, Strength of Materials

Course Objectives:

- Impart the knowledge on mohr's circles
- Understand about two dimensional problems in rectangular coordinates
- Understand about two dimensional problems in polar coordinates
- Impart the knowledge on combined stresses

Course Outcomes:

Students will be able to:

- Able to construct the Mohr's circles.
- Analyze the two dimensional problems in rectangular coordinates.
- Analyze the two dimensional problems in polar coordinates
- Understand the experimental study of plastic deformations under combined stresses

UNIT I

Introduction

Elasticity; Stress; Notation for forces and stresses; Components of stress; Components of strain; Hooke's law; Index notation; Plane stress; Plane strain; Stress at a point; Strain at a point; Measurement of surface strains; Construction of Mohr strain circle for strain rosette; Differential equations of equilibrium; Boundary conditions; Compatibility equations; Stress functions.

UNIT II

Two-dimensional problems in rectangular coordinates

Solution by polynomials; End effects; Saint–Venant's principle; Determination of displacements; Bending of a cantilever loaded at the end; Bending of a beam by uniform load, Other cases of continuously loaded beams; Solution of the two dimensional problems in the form of a Fourier series; Other applications of Fourier series - Gravity loading; End effects - Eigen solutions.

UNIT III

Two dimensional problems in polar coordinates

General equations in polar coordinates; Stress distribution symmetrical about an axis; Pure bending of curved bars; Strain components in polar coordinates; Displacements for symmetrical stress distributions; Rotating disks; Bending of a curved bar by a force at the end; Edge dislocation; The effect of circular holes on stress distributions in plates.

UNIT IV

(contd) Two dimensional problems in polar coordinates

Concentrated force at a point of a straight boundary; Any vertical loading of a straight boundary; Force acting on the end of a wedge; Bending couple acting on the end of a wedge, Concentrated force acting on a beam; Stresses in a circular disk; Force at a point of an infinite plate; Generalized solution of the two-dimensional problem in polar coordinates; Applications of the generalized solution in polar coordinates; A wedge loaded along the faces; Eigen solutions for wedges and notches.

UNIT V

Equations of plastic state

On the mechanical properties of solids - change in density and change in shape of a solid, elastic and plastic deformation, strain hardening, strain anisotropy, effect of strain rate, and creep; On the experimental study of plastic deformations under combined stresses - simple and complex loading – on experiments, and simple and complex loading; On yield conditions - yield surface and yield curve; The constant maximum shearing stress condition (Tresca-Saint Venant condition); The constant shearing stress intensity condition (Von Mises condition); On strain hardening conditions - loading surface - loading and unloading, loading surface, and unloading; Conditions of isotropic strain hardening - simple variant of the condition of isotropic strain hardening, “unique curve” hypothesis, energy condition of strain hardening, and Odquist’s condition; Theory of plastic flow.

TEXT BOOK

For elasticity part:

Theory of Elasticity *by* S.P. Timoshenko and J.N. Goodier; *Publisher: McGraw Hill*.

For plasticity part:

Fundamentals of Theory of Plasticity by L.M.Kachanov; *Publisher: Mir Publisher.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective II	**4**	**0**	**4**

(R11MED1129) ROBOTICS

Course Prerequisites: Kinematics of Machines, Mathematics

Course Objectives:

- Understand the knowledge on manipulators
- Understand about feedback components and sensors
- Impart the knowledge on programming languages
- Understand about applications of robots

Course Outcomes:

Students will be able to:

- Evaluate the positions, angles of the manipulators given the required motion analysis, kinematics, dynamics and trajectory planning concepts.
- Analyze the different types of feedback components and sensors used in robots.
- Create and analyze the program for a robot using the programming languages.
- Analyze the applications of robots in manufacturing by studying different work cells of the robots.

UNIT I

Introduction

Brief history; Types of robots; Technology of robots; Basic principles in robotics; Notation; Symbolic computation and numerical analysis.

Mathematical representation of robots

Introduction; Position and orientation of a rigid body – some properties of rotation matrices, successive rotations of a rigid body, representation of orientation by three angles, and other representations of orientation; Transformation between coordinate systems-homogeneous transformation; properties of ${}_{B}^{A}[T]$; Representation of joints-rotary joint, prismatic joint, screw joint, cylindrical joint, spherical joint, spherical-spherical joint pair, and other joints; Representation of links using Denavit-Hartenberg – link parameters for intermediate links, and first and last links; Link transformation matrices-applications-the planar 3R manipulator, the puma 560 manipulator, and a scara manipulator, the planar four-bar mechanism, a three-DOF parallel manipulator; Homogeneous coordinates, lines, screws and twists.

UNIT II

Kinematics of serial manipulators

Introduction; Degrees of freedom of a manipulator; Direct kinematics of serial manipulators - the planar 3R manipulator, the PUMA 560 manipulator; and a SCARA manipulator; Inverse kinematics of serial manipulators - the planar 3R manipulator, and the PUMA 560 manipulator; Manipulator with non-intersecting wrist; Inverse kinematics of a general 6R robot; Inverse kinematics for manipulators with n<6; Inverse kinematics of redundant manipulators; Solution methods for non-linear equations.

UNIT III

Kinematics of parallel manipulators

Introduction; Degrees of freedom; Loop-closure constraint equations; Direct kinematics of parallel manipulators - the planar four-bar mechanism, a three-DOF parallel manipulator, and a six-DOF parallel manipulator; Direct kinematics of Stewart-Gough platform; Mobility of parallel manipulators - the planar four-bar mechanism, and a three-DOF parallel manipulator; Inverse kinematics of parallel manipulators - a six-DOF hybrid manipulator, and the Stewart platform.

Velocity analysis and statics of manipulators

Introduction; Linear and angular velocities of a rigid body; Linear and angular velocities of links in serial manipulators - the planar 3R manipulator; Serial manipulator Jacobian; Parallel manipulator Jacobians - the planar four-bar mechanism and a three-DOF parallel manipulator, Statics of serial manipulators - the planar 3R manipulator; Statics of parallel manipulators.

UNIT IV

Dynamics of manipulators

Introduction; Inertia of a link; The Lagrangian formulation - equations of motion of a planar 2R manipulator, and equations of motion of a planar four-bar mechanism; Dynamic equations in cartesian space; Inverse dynamics of manipulators - inverse dynamics of planar 2R manipulator; Simulation of equations of motion - simulation of a planar 2R manipulator, and simulation of a planar four-bar mechanism.

Trajectory planning and generation - Introduction; Joint space schemes - a cubic trajectory; Joint space schemes with via points - a cubic trajectory with a via point, and a cubic trajectory with matching velocity, and acceleration at a via point; Cartesian space schemes-cartesian straight line motion, cartesian circular motion, and trajectory planning for orientation; Additional issues;

UNIT V

Position and force control of manipulators

Introduction; Feedback control of a single-link manipulator – usefulness of feedback, first-order system, second-order system, PID control of a single-link manipulator, and digital control of a single-link manipulator; PID control of a multi-link manipulator; Non-linear control of manipulators-time required to compute the model; Lack of knowledge of model parameters; Simulation and experimental results - simulation results, and experimental results; Non-linear control of constrained and parallel manipulators; Cartesian control of manipulators; Force control of manipulators - Force control of a single mass, and partitioning a task for force and position control- case study: peg-in-hole assembly.

Overview of robot actuators and feedback components

TEXT BOOK

Robotics: Fundamental Concepts and Analysis *by* Ashitava Ghosal; *Publisher: Oxford University Press*.

REFERENCE

1. Robot Dynamics and Control by M.W.Sponge and M.Vidyasagar; *Publisher: John Wiley*.
2. Introduction to Robotic Mechanics and Control by JJ Craig; *Publisher: Pearson education.*
3. Robotics by K.S.Fu; *Publisher: McGraw Hill.*
4. Industrial Robotics by M.P.Groover; *Publisher: Pearson Education.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective II	**4**	**0**	**4**

(R11MED1130) COMPOSITE MATERIALS

Course Prerequisites: Maths, Physics, Chemistry and Engineering Mechanics

Course Objectives:

- Understand composite materials and their properties, relationship between them and manufacturing of different types.
- Understand the principles of material science applied to composite materials.
- Study the equations to analyze problems by making good assumptions and learn systematic engineering method to solve practical composite mechanics problems.
- Impart the knowledge on strength of composites

Course Outcomes:

Students will be able to:

- Apply fundamental knowledge of mathematics to modeling and analysis of composite materials.
- Analyze the manufacturing methods of various composite materials.
- Analyze the failure of composites.
- Synthesize and use right composite materials for the right component

UNIT I

General introduction

Types of composite material; Design of composite materials; The concept of load transfer.

Fibres and matrices

Reinforcements **-** carbon fibres, glass fibres, organic fibres, silicon carbide, alumina, and aluminiosilicates; The strength of reinforcements **-** thermal stability, compressive strength, fibre fracture and flexibility, and a statical treatment of fibre strength; Matrices - polymer matrices, metal matrices, and ceramic matrices.

UNIT II

Fibre architecture

General considerations - volume fraction and weight fraction, fibre packing arrangements, and clustering of fibres and particles; Long fibres - laminates, woven, braided and knitted fibre arrays, and characterization of fibre orientations in a plane; Short fibre - fibre orientation distributions in three dimensions, and fibre length distributions; Voids - fibre orientation during processing.

UNIT III

Elastic deformation of long-fibre composites

Axial stiffness; Transverse stiffness, shear stiffness, Poisson contraction effects.

Elastic deformation of laminates

Elastic deformation of anisotropic materials - Hook's law, and effects of symmetry; Off-axis elastic constants of laminae - calculation procedure, and engineering constants; Elastic deformation of laminates - loading of a stack of plies, and predicted behavior; Stresses and distortions - balanced laminates, stresses in individual plies of a laminate, coupling stresses, and symmetric laminates;

UNIT IV

Stresses and strains in short-fibre composites

The shear lag model - stresses and strain distributions, the stress transfer length, transfer of normal stress across fibre ends, prediction of stiffness, and onset of inelastic behavior; The Eshelby method - a misfitting ellipsoid, the equivalent homogeneous ellipsoid, the background stress, and composite stiffness.

UNIT V

The interface region

Bonding mechanisms **-** adsorption and wetting, interdiffusion, and chemical reaction, electrostatic attraction, mechanical keying, and residual stresses**.**

Strength of composites

Failure modes of long-fibre composites **-** axial tensile failure, transverse tensile failure, shear failure, and failure in compression; Failure of laminae under off-axis loads **-** maximum stress criterion, other failure criteria, and experimental data for single laminae; Strength of laminates - **t**ensile cracking, interlaminar stresses, and edge effects.

TEXT BOOK

An Introduction to Composite Materials *by* D.Hull and T.W. Clyne; *Publisher: Cambridge University Press*.

REFERENCE

1. Composite Materials Science and Engineering by K.K.Chawla; Publisher: Springer, 2009.
2. Mechanics of Composite Materials *by* R.M.Jones; *Publisher: McGraw Hill.*
3. Analysis and performance of Fibre Composites by B.D.Agarwal, L.J.Broutman, and K.Chandrasekhara; *Publisher: John Wiley*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective II	**4**	**0**	**4**

(R11MED1131) POWER PLANT ENGINEERING

Course Prerequisites: Thermal Engineering and Basic Electrical Engineering

Course Objectives:

- Understand the layout of the different types of Power plants.
- Knowledge on various components in the power plants.
- Understand the power plant economics and power distribution.
- Impart the knowledge on power distribution

Course Outcomes:

Students will be able to:

- Analyzing the working principal of the power plant , scope for future expansion
- Understanding the concept on various equipments used in the plant
- Evaluating the power plant economics and environmental consideration
- Applying the Knowledge to the power distribution and load factor importance

UNIT I

Introduction

Energy and power; Background of power study; Working processes; The power age; Power plant engineering and design; Drawings; Specifications; Correspondence; Electric power systems.

The variable load problem

Industrial production and power generation compared; Ideal and realized load curves; Terms and factors; Effect of variable load on power plant design; Effect of variable load on power plant operation; Methods of meeting the load.

UNIT II

Power plant economics

Source of income; Effect of plant type on costs; Rates; Fixed element; Energy element; Customer element; The investor's profit; Depreciation and replacement; Theory of rates; Making up rate structures.

Fuels and combustion

Fuels, gas and oil; Internal combustion engine fuel; Furnace fuel oil; Coal; Fuel tests for heating value; Proximate analysis; Ash and refuse analyses; Combustion; Illustrative examples in combustion; Approximations and short-cuts; smoke.

UNIT III

Overview of Internal combustion engine power plant

Overview of gas turbine power plant

Stationary gas turbine; Constant pressure combustion cycle; The simple gas turbine plant; Thermal refinement of the gas turbine cycle; Field for gas turbine power.

Hydro Power

Introduction; Principles; Assessing the resource for small installations; Hydrological cycle/ Flow measurement; Drainage area characteristics; Hydrographs; Storage and pondage; classification of dams and spillways; Hydro projects and power plant; Social and environmental aspects.

UNIT IV

Energy flow in the steam power plant

The steam power plant; Functional relation of equipment; Production of heat energy; Thermal level; Heat flow; Conduction; Surface convection; Mean temperature difference; Convective heat transfer from products of combustion; Convective heat transfer between condensing steam and water; Surface convection calculations; Radiation; Apportionment of heating surface.

Steam generators

Components; Design criteria; Boiler types; Representative fire-tube boiler; Representative water-tube boilers; Water walls; Boiler installation; Furnace; Superheat; Boiler accessories and trim; Combustion equipment; Spreader stoker; Conveyor stoker; Underfeed stoker; Coal burners; Gas and oil burners; Operation and performance; Heat balance of a steam generator.

UNIT V

The gas loop

Function of the gas loop; Coal storage; Coal conveyors; Pulverized coal systems; Oil and gas supply systems; Flue gas cleaning; Ash handling; Air preheater; Draft; Gas conduits; Draft by fans; Draft by chimneys; Control of gas loop flows; Combustion control equipment.

Overview of nuclear power plant.

TEXT BOOK

Power Plant Engineering *by* Frederick T. Morse; *Publisher: East West Publishing (EWP)*.

REFERENCE

1. Power Plant Engineering *by* P.K.Nag; *Publisher: TMH*
2. A Course in Power Plant Engineering by S.C.Aurora and S.Domkundwar

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective II	**4**	**0**	**4**

(R11MED1132) ADVANCED MACHINE DESIGN

Course Prerequisites: Design of Machine Elements

Course Objectives:

- Understand the modern integrated and modularized products
- Understand about static failure theories
- Impart the knowledge on fatigue failure theories
- Understand the knowledge on surface failure

Course Outcomes:

Students will be able to:

- Plan and lead product development work of modern integrated and modularized products.
- Design and detail both simple products as well as subsystems of more complicated mechanical products from idea to manufacturing drawings and prototype.
- Analyze and dimension both simple products as well as subsystems of more complicated mechanical products in an engineering manner.
- Develop and estimate loads for both simple products as well as subsystems of more complicated mechanical products, as a basis for dimensioning of structure elements as well as selection of machine elements and materials.

UNIT I

Load determination

Introduction; Loading classes; Free-body diagrams; Loads analysis – three dimensional analysis, two dimensional analysis, and static load analysis; Two-dimensional static loading case studies – case study 1A – bicycle break lever loading analysis, case study 2A – hand operated crimping – tool loading analysis, case study 3A – automobile scissors – jack loading analysis; Three-Dimensional, static loading case study – case study 4A – bicycle break arm loading analysis; Dynamic loading case study – case study 5A – four bar linkage loading analysis; Vibration loading – natural frequency, dynamic forces, and case study 5b – four bar linkage dynamic loading measurement; Impact loading – energy method; Beam loading – shear and moment, Singularity functions, and Superposition.

UNIT II

Static failure theories

introduction; Failure of ductile materials under static loading – the Von Mises-Hencky or distortion-energy theory, the maximum shear-stress theory, maximum normal-stress theory, and comparison of experimental data with failure theories; Failure of brittle materials under

static loading – even and uneven materials, the Colomb-Mohr theory, the modified-Mohr theory, fracture-mechanics – fracture mechanics theory, fracture toughness Kc; Using the static-loading failure theories; Case studies in static failure analysis – case study 1C – bicycle break lever failure analysis, case study 2C – crimping – tool failure analysis, case study 3C – automobile scissors – jack failure analysis, and case study 4C – bicycle break arm factors of safety

UNIT III

Fatigue failure theories

Introduction - history of fatigue failure; Mechanism of fatigue failure – crack-initiation stage, crack propagation stage, and fracture; Fatigue-failure models – fatigue regimes, the stress-life approach, the strain-life approach, the LEFM approach; Machine design considerations; Fatigue loads – rotating machinery loading, and service equipment loading.

UNIT IV

Surface failure

Introduction; Surface geometry; Mating surfaces; Friction – effect of roughness on friction, effect of velocity on friction, rolling friction, and effect of lubricant on friction; Adhesive wear – the adhesive wear coefficient; Abrasive wear – abrasive materials, and abrasion-resistant materials; Corrosion wear – corrosion fatigue, and fretting corrosion; Surface fatigue; Spherical contact – contact pressure and contact patch in spherical contact, static stress distributions in spherical contact; Cylindrical contact - contact pressure and contact patch in parallel cylindrical contact, and static stress distributions in parallel cylindrical contact; General contact - contact pressure and contact patch in general contact, and stress distribution in general contact; Dynamic contact stresses – effect of sliding component on contact stresses.

UNIT V

Design case studies

Introduction; Case study 7 – A portable air compressor – case study 7a – preliminary design of a compressor drive train; Case study 8 – A hay-bale lifter – Case study 8a – preliminary design of a winch lift; Case study 9 – A cam – testing machine – case study 9a - preliminary design of a cam dynamic text fixture (CDTF)

TEXT BOOK

Machine Design: Integrated Approach *by* Robert L. Norton; *Publisher: Pearson Education.*

REFERENCE

1. Mechanical Engineering Design (SI edition) *by* J.E. Shigley; *Publisher: McGraw Hill.*
2. Mechanical Engineering Design (SI edition) *by* J.E.Shigley and Mischke.
3. Mechanical Engineering Design (International edition) *by* J.E.Shigley, Mischke, and Budynas; *Publisher: McGraw Hill.*
4. Mechanical Engineering Design (International edition) *by* J.E.Shigley, Mischke, R.G.Budynas, and K.J.Nisbett; *Publisher: TMH.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective II	**4**	**0**	**4**

(R11AME1110) AUTOMOBILE ENGINEERING

Course Prerequisites: Thermodynamics, Basic Electrical Engineering

Course Objectives:

- Understand the Working of Fuel, Ignition, and cooling Systems
- Understand the Working of Lubrication and Electrical Systems.
- Understand the Working of transmission, Suspension, Steering and Braking Systems.
- Understand about constructional details of electronic components

Course Outcomes:

Student should be able to:

- Learn the concepts, functions and working of automotive systems and subsystems.
- Gain knowledge on constructional details and functionality of automotive cooling, lubrication and fuel systems.
- Able to explain the constructional details and functionality of automotive electrical, driveline and transmission systems.
- Able to explain the constructional details and functionality of automotive electrical, driveline and transmission systems

UNIT I

Automotive service and shop work

Introduction to automobile - regulating the automobile, future power plants and electric vehicles;

Jobs in automotive service - opportunities in automotive service, and automotive technician certification;

Shop work and service information - finding and using automotive service information, and identifying a recalled vehicle;

Automotive shop safety - shop safety rules, and hazardous material and hazardous waste;

Measuring systems and measuring tools - linear, pressure, and vacuum measurements;

Automotive fasteners, gaskets, and sealants - prevailing torque fasteners, torque-to-yield bolts, gaskets, seals, sealants, and thread-locking chemicals;

Shop hand tools - striking, turning, gripping, and cutting tools, torque wrench, and torque-angle gauge;

Shop equipment and power tools – electric, pneumatic, and hydraulic tools.

UNIT II

Automotive engines

Fundamentals of engine operation - combustion and actions in the engine cylinder;

Electricity and electronic engine controls - electricity, magnetism, Ohm's law, electronics and semiconductor devices, microprocessor, memory, and electronic engine control;

Piston-engine operation - basic engine construction, and operation;

Engine types and classifications - cylinder numbering and firing order, two-stroke-cycle and four-stroke-cycle engines, and adiabatic, gas-turbine, and Wankel engines;

Engine construction - cylinder blocks, cylinder heads, manifolds, crankshaft, bearings, rods, pistons, and rings;

Valves and valve trains - driving and timing the camshaft, valves, valve seats, valve-train components, valve timing and variable valve timing;

Engine measurements and performance - engine mechanical and performance measurements, compression ratio, and volumetric efficiency.

UNIT III

Automotive engine systems

Automotive engine fuels - fuels, combustion, abnormal combustion, detonation, alcohol, alcohol-blend, and other fuels;

Engine fuel and exhaust systems - air intake and mixer distribution, exhaust system and electronic noise control;

Superchargers and turbochargers - supercharger and turbocharger construction and operation, supercharger and turbocharger diagnosis and service;

Electronic fuel-injection systems - air-fuel and stoichiometric ratio, and injectors- sensors-actuators in port and TBI systems;

Fuel-injected fuel systems - diagnosis and service - On-board diagnostics and retrieving trouble codes, sensor and ECM diagnosis and testing, cleaning injectors, and servicing fuel-injection systems.

UNIT IV

(Contd) **Automotive engine systems**

Carburetors **-** carburetors (single, multiple-barrel, and variable-venturi), and electronically controlled feedback carburetors;

Carbureted fuel systems - diagnosis and service, testing mixture-control solenoid, carburetor adjustments and service;

Diesel fuel-injection systems - diesel fuel, fuel injection pumps, governors, diesel injection nozzles, and electronic controls;

Engine lubricating systems - engine oil, lubricating systems, indicators, lubricating-system trouble diagnosis and service;

Engine cooling systems - Antifreeze and cooling-system components, Drive belts, electric fans, and indicators.

Elements of automotive chassis

UNIT V

Automotive electrical and electronic equipment

Automotive electrical and electronic systems - electrical-circuit components, symbols, and wiring diagrams, basic electrical diagnosis, tests and measurements;

Automotive battery - battery construction, operation, maintenance, battery testing, diagnosis, charging and replacement;

Starting system - operation and service - permanent-magnet and electromagnet starting motors, starting-system trouble diagnosis, testing and service;

Charging system - operation and service - alternators and regulators, charging-system trouble diagnosis, testing, and service;

Contact-point ignition system - ignition-system components, timing, spark advance, spark plugs, and heat range.

TEXT BOOK

Automotive Mechanics *by* William H. Crouse and Donald L. Anglin; *Publisher: McGraw Hill*

REFERENCE

1. Automotive Mechanics *by* Heitner.
2. Automotive Engineering *by* Newton Seeds and Garrett
3. A Systems Approach to Automobile Technology *by* Jack Erjavec; *Publisher: YESSDEE Publishers*.

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective III	**4**	**0**	**4**

(R11MED1133) MECHATRONICS

Course Prerequisites: Instrumentation and Control Systems

Course Objectives:

- Impart the knowledge on transducers
- Understand about concept of actuation systems
- Understand about dynamic response of the system
- Impart the knowledge on Microprocessors

Course Outcomes:

Student should be able to:

- Know about the sensors and transducers used in mechatronics system.
- Understand the concept of actuation systems
- Able to know the dynamic response of the system.
- Apply the microprocessors

UNIT I

Introduction

Scope of mechatronics; Systems; Measurement systems; Control systems, Microprocessor-based controllers; Response of systems; The mechatronics approach.

Sensors and transducers

Introduction; Performance terminology, Displacement, position and proximity; Velocity and motion; Force; Fluid pressure; Liquid flow; Liquid level; Temperature; Light sensors; Selection of sensors; Inputting data by switches.

UNIT II

Signal conditioning

Introduction; The operational amplifier; Protection; Filtering, Wheatstone bridge; Digital signals; Multiplexers; Data acquisition; Digital signal processing; Pulse modulation.

Data presentation systems

Displays; Data presentation elements; Magnetic recording; Data acquisition systems; Measurement systems, Testing and calibration.

UNIT III

Pneumatic and hydraulic actuation systems

Actuation systems; Pneumatic and hydraulic systems; Directional control valves; Pressure control valves; Cylinders; Process control valves; Rotary actuators.

Mechanical actuation systems

Mechanical systems; Types of motion; Kinematic chains; Cams, Gear trains; Ratchet and pawl; Belt and chain drives; Bearings; Mechanical aspects of motor selection.

UNIT IV

Electrical actuation system

Electrical systems; Mechanical switches; Solid-state switches; Solenoids; DC Motors; AC Motors; Stepper motors.

Basic system models

Mathematical models; Mechanical systems building blocks; Electrical system building blocks; Fluid system building blocks; Thermal system building blocks.

System models

Engineering systems; Rotational–translational systems; Electro-mechanical systems; Hydraulic-mechanical systems.

UNIT V

Dynamic responses of systems

Modeling dynamic systems; First order systems; Second order systems; Performance measures for second order systems; System identification.

System transfer function

The transfer function; First order systems; Second order systems,; Systems in series; Systems with feed back loops; Effect of pole locations on transient response.

Closed loop controllers

Continuous and discrete processes; Control modes; Two step mode; Proportional mode; Derivative control; Integral control; PID controller; Digital controllers; Control system performance; Controller tuning, Velocity control, Adaptive control.

Microprocessors

Control; Microprocessors systems; Microcontrollers; Applications; Programming.

TEXT BOOK

Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering *by* W. Bolton; *Publisher: Pearson Education*.

REFERENCE

1. Mechatronics; *Publisher: HMT and TMH*
2. Introduction to Mechatronics and Measurement Systems by David G. Alciatore, Michael B.Histand; *Publisher: McGraw Hill.*
3. Mechatronic System Design by Devdas Shetty and Richard A. Kolk; *Publisher: Cengage Learning.*
4. INSTRUMENTATION *by* B.E. Noltingk (Part Numbers 1, to 5); *Publisher: Butterworth-Heinemann*

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective III	**4**	**0**	**4**

(R11MED1134) ADVANCED MECHANICS OF SOLIDS

Course Prerequisite: Mechanics of Solids, Engineering Mechanics, Mathematics

Course Objectives:

- Understand the concept of stress and strain in 3-D, cauchy's formula, Mohr's circle, Drucker-pager yield criteria, shear effect on inelastic bending etc.
- Understand the concept of torsion, buckling and stability, columns with eccentric axis loads.
- Understand method of superposition, principal of work, power and energy and its importance.
- Impart the knowledge on analysis of stresses

Course Outcomes:

Students will be able to:

- Quote Stress equilibrium equations to Solve solid mechanics problems effectively.
- Describe the theories of failure for various design aspects.
- Apply the concepts of torsion, buckling and stability, columns with eccentric axis loads for real life situations.
- Analyze stresses built in various members for a given application.

UNIT I

Linear stress-strain-temperature relations

First law of thermodynamics, internal energy density, and complementary internal energy density – elasticity and internal-energy density, and elasticity and complementary internal-energy density; Hooke's law: anisotropic elasticity; Hooke's law: isotropic elasticity – isotropic and homogeneous materials, and strain-energy density of isotropic materials; Equations of thermoelasticty for isotropic materials; Hooke's law: orthotropic materials.

Inelastic material behavior

Limitations on the use of uniaxial stress-strain data – rate of loading, temperature lower than room temperature, temperature higher than room temperature, unloading and load reversal, and multiaxial states of stress; Nonlinear material response – models of uniaxial stress-strain curves; Yield criteria: general concepts – maximum principal stress criterion, maximum principal strain criterion, and strain-energy density criterion; Yielding of ductile metals – maximum shear-stress (Tresca) criterion, distortional energy density (von mises) criterion, and effect of hydrostatic stress and the π-plane; Alternative yield criteria – Mohr-coulomb yield criterion, Drucker-Prager yield criterion, and Hill's criterion for orthotropic materials; General yielding – elastic-plastic bending, fully plastic moment, shear effect on inelastic bending, modulus of rupture, comparison of failure criteria, and interpretation of failure criteria for general yielding.

UNIT II

Curved beams

Introduction; Circumferential stresses in a curved beam – location of neutral axis of cross section; Radial stresses in curved beams – curved beams made from anisotropic materials; Correction of circumferential stresses in curved beams having I, T, or similar cross sections – Bleich's correction factors; Deflections of curved beams – cross sections in the form of an I, T, etc.; Statically indeterminate curved beams: closed ring subjected to a concentrated load; Fully plastic loads for curved beams – fully plastic versus maximum elastic loads for curved beams.

UNIT III

Beams on elastic foundations

General theory; Infinite beam subjected to concentrated load: boundary conditions – method of superposition, and beam supported on equally spaced discrete elastic supports; Infinite beam subjected to a distributed load segment – uniformly distributed load, $\beta L' \leq \pi$, $\beta L' \rightarrow \infty$, intermediate values of $\beta L'$, and triangular load; Semiinfinite beam subjected to loads at its end; Semiinfinite beam with concentrated load near its end; Short beams; Thin-wall circular cylinders.

UNIT IV

The thick-wall cylinder

Basic relations – equations of equilibrium, strain-displacement relations and compatibility condition, stress-strain-temperature relations, and material response data; Stress components at sections far from ends for a cylinder with closed ends – open cylinder; Stress components and radial displacement for constant temperature – stress components, radial displacement for a closed cylinder, and radial displacement for an open cylinder; Criteria of failure – failure of brittle materials, failure of ductile materials, material response data for design, and ideal residual stress distributions for composite open cylinders; Fully plastic pressure and autofrettage; Cylinder solution for temperature change only – steady-state temperature change (distribution), and stress components; Rotating disks of constant thickness.

UNIT V

Flat plates

Introduction; Stress resultants in a flat plate; Kinematics: strain-displacement relations for plates – rotation of a plate surface element; Equillibrium equations for small-displacement theory of flat plates; Stress-strain-temperature relations for isotropic elastic plates – stress components in terms of tractions and moments, and pure bending of plates; Strain energy of a plate; Boundary conditions for plates; Solution of rectangular plate problems – Solution of $\nabla^2 \nabla^2 w = P/D$ for a rectangular plate, Westerguaard approximate solution for rectangular plates: uniform load, deflection of a rectangular plate: uniformly distributed load;

Solution of circular plate problems – solution of $\nabla^2 \nabla^2 w = P/D$ for a circular plate, circular plates with simply supported edges, circular plates with fixed edges, circular plate with a circular hole at the center; summary of circular plates with simply supported edges,

summary for stresses and deflections in flat circular plates with central holes, summary for large elastic deflections of circular plates: clamped edge and uniformly distributed load, significant stress when edges are clamped, load on a plate when edges are clamped, summary for large elastic deflections of circular plates: simply supported edge and uniformly distributed load, rectangular or other shaped plates with large deflections.

Contact stresses

Introduction; The problem of determining contact stresses; Geometry of the contact surface – fundamental assumptions, contact surface shape after loading, justification, and brief discussion of the solution; Notation and meaning of terms; Expressions for principal stresses; Method of computing contact stresses – principal stresses, maximum shear stress, maximum octahedral shear stress, maximum orthogonal shear stress, and curves for computing stresses for any value of B/A; Deflection of bodies in point contact – significance of stresses; Stress for two bodies in line contact: loads normal to contact area – maximum principal stresses:*k*=0, maximum shear stress:*k*=0, and maximum octahedral shear stress:k=0; Stresses for two bodies in line contact:loads normal and tangent to contact area – roller on plane, principal stresses, maximum shear stress, maximum octahedral shear stress, effect of magnitude of friction coefficient, and range of shear stress for one load cycle.

Overview of creep: time-dependent deformation.

TEXT BOOK

Advanced Mechanics of Materials (6E) by Arthur P. Boresi and Richard J. Schmidt; *Publisher: John Wiley.*

REFERENCE

Strength of Materials (part 2): Advanced Theory and Problems *by* Stephen Timoshenko; *Publisher: CBS.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective III	**4**	**0**	**4**

(R11MED1135) METAL FORMING

Course Prerequisites: Production Technology, Metallurgy & Material Science

Course Objectives:

- To understand the concepts of various metal forming techniques
- To analyze the mechanics of metal forming
- To estimate the metallurgical & mechanical properties of metals
- To know the concepts of sheet metal forming

Course Outcomes:

Students will be able to:

- To acquire a deeper knowledge about metal forming under different conditions and in various processes.
- Analyze metal forming mechanics.
- Understand Workability of testing techniques.
- Apply Tribology in metal forming and other phenomena.

UNIT I

Elements of the theory of plasticity

Introduction; The flow curve; True stress and true strain; Yield criteria for ductile metals; Combined stress tests; The yield locus; Anisotropy in yielding; Yield surface and normality; Octahedral shear stress and shear strain; Invariants of stress and strain; Plastic stress and strain relations.

UNIT II

Fundamentals of metal forming

Classification of forming processes; Mechanics of metal working; Flow stress determination; Temperature in metalworking; Strain rate effects; Metallurgical structure; Friction and lubrication; Deformation zone geometry; Hydrostatic pressure; Workability; Residual stresses; Experimental techniques for metalworking processes; Computer aided manufacturing.

UNIT III

Forging

Classification of forging processes; Forging equipment; Forging in plane strain; Open die forging; Closed die forging; Calculation of forging loads in closed die forging; Forging defects; Powder metallurgy forging; Residual stresses in forgings.

Rolling of metals

Classification of rolling processes; Rolling mills; Hot rolling; Cold rolling; Rolling of bars and shapes; Forces and geometrical relationship in rolling; Simplified analysis of rolling load - rolling variables; Problems and defects in rolled products; Rolling-mill control; Theories of cold rolling; Theories of hot rolling; Torque and power.

UNIT IV

Extrusion

Classification of extrusion processes; Extrusion equipment; Hot extrusion; Deformation, lubrication and defects in extrusion; Analysis of extrusion process; Cold extrusion and Cold forming; Hydrostatic extrusion; Extrusion of tubing; Production of seamless pipe and tubing.

UNIT V

Drawing of rods, wires, and tubes

Introduction; Rod and wiredrawing; Analysis of wiredrawing; Tube drawing processes; Analysis of tube drawing; Residual stresses in rod, Wire and tubes.

Sheet metal forming

Introduction; Forming methods; Shearing and blanking; Bending; Stretch forming; Deep drawing; Forming limit criteria; Defects in formed parts.

TEXT BOOK

Mechanical Metallurgy *by* George E. Dieter; *Publisher: McGraw-Hill*.

REFERENCE

1. Handbook of Metal Forming by Kurt Lange and Klaus Pohlandt; *Publisher: McGraw Hill.*
2. Theory of Metal Forming Processes by Surender Kumar; *Publisher: PHI*

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective III	**4**	**0**	**4**

(R11MED1136) TRIBOLOGY

Course Prerequisite: Engineering Materials

Course Objectives:

- Impart the knowledge on anti-friction and anti-wear components and the lubricants
- Understand about operation of anti-friction or anti-wear components
- Understand about tribological design
- Impart the knowledge on preparing technical project reports and technical presentations

Course Outcomes:

Students will be able to:

- Gain Knowledge on common anti-friction and anti-wear components and the lubricants.
- Describe the detailed operation of selected anti-friction or anti-wear components.
- Design a Tribological system for optimal performance.
- Develop technical project reports and technical presentations.

UNIT I

Introduction to the concept of tribodesign

Specific principles of tribodesign; Tribological problems in machine design - plain sliding bearings, rolling contact bearings, piston, piston rings, cylinder liners, friction drives, overview of gears.

Basic principles of tribology

Origins of sliding friction; Contact between bodies in relative motion; Friction due to adhesion; Friction due to ploughing; Friction due to deformation; Energy dissipation during friction; Friction under complex motion conditions; Types of wear and their mechanisms - adhesive wear, abrasive wear, wear due to surface fatigue, and wear due to chemical reactions; Sliding contact between surface asperities; The probability of surface asperity contact.

UNIT II

(Cont'd) **Basic principles of tribology**

Wear in lubricated contacts - rheological lubrication regime, functional lubrication regime, fractional film defect, load sharing in lubricated contacts, adhesive wear equation, and fatigue wear equation; Relation between fracture mechanics and wear **-** estimation of stress intensity under non-uniform applied loads; Film lubrication - coefficient of viscosity, fluid film in simple shear, viscous flow between very close parallel surfaces, shear stress variations within the film, lubrication theory by Osborne Reynolds, high-speed unloaded journal,

equilibrium conditions in a loaded bearing, loaded high-speed journal, equilibrium equations for loaded high-speed journal, reaction torque acting on the bearing, the virtual coefficient of friction, and the Sommerfeld diagram.

UNIT III

Elements of contact mechanics

Introduction; Concentrated and distributed forces on plane surfaces; Contact between two elastic bodies in the form of spheres; Contact between cylinders and between bodies of general shape; Failures of contacting surfaces; Design values and procedures;

Thermal effects in surface contacts - analysis of line contacts, refinement for unequal bulk temperatures, refinement for thermal bulging in the conjunction zone, the effect of surface layers and lubricant films, critical temperature for lubricated contacts, the case of circular contact, contacts for which size is determined by load, and maximum attainable flash temperature;

Contact between rough surfaces - characteristics of random rough surfaces, and contact of nominally flat rough surfaces; Representation of machine element contacts.

UNIT IV

Friction, lubrication and wear in lower kinematics pairs

Introduction; The concept of friction angle - friction in slideways, and friction stability; Friction in screws with a square thread - application of a threaded screw in a jack; Friction in screws with a triangular thread; Plate clutch - mechanism of operation; Cone clutch - mechanism of operation - driving torque; Rim clutch - mechanism of operation - equilibrium conditions, auxiliary mechanisms, and power transmission rating; Centrifugal clutch - mechanism of operation; Boundary lubricated sliding bearings - axially loaded bearings, and pivot and collar bearings; Drives utilizing friction force - belt drive, mechanism of action, power transmission rating, relationship between belt tension and modulus, and V-belt and rope drives; Overview of frictional aspects of brake design.

UNIT V

Sliding-element bearings

Derivation of the Reynolds equation; Hydrostatic bearings; Squeeze-film lubrication bearings; Thrust bearings **-** flat pivot, the effect of the pressure gradient in the direction of motion, equilibrium conditions, and coefficient of friction and critical slope; Journal bearings - geometrical configuration and pressure generation, mechanism of load transmission, thermoflow considerations, design for load-bearing capacity, unconventional cases of loading, numerical example.

TEXT BOOK

Tribology in Machine Design *by* T.A. Stolarski; *Publisher: Butterworth and Heinemann/Industrial Press.*

REFERENCE

1. Tribology: Friction and Wear of Engineering Materials by I.M.Hutchings; *Publisher: Edward Arnold.*
2. Industrial Tribology: The Practical Aspects of Friction, Lubrication and Wear by M.H.Jones and Douglas Scott; *Publisher: Elsevier*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective III	**4**	**0**	**4**

(R11MED1137) RENEWABLE ENERGY SOURCES: SOLAR ENERGY

Course Prerequisite: Fluid Mechanics and Heat Transfer

Course Objectives:

- Understand about the concept of renewable energy sources
- Impart the knowledge on governing equations for power generation
- Understand about the different types of solar and wind equipments
- Understand about the improvement of work efficiencies

Course Outcomes:

Students will be able to:

- To understand the working principles of renewable energy.
- Development of governing equations for power generation.
- Design, Fabricate and testing of different solar equipments.
- Design and improve working efficiency of wind turbine

UNIT I

Principles of renewable energy

Introduction; Energy and sustainable development; Fundamentals; Scientific principles of renewable energy; Technical implications; Social implications.

Essentials of fluid dynamics

Introduction; Conservation of energy-Bernoulli's equation; Conservation of momentum; Viscosity; Turbulence; Friction in pipe flow; Lift and drag forces-fluid and turbine machinery.

UNIT II

Heat transfer

Introduction; Heat circuit analysis and terminology; Conduction; Contents; Convection; Radiative heat transfer; Properties of transparent materials; Heat transfer by mass transport; Multimode transfer and circuit analysis.

UNIT III

Solar radiation

Introduction; Extraterrestrial solar radiation; Components of radiation; Geometry of the Earth and Sun; Geometry of collector and the solar beam; Effects of the Earth's atmosphere; Measurements of solar radiation; Estimation of solar radiation.

Solar water heating

Introduction; Calculation of heat balance-general remarks; Uncovered solar water heaters–progressive analysis; Improved solar water heaters; Systems with separate storage; Selective surfaces; Evacuated collectors; Social and environmental aspects.

UNIT IV

Buildings and other solar thermal applications

Introduction; Air heaters; Energy-efficient buildings; Crop driers; Space cooling; Water desalination; Solar ponds; Solar concentrators; Solar thermal electric power systems; Social and environmental aspects.

UNIT V

Photovoltaic generation

Introduction; The silicon *P–N* junction; Photon absorption at the junction; Solar radiation absorption; Maximising cell efficiency; Solar cell construction; Types and adaptations of photovoltaics; Photovoltaic circuit properties; Applications and systems; Social and environmental aspects.

Overview of Energy storage

TEXT BOOK

Renewable Energy Sources *by* John Twidell and Tony Weir; *Publisher: Taylor and Francis Group.*

REFERENCE

1. Principles of Solar Energy by Frank Krieth and J.F. Kreider
2. Solar Power Engineering by B.S.Magal, Frank Krieth, and J.F. Kreider.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective III	**4**	**0**	**4**

(R11MED1138) INDUSTRIAL ENGINEERING

Course Prerequisite: Manufacturing, General Management, Business Economics, Mathematics & Statistics

Course Objectives:

- Perform as industry leaders in the global marketplace, capable of successfully planning, controlling, and implementing large-scale projects.
- Flourish and work effectively in diverse, multicultural environments emphasizing the application of teamwork and communication skills.
- Understand and apply the principles of Management, science, technology, engineering, and mathematics involving industry-relevant problems.
- Understand about the knowledge on professional practice

Course Outcomes:

Students will be able to:

- Apply knowledge of Management, mathematics, science, and engineering.
- Evaluates the system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
- Analyzes and applies the IEM, Communicate effectively, Function on multidisciplinary teams.
- Solves the contemporary & emerging issues important to professional practice.

BUSINESS QUALITY MANAGEMENT

UNIT I

The quality of products and services and total quality control

New impact of quality; Total quality control and its purpose; The meaning of "Quality"; The meaning of "Quality"—Orientation to customer satisfaction; The meaning of "Control" in industry; Scope of total quality control; Total quality control's organization wide impact—total quality management; Systems engineering and management—foundation for total quality control; The evolution of total quality control; Quality—a major business management strategy; The place of total quality control in the modern business management concept: profitability and positive cash flow, examples, the range and timing of results and benefits, and return on investment; Quality: responsibility to society; The quality challenge facing industry.

The buyer, the producer, and the new marketplace demands for quality

The buyer - a profile, and consumerism; The buyer and the service industries; The producer - a profile; Product and service liability and the producer; The warranty and the producer; Product recall and the producer; The marketplace - an overview; The marketplace - an example; The marketplace - opportunity from quality leadership.

Productivity, technology, and the internationalization of quality

The worker - a profile; Total quality and total productivity - an example; Total quality and product development; Quality, mechanization, and automation; Quality information processing, computer technology, and software quality control; Total quality, standards, and specifications; Total quality and safety; Total quality and liability loss prevention; Total quality and internationalism - the role of government.

Factors in controlling quality and the jobs of quality control

The 9 M's: fundamental factors affecting quality; Complications of modern quality problems; Usage of quality control; Jobs of quality control; New-design control; Incoming-material control; Product control; Special process studies; Role of statistics in the quality-control job; Role of other methodology in the quality-control job; Application of the jobs of quality control to job lot as well as to high-quantity production; Accomplishment of jobs of quality control.

THE TOTAL QUALITY SYSTEM

UNIT II

The systems approach to quality

Today's systems requirement; Definition of the total quality system; The total quality system and the engineering technology of quality control; The systems engineering and systems management approach; The organization wide scope of the total quality system and the role of general management; Systems engineering and systems management activities for quality control; Characteristics of the total quality system; The meaning of the total quality system; Necessity of a total quality system-an example.

Establishing the quality system

Controlling the quality-systems activity; Total quality-system principles; Key systems activities for total quality control; Preproduction quality evaluation; Product- and process-quality planning; Purchased-material quality planning, evaluation, and control; Product-and process-quality evaluation and control; Quality information feedback; Quality information equipment; Quality training, orientation, and work force development; Postproduction quality service; Management of the quality activity; Special quality studies; Key areas of systems measurement; Key systems activities for quality control-an example; The quality-systems manual; Quality-systems management; Recognizing an effective quality system - a summary.

Quality costs - foundation of quality-systems economics

Scope of quality costs; Operating quality costs; Reduction of quality costs by total quality control; Quality-cost establishment; Identifying quality-cost items; Collecting and reporting quality-cost information; Analysis of quality costs; Selection of measurement bases for operating quality costs; Establishment of quality-cost goals; Applications of quality costs; Return on investment and quality costs; Other quality-cost categories in quality-systems economics; Indirect quality costs and vendor quality costs; Intangible quality costs and "liability exposure" costs; Equipment quality costs; Life cycle and use-oriented quality costs - structuring the costs, and cost input and measurement bases; Other measures for decision making in quality control; Quality costs and economic growth - a summary.

MANAGEMENT STRATEGIES FOR QUALITY

UNIT III

Organizing for quality

Requirements for quality organization; Defining the organizationwide impact of total quality control; The task of quality organization; Formal organization for quality in the past; The status of quality responsibilities in these organizations; Issues from this distribution of responsibilities; Process of "control"; Organizing principles; The first principle - key organization wide quality responsibilities and authorities; The second principle - key quality-control responsibilities and authorities; Structuring total quality organization - general management responsibility; The three quality-control sub functions; Organizing the quality-control function in a company; Basic questions for organization structuring; Centralization and decentralization of issues of quality control function; Structuring of quality control component; Quality assurance and quality control; Location of the function; Organizing for reliability and other product-quality parameters; Problems in organizing for quality control; Broad behavioral science view of quality-control organization; Size of the quality-control component; The special quality requirements imposed by internationalism; Organizing for international quality control.

Achieving total commitment to quality

The scope of quality commitment; The role of quality education; Quality education as a process; Analysis of the existing quality-education process; Use of answers to the questions; Quality-mindedness; Participative approaches to quality commitment-quality circles; Quality of working life (QWL), and other key approaches; Formalized training in quality control; The range covered by quality-control training programs; Alternative resources for quality-control training programs; Responsibility for quality-control training; Motivation for the development of total quality control and total quality systems; Sequence for obtaining a commitment to a total-quality-control program; Steps in achieving a widespread quality-control commitment; The attitude for quality proponents themselves; Introducing quality control in the multiplant company; Communicating quality commitment to

vendors; Communicating quality commitment to customers; Communicating quality control precisely; Commitment to quality - growth of the quality-control profession; Commitment to quality - worldwide growth of the quality field.

ENGINEERING TECHNOLOGY OF QUALITY

UNIT IV

Quality-engineering technology

The technological triangle; Quality-Engineering technology; The techniques of quality engineering, Quality objectives and quality policy; Approaches to analysis; Quality-Engineering analytical techniques; Delineation of quality requirements; Designed experiments; Analysis of product reliability and life cycle; Analysis of environmental and end-use effects; Analysis of safety; Review of designs; Evaluation of effects of new methods, new processes, and new materials; Adjustment of product and process for compatibility; Vendor-facilities evaluation; Quality-cost optimization; Approaches to planning; Quality-engineering-planning techniques; Classification of characteristics; Acceptance sampling; Determination of quality measurements to be made; Determination of quality-measuring equipment requirements; Documentation of quality planning; Making quality requirements understood by vendors; Servicing of vendors; Material-certification plans; Quality information feedback; Liability loss control; Data processing and the use of computers; Software control; Communication with other functions; Feedback of information from the field; Corrective action; Audit planning-product, procedure, and system; Quality control in the field; Customer attitude; Promotion of quality to the customer; Configuration control, design changes, and traceability;

Process-control-engineering technology

Process-control-engineering technology; Process-control-engineering analytical techniques; Machine- and process-capability analysis; Quality-measuring equipment capability and repeatability analysis, Analysis of pilot-run results; Incoming-material testing, inspection, and laboratory analysis; Quality-assurance inspection; Production testing; Process-variation analysis; Test-data analysis; Field complaint analysis; Process-control-engineering techniques used for in-process control; Vendor rating and vendor performance rating; "Structure table" control; Control charts; Work sampling; Process engineering techniques for implementing the quality plan; Use of manuals and standing instructions; Interpretation of drawings, specifications, and quality planning; Temporary quality planning; First-piece inspection; Disposition of discrepant or nonconforming material, Process engineering techniques-quality audit; Product audits; Procedures audits, Quality-system audits; Other areas of quality audit; Use of the technology by the process-control-engineering component; Key checkpoints for process control.

Quality information equipment engineering technology

The job of modern equipment; Quality information equipment engineering; The relationship among quality information equipment engineering, quality engineering, and process-control engineering; The relationship among quality information equipment engineering, quality engineering, and process-control engineering; Some forms of quality information equipment; Advanced development areas; Quality information equipment functional concept; Degree of mechanization for the control of processes; Computer-aided quality; The points of process for application of quality information equipment; Preprocess measurement and control; In-process measurement and control; Postprocess control techniques; Post process control-major quality information equipment requirements; Combined process measurement and control techniques; Integrated process control; Information recording, analysis, and feedback; Evaluating and analyzing the measurement operation; Specifying the equipment; Getting the equipment built; Getting the equipment into operation; Summary of quality information equipment-basic factors in productivity, mechanization, and electronicization; Overview of statistical quality control.

APPLYING TOTAL QUALITY CONTROL IN THE COMPANY

UNIT V

New-design control

The importance of the control of new designs; The needs for new-design control-influence during product planning; The scope of new-design control; Defining new-design control; Application of new-design control; Organizing for new-design control; Pattern for the new-design control routine-the fundamental activities; Typical new-design control routines; Operation of new-design control routine-preliminary design, testing and reliability, intermediate design, and final design and product qualification; Quality-control function's technical participation in new-design control; Techniques used in new-design control; Tolerance analysis; Planned inspection, Overview of statistical analysis of tools specially purchased for the new product; Failure mode, effect, and criticality analysis; Safety studies; Some practical aspects of new-design control; Pilot run to determine spring specification; An example of quality/design teamwork; Testing new products; Reliability testing; Overall new-design control program on a new electromechanical switch.

Incoming-material control

The needs for incoming-material control; Defining incoming-material control; principles of vendor-purchaser relations in quality; Organizing for incoming-material control; Pattern for the incoming-material control routine and examples - purchase analysis, vendor selection and order placement, material receipt and material examination, material disposal, record keeping and follow-through, and vendor relations and vendor surveillance, Techniques used in incoming-material control; Vendor relations; Vendor records and information processing; Vendor ratings; Incoming inspection gage control; Study of rejects on incoming plastic

cases; Integrated vendor-purchaser control of paint treatments; Control of purchased springs; Control of printed circuit requirements; Instituting improved control over incoming material in a going business; vendor rating through data processing.

Product control

The needs for product control; Defining product control; Organizing for product control; The role of process-control engineering in product control; The pattern; Standards; Manufacturing control; High quantities versus job lots; Job-lot machine shop; Process sampling in a machine shop; Characteristics approach to numerical control; High-quantity subassembly; Assembly; Techniques used in product control; Background; Concepts of capability studies; Calculation of the process capability; Use of process-capability studies, Product-control audits of procedures, systems, and measurements; Audit of quality of research and development work; Product traceability; Software product control; Quality information processing and flow.

Special process studies

Defining special process studies; The elements of special process studies; Organizing for special process studies; Thermometal; Casting of sintered blocks.

Total quality imperative

The total quality imperative; Benchmarks of total quality control; Management principles of total quality.

TEXT BOOK

Total Quality Control *by* Armand V. Feigenbaum; *Publisher: Mc Graw Hill.*

REFERENCE

1. Guide to Quality Control *by* Kaoru Ishikawa; Publisher Asian Productivity Organization.
2. Juran's Quality Control Handbook *by* J.M.Juran and F.M.Gryna; *Publisher: McGraw Hill.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective IV	**3**	**0**	**3**

(R11MED1139) UNCONVENTIONAL MACHINING PROCESSES

Course Prerequisites: Manufacturing Technology & Engineering Materials

Course Objectives:

To make the students to:

- Know the classification of various Non-Traditional machining processes and know the importance of Thermal energy based machining processes.
- Understand the working principles of chemical energy based material removal processes.
- Remember the Working principles of thermal energy and electrical energy based material removal processes
- Remember the working principles of mechanical energy based material removal processes.

Course Outcomes:

Students will be able to:

- Understand the classification of Advanced Machining methods and decide the process parameters to be adopted and applicability of various materials that are suitable for thermal energy based machining processes.
- Analyze the concepts and decide the process parameters to be adopted and applicability of various materials that are suitable for chemical energy based machining processes.
- Decide the process parameters to be adopted and applicability of various materials that are suitable for electrical and thermal based machining processes and their applicability for the real world situation.
- Decide the process parameters to be adopted and applicability of various materials that are suitable for mechanical energy based machining processes and their applicability for the real world situation

UNIT I

Early progress in machining;

Electron beam machining (EBM)

Introduction; Basic equipment; Emission current; Theoretical considerations; Rates of material removal in EBM; Surface roughness of work piece in EBM; Heat-affected zone; Applications of EBM.

Ion beam machining

Introduction; Ion beam machining system; Collision mechanism; Rates of material removal in IBM; Accuracy and surface effects; Applications.

UNIT II

Electrochemical machining

Introduction; Electrolysis; Characteristics of ECM; Basic working principles; Industrial electrochemical machine; Rates of machining; Surface finish in ECM; Accuracy and dimensional control; Overview of theory of shaping in ECM; Applications; Special ECM applications.

UNIT III

Laser machining

Introduction; Spontaneous emission of radiation; Stimulated emission; Laser oscillation; Types of laser; Laser beam characteristics; Effects of laser on materials; Effects of work piece material; Overview of Rates of machining and heat-affected zones; Applications.

Electro discharge machining

Introduction; Lazarenko relaxation (RC) circuit; Development of controlled pulse generators; Mechanism of materiel removal; Dielectric fluids; Tool materials; Overview of metal removal rates, surface effects, and accuracy; Applications.

UNIT IV

Overview of Plasma arc machining

Ultrasonic machining (USM)

Introduction; Principles of USM; Mechanism of material removal; Brittleness criterion; Effects of process conditions on rate of USM; Theory of material removal rates in USM; Surface finish; Accuracy; Applications; Ultrasonic twist drilling; Industrial ultrasonic machine.

UNIT V

Water-jet machining

Introduction; Basic equipment; Theoretical considerations; Advantages of WJM, Applications.

TEXT BOOK

Advanced Methods of Machining *by* J.A. McGeough; *Publisher: Chapman and Hall.*

REFERENCE

1. Manufacturing Engineering and Technology *by* Serope Kalpakjian and Steven R. Schmid; *Publisher: Pearson.*
2. New Technology *by* A. Battacharya; *Publisher: The Institution of Engineers, India, 1984.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective IV	**3**	**0**	**3**

(R11MED1140) PLANT LAYOUT AND MATERIAL HANDLING

Course Prerequisite: Manufacturing, Operations Research

Course Objectives:

- Understand plant layout system, its types and software tools used.
- Identify and learn elements of various material handling systems.
- Understand the benefit of an efficient material handling system and storage system
- To select the various load lifting attachments

Course Outcomes:

Students will be able to:

- Evaluate an appropriate plant layout for a plant.
- Create Flexible Plant layout to accommodate changes in product volume or product type.
- Analyze an appropriate material handling system
- Evaluate the systems and equipments used for material storage

UNIT I

Plant layouts

Fundamentals of plant layouts; Software tools used for making plant layouts; Case studies Overview of process Layout and product layout;

Elements of material handling system

Importance; Terminology; Objectives and benefits of better material handling; Principles and features of Material Handling System; Interrelationships between material handling and plant layout; Physical facilities and other organizational functions; Classification of material handling equipments.

UNIT II

Selection of material handling equipments

Factors affecting for selection; Material handling equation; Choices of material handling equipment; General analysis procedures; Basic analytical techniques; The unit load concept; Selection of suitable types of systems for applications; Activity cost data and economic analysis for design of components of material handling systems; Functions and parameters affecting service; Packing and storage of materials.

UNIT III

Hoists

Drives for hoisting; Components and hoisting mechanisms; Rail traveling components and mechanisms; Hoisting gear operation during transient motion; Selecting the motor rating and determining breaking torque for hoisting mechanisms.

Cranes

Hand-propelled and electrically driven E.O.T. overhead traveling cranes; Traveling mechanisms of cantilever and monorail cranes; Design considerations for structures of rotary cranes with fixed radius; Fixed post and overhead traveling cranes; Stability of stationary rotary and traveling rotary cranes.

UNIT IV

Load lifting attachments

Load chains and types of ropes used in material handling system; Forged, Standard and ramshorn hooks; Crane grabs and clamps; Grab buckets; Electromagnet; Design consideration for conveyor belts; Application of attachments.

UNIT V

Study of systems and equipments used for material storage

Objectives of storage; Bulk material handling; Gravity flow of solids through slides and chutes; Storage in bins and hoppers; Belt conveyors; Bucket-elevators; Screw conveyors; Vibratory conveyors; Cabin conveyors; Mobile racks etc.

TEXT BOOK

1. Material Handling Equipment *by* N. Rudenko; *Publisher: Peace publishers.*
2. Facility layout, location and analytical approach by R.L. Francis, L.F. McLinnis Jr., White; *Publisher: PHI*

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective IV	**3**	**0**	**3**

(R11MED1141) COMPUTATIONAL FLUID DYNAMICS

Course Prerequisite: C Programming, Numerical Methods, Fluid Mechanics.

Course Objectives:

- Understand different methods involved in solving problem numerically.
- Formulate different kinds of physical problems with the different schemes and boundary conditions.
- Develop a code in a programming language to numerically solve a practical problem.
- Impart the knowledge on stability analysis

Course Outcomes:

Students will be able to:

- Solve fluid flow and heat transfer problems using numerical methods & Programming.
- Critically analyze different mathematical models and computational methods for flow simulations
- Write algorithms to solve the complex non linear equations numerically and able to do a project demonstrating your understanding
- Conduct the stability analysis and check the applicability of different schemes.

BASIC THOUGHTS AND EQUATIONS

UNIT I

Philosophy of Computational Fluid Dynamics

Need for computational fluid dynamics; Computational fluid dynamics as a research tool; Computational fluid dynamics as a design tool; The impact of computational fluid dynamics – examples - automobile and engine applications, industrial manufacturing applications, civil engineering applications, environmental engineering applications, naval architecture applications (submarine example); computational fluid dynamics technique.

The Governing Equations of Fluid Dynamics - Derivation, Physical Meaning, and Forms Particularly Suitable to CFD

Introduction; Models of the flow - Finite control volume, and infinitesimal fluid element; The substantial derivative (time rate of change following a moving fluid element); The divergence of the velocity - its physical meaning;

The continuity equation - model of the finite control volume fixed in space, model of the finite control volume moving with the fluid, model of an infinitesimally small element fixed in space, model of an infinitesimally small fluid element moving with the flow, integral versus differential form of the equations, and similarities and differences in equations;

The momentum equation; The energy equation;

Summary of the governing equations for fluid dynamics - equations for viscous flow (the navier-stokes equations), equations for inviscid flow (the Euler equations);
Physical boundary conditions; Forms of the governing equations particularly suited for CFD.

UNIT II

Mathematical behavior of partial differential equations - the impact on CFD

Introduction; Classification of quasi-linear partial differential equations; A general method of determining the classification of partial differential equations - the eigenvalue method; General behavior of the different classes of partial differential equations - impact on physical and computational fluid dynamics - hyperbolic equations, parabolic equations, elliptic equations, and applications.

BASICS OF THE NUMERICS

UNIT III

Basic aspects of discretization

Introduction; Introduction to finite differences; Difference equations; Explicit and Implicit approaches - definitions and contrasts; Errors and an analysis of stability.

Grids with appropriate transformations

Introduction; General transformation of the equations; Metrics and Jacobians; Convenient form of the governing equations particularly suited for CFD; Stretched (compressed) grids; Boundary-fitted coordinate systems; Elliptic grid generation.

UNIT IV

Introduction to CFD Techniques

Introduction; The Lax-Wendroff technique; MacCormack's technique;
Viscous flows, conservation form, and space marching; The relaxation technique and is use with low-speed inviscid flow; Aspects of numerical dissipation and dispersion - artificial viscosity; The alternating-direction-implicit (ADI) technique.

UNIT V

(Contd) Introduction to CFD Techniques

The pressure correction technique - application to incompressible viscous flow - the incompressible navier-stokes equations, Central differencing of the incompressible Navier-stokes equations - the need for a staggered grid; The philosophy of the pressure correction method; The pressure correction formula; The numerical procedure - the SIMPLE algorithm; Boundary conditions for the pressure correction method.

APPLICATIONS

Numerical solutions of quasi-one-dimensional nozzle flows – simple problems

Overview of Numerical solution of a two-dimensional supersonic flow- Prandtl-Meyer expansion wave

TEXT BOOK

Computational Fluid Dynamics: the basics with applications *by* John D. Anderson, Jr.; *Publisher: McGraw Hill*

REFERENCE

1. Computational Fluid Dynamics: An Introduction by J.F.Wendt and J.D.Anderson; Publisher: Springer
2. Computational Fluid Dynamics by J.Blazek; Publisher: Elsevier.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective IV	**3**	**0**	**3**

(R11EIE1123) FUNDAMENTALS OF BIOMEDICAL INSTRUMENTATION

Course Prerequisites: Instrumentation Engineering

Course Objectives:

- Impart the knowledge on various biomedical devices and sensors
- Understand about the design of amplifying the bioelectrical signals
- Understand about the knowledge of sensors
- Understand about the solving of biomedical engineering problems

Course Outcomes:

Students will be able to:

- Describe and explain the principles of various biomedical devices and sensors
- Describe and design the instrumentation for amplifying the bioelectrical signals
- Demonstrate an ability to use appropriately and safely the techniques, sensors, and selected modern engineering tools necessary for bioengineering practice.
- Identify, formulate and solve biomedical engineering problems

UNIT I

Introduction to biomedical instrumentation

The age of biomedical engineering; Development of biomedical instrumentation; Biometrics; Introduction to the man-instrument system; Components of the man-instrument system; Physiological systems of the body; Problems encountered in measuring a living system.

Basic transducer principles

The transducer and transduction principles; Active transducers; Passive transducers; Transducers for biomedical applications.

UNIT II

Sources of bioelectric potentials

Resting and action potentials; Propagation of action potentials; The bioelectric potentials.

Electrodes

Electrode theory; Biopotential electrodes; Biochemical transducers.

UNIT III

The cardiovascular system

The heart and cardiovascular system; The heart; Blood pressure; Characteristics of blood flow; Heart sounds.

UNIT IV

Cardiovascular measurements

Electrocardiography; Measurement of blood pressure; Measurement of blood flow and cardiac output; Plethysmography; Measurement of heart sounds.

UNIT V

Patient care and monitoring

The elements of intensive-care monitoring; Diagnosis, calibration, and reparability of patient-monitoring equipment; Other instrumentation for monitoring patients; The organization of the hospital for patient-care monitoring.

TEXT BOOK

BioMedical Instrumentation and Measurements *by* Leslie Cromwell; *Publisher: Prentice Hall.*

REFERENCE

1. Handbook of Biomedical Instrumentation by Khandpur; *Publiser: TMH*
2. INSTRUMENTATION *by* B.E. Noltingk (Part Numbers 1, to 5); *Publisher: Butterworth-Heinemann.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective IV	**3**	**0**	**3**

(R11MED1142) INDUSTRIAL MANAGEMENT

Course Prerequisite: Manufacturing, General Management, Business Economics, Mathematics & Statistics

Course Objectives:

- Impart about the knowledge of management
- Understand about the knowledge of manufacturability and sustainability growth
- Impart the knowledge on principles of IEM
- Understand about the issues involved in professional practice

Course Outcomes:

Students will be able to:

- Apply knowledge of Management, mathematics, science, and engineering.
- Evaluates the system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.
- Analyzes and applies the IEM, Communicate effectively, Function on multidisciplinary teams.
- Solves the contemporary & emerging issues important to professional practice

UNIT I

Introduction to industrial management.

Importance of TQM in industrial management.

Introduction to TQM

Definition; Basic approach; Gurus of TQM;TQM framework; Awareness; Defining quality; Historical review; Obstacles; Benefits of TQM.

Leadership

Definitions; Characteristics of quality leaders; Leadership concepts; The seven habits of highly effective people; Ethics; The Deming philosophy; Role of TQM leaders; Implementation; Quality council; Core values, concepts and framework; Quality statements; Strategic planning; Communications; Decision making.

Customer satisfaction

Introduction; About the customer; Customer perception of quality; Feedback; Using customer complaints; Service quality; Translating needs into requirements; Customer retention; Case study.

UNIT II

Employee involvement

Introduction; Motivation; Employee surveys; Empowerment; Teams; Suggestion systems; Recognition and reward; Gainsharing; Performance appraisal; Unions and employee involvement; Benefits of employee involvement; Case study.

Continuous process improvement

Introduction; Process; The Juran triology; Improvement strategies; Types of problems; The PDSA cycle; Problem-solving method; Kaizen; Reengineering; Six-Sigma; Case study.

Supplier partnership

Introduction; Principles of customer/supplier relations; Partnering; Sourcing; Supplier selection; Supplier certification; Supplier rating; Relationship development; Case study.

UNIT III

Performance measures

Introduction; Basic concepts; Strategy; Performance measure presentation; Quality costs; Case study.

Benchmarking

Introduction; Definition of benchmarking; Reasons for benchmark; Process; Deciding on benchmarking; Understanding current performance; Planning; Studying others; Learning from the data; Using the findings; Pitfalls and criticisms of benchmarking; Case study.

Information technology

Introduction; History; Computers and the quality function; The internet and other electronic communication; Information quality Issues; Technologies of the future**.**

Quality management systems

Introduction; Benefits of ISO registration; ISO 9000 series of standards; Sector-specific standards; ISO 9001 requirements; Implementation; Documentation; Writing the documents; Internal audits; Registration.

UNIT IV

Environmental management systems (EMS)

Introduction; ISO 14000 series standards; Concepts of ISO 14001; Requirements of ISO 14001; Benefits of EMS; Integrating ISO 14000 with ISO 9000; Relationship to health and safety; Additional comments; Case study.

Quality function deployment

Introduction; The QFD team; Benefits of QFD; The voice of the customer; Organization of information; House of quality; Building a house of quality; QFD process; Case study.

Quality by design

Introduction; Rationale for implementation; Benefits; Teams; Communication models; Implementation; Tools; Misconceptions and pitfalls; Case study.

UNIT V

Failure mode and effect analysis (FMEA)

Introduction; Reliability; Reliability requirements; Failure rate; Intent of FMEA; FMEA team; FMEA documentation; Stages of FMEA; The design FMEA document; The process FMEA document; Other types of FMEA; FMEA document preparation.

Products liability

Introduction; History; Product safety law; Products liability law; Defences; Proof and the expert witness; Financial laws; The future of products liability; Prevention; Case study.

Total productive maintenance

Introduction; The plan; Learning the new philosophy; Promoting the philosophy; Training; Improvement needs; Goal; Developing plans; Autonomous work groups; Case study.

Management tools

Introduction; Purpose; Forced field analysis; Nominal group technique; Affinity diagram; Interrelationship diagraph; Tree diagram; Matrix diagram; Prioritization of Matrices; Process decision program chart; Activity network diagram; Case study.

TEXT BOOK

Total Quality Management *by* Dale H. Besterfield, Carol Besterfield – Michna; Glen H. Besterfield, and Mary Besterfield – Sacre; *Publisher: Pearson Education.*

REFERENCE

1. Total Quality Management: An Introductory Text *by* P.T.J.James; *Publisher: Prentice Hall*
2. Total Quality Management: Text, Cases, and Readings *by* J.E.Ross and S.Perry

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
Elective IV	**3**	**0**	**3**

(R11MED1143) THEORY OF METAL CUTTING

Course Prerequisites: Production Technology, Machine Tools

Course Objectives:

- Understand the cutting tools geometry and their areas of application based on principle of cutting.
- Understand cutting forces and their measurement.
- Understand tool wear, replacement strategy and optimization of cutting tool usage.
- To understand the economics of metal cutting

Course Outcomes:

Students will be able to

- Analyze a cutting tool, its geometry and arrive at the cutting process.
- Create a cutting tool material and appropriate material to be cut.
- Apply the methods of measuring the cutting forces, temperature and their significance
- Apply a cutting tool with optimal tool life to maximize material removal rate.

UNIT I

Introduction

Metal cutting; The wedge - the basic shape of any cutting tool; Elements of cutting process; System of tool nomenclature - tool-in-hand nomenclature, tool reference system, machine reference system, and assumed feed system;

Geometry of tool shapes - location of cutting edges, orientation of face and flank surfaces, interrelation between different systems of tool nomenclature, sign conventions, normal rake angle (γ_n), clearance angles, a graphical procedure for transference from one system of nomenclature to another, grinding of a single point cutting tool, and comparative merits and demerits of tool nomenclature systems;

Overview of geometry of drills.

UNIT II

Mechanism of chip formation

Deformation of uncut layer in shear; Mechanism of deformation – fracture, mechanism of yielding; On the process of chip formation - class of chips, discontinuous chips, continuous chips without built-up edge, partially continuous chips, element chips, continuous chips with built-up edge, occurrence of various types of chips, and nature of deformation; The shear

plane - shear surface for non-uniform chips, angle of deviation of chip flow, normal chip reduction coefficient under conditions of oblique cutting, true shear angle, and effective rake angle; Chip formation process in drilling; Chip formation in milling process; Overview of determination of cutting strain.

UNIT III

Mechanism of metal cutting

Forces of deformation at the cutting edge; Photo-elastic analysis for observing direction and magnitude of R during chip formation process; The force system during turning - frictional force system at the chip tool interface, and force system at the shear plane; Velocity relationships; Stress in conventional shear plane; Energy of cutting process; The obliquity effect in restricted cutting; Effect of nose radius; Force analysis during oblique cutting($\lambda \neq 0$); Effect of wear land on force system; Overview of the forces in drilling process; Overview of the force system in milling process; Forces in face milling process.

UNIT IV

Fundamental factors which affect tool forces

On the dynamic shear stress; Correlation τ_s with standard mechanical tests - determination of τ_s from hardness tests, and dynamic shear stress of brittle materials; Stagnant phenomenon at contact surface; Rate of shear strain ε - determination bulk stain rate, rate of deformation at the different layers of stagnant zone, and distribution of strain rate in the deformation zone; Effect of rate of strain in modifying stress - macroscopic analysis, and atomistic analysis on strain rate and shear stress by applying 'dislocation theory'; Kinetic coefficient of friction and stresses at the chip tool interface - fundamentals of friction process, on the nature of contact at the chip tool interface, the stresses at the 'cutting edge', distribution of normal stresses at the cutting edge, and distribution of frictional shear stress at the chip tool interface; Formation of built-up edge and contact phenomenon; Overview of effect of cutting variables on cutting forces: experimental observations and empirical laws.

UNIT V

Experimental and theoretical determination of cutting forces

Measurement of cutting forces; Certain basic requirements of measuring techniques; Electrical transducers for force measurement; Survey of various types of cutting force dynamometers - design requirements, turning dynamometers, drill dynamometers, and milling and grinding dynamometers; Overview of Theoretical determination of cutting forces; Development of an equation for the theoretical determination of torque in drilling ductile materials; Overview of estimation of drill thrust.

TEXT BOOK

Principles of Metal Cutting *by* G.C. Sen and A. Bhattacharya; *Publisher: New Central Book Agency.*

REFERENCE

1. Theory of Metal Cutting *by* Paul Howard Black; *Publisher: McGraw Hill.*
2. Metal Cutting: Theory and Practice by A. Bhattacharya; *Publisher: Jamini Kanta Sen of Central Book Publishers.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11MED1209) CAD/ CAM LAB

Course Prerequisites: CAD, CAM and SOM.

- Understand the ways in which 2D sketches and 3D models –solid and surface are made using appropriate CAD packages.
- Know the procedure of building assembly drawings and obtain drafted views from it.
- Learn the part programming techniques in turning, milling and drilling operations.
- Understand the determination of stresses and strains in systems like trusses and beams.

Course Outcomes:

Students will be able to:

- Summarize the skills learnt in sketching and modeling using CAD packages
- Design product assemblies and obtain drafted views from it.
- Analyze the stress and strain in various structures.
- Produce components with different features using CNC machines and machining centers.

12 experiments from the following syllabus:

1. Part Modeling**:** Generation of 3D models of various parts using feature based and parametric software;
   Creation of various features; Study of parent child relation;
   Surface and assembly modeling; Study of various standard translators.
2. Finite element analysis
   a) Determination of deflection and stresses in 2D and 3D trusses and beams.
   b) Determination Principal/ Von-Mises stresses and deflections, in plane stress/ plane strain/ axisymmetric models.
   c) Determination of stresses in 3D and shell structures.
   d) Estimation of natural frequencies and mode shapes, and harmonic response of 2D beam.
3. Computer aided manufacturing
   a) Development of process sheets for various components.
   b) Development of manufacturing and tool management systems.
   c) Study of various post processors used in NC Machines.
   d) Development of NC code for turning and milling jobs using CAM packages.

e) Machining of simple components on NC lathe and Mill by transferring NC Code/ from a CAM package through RS 232.
f) Quality Control and inspection.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME I Sem	**L**	**T/P/D**	**C**
	0	**3**	**2**

(R11EIE1210) AUTOMATION SYSTEMS DESIGN LABORATORY

Course Prerequisites: Computer Interfaces (Serial & Parallel), Basic Digital Electronics, Labview Software

Course Objectives:

- Impart the knowledge on basic labview programming
- Understand about digital electronics
- Understand about the knowledge on PLC
- Understand about sensors and measurements

Course Outcomes:

Students will be able to:

- Understand about the knowledge on different types of sensors / transducers used in industries
- Apply the knowledge on ladder logic programming
- Apply the knowledge on labVIEW programming

Twelve experiments from the following:

1. Simple programs for acquisition of sensory data into a PC, using LabVIEW software:
   (a) Analog signal
   (b) Digital signal
2. Serial and parallel ports - hardware interfaces for PC based acquisition of sensory data:
   (a) RS232 interface
   (b) GPIB interface
3. Conversion of sensory data from analog to digital form and vice versa
   (a) D/A converter
   (b) A/D converter
4. Placement and installation of sensors in automation systems: examples of sensors – load cell, accelerometer, thermocouple etc.
5. Programming for control of valves and DC motor:
   (a) On/ Off control valve
   (b) Linear control valve
   (c) Equal percentage control valve
   (d) DC motor
6. Control circuits for an automation system.
7. Electrical design specifications (including wiring) for an automation system.
8. Programming for control of automation systems using LabVIEW software.
9. PLC programming for control of automation systems.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
	3	**0**	**3**

(R11MED1144) COMPUTER INTEGRATED MANUFACTURING

Course Prerequisites: Automation in Manufacturing

Course Objectives:

- To understand the latest techniques in manufacturing and learning their procedures
- To assess the importance of classification and coding systems used in manufacturing as a part of group technology
- To understand , analyze and measure all the quality control methodologies in manufacturing
- To know the latest dynamic environments in manufacturing such as JIT, lean, agile etc.

Course Outcomes:

Students will be able to:

- Evaluate the NC, CNC, DNC and Robotic Procedures and related technologies.
- Evaluate the philosophies of Group technology and thereby learning FMS Scenario in the context of GT.
- Apply the various traditional and modern quality control methodologies for solving problems statistically using computer.
- Evaluate the concepts of Product and Process design in the dynamic manufacturing environments of Lean and JIT Environments.

AUTOMATION AND CONTROL TECHNOLOGIES

UNIT I

Numerical control

Fundamentals of NC technology; Computer numerical control; Distributed numerical control; Applications of NC; Engineering analysis of NC positioning systems; NC part programming; Coding for manual part programming; Part programming with APT.

Industrial robotics

Robot anatomy and related attributes; Robot control systems; End effectors; Sensors in robotics; Industrial robot applications; Robot programming; Robot accuracy and repeatability.

UNIT II

Discrete control using programmable logic controllers and personal computers

Discrete process control; Ladder logic diagrams; Programmable logic controllers; Personal computers using soft logic.

MANUFACTURING SYSTEMS

Cellular manufacturing

Part families; Parts classification and coding; Production flow analysis; Cellular manufacturing; Applications of group technology; Quantitative analysis in cellular manufacturing.

Flexible manufacturing systems

Flexible manufacturing systems; FMS components; FMS applications and benefits; FMS planning and implementation issues; Quantitative analysis of Flexible manufacturing systems.

QUALITY CONTROL IN MANUFACTURING SYSTEMS

UNIT III

Quality programs for manufacturing

Quality in design and manufacturing; Traditional and modern quality control; Process variability and process capability; Statistical Process Control; Six sigma; The Six sigma DMAIC procedure; Taguchi Methods in quality Engineering; ISO 9000.

Inspection principles and practices

Inspection fundamentals; Sampling vs. 100% inspection; Automated inspection; When and where to inspect; Quality analysis of inspection.

Inspection technologies

Inspection metrology; Contact vs. noncontact inspection techniques; Conventional measuring and gaging techniques; Coordinate measuring machines; Surface measurement; Machine vision; Other optical inspection techniques; Noncontact non optical inspection technologies.

MANUFACTURING SUPPORT SYSTEMS

UNIT IV

Product design and CAD/CAM in the production systems

Product design and CAD; CAD system hardware; CAM, CAD/CAM, and CIM; Quality function deployment.

Process planning and concurrent engineering

Process planning; Computer-aided process planning; Concurrent engineering and design and manufacturing; Advanced manufacturing planning.

UNIT V

Production planning and control systems

Aggregate production planning and the master production schedule; Material requirement planning; Capacity planning; Shop floor control; Inventory control; Extensions of MRP.

Just-in-time and lean production

Lean production and waste in manufacturing; Just-in Time production systems; Autonomation; Worker involvement.

TEXT BOOK

Automation, Production Systems and Computer-Integrated Manufacturing *by* Mikell P. Groover; *Publisher: Pearson Education/Prentice Hall*.

REFERENCE

1. Principles of Computer Aided Design and Manufacturing *by* Farid Amirouche; *Publisher: Pearson Education.*
2. CAD/CAM/CIM *by* Radhakrishnan and Subramanyam; *Publisher: New Age Publishers.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective V	**3**	**0**	**3**

(R11MED1145) NANOTECHNOLOGY

Course Prerequisites: Physics, Metallurgy, Composite Materials

Course Objectives:

- Understand about the importance of nanotechnology
- Understand about the knowledge on Nano Materials
- Understand about the nanotubes and Nano materials
- Understand about the applications of nano science in various sectors

Course Outcomes:

Students will be able to:

- Create solutions in engineering, biotechnology and manufacturing by identifying current nanotechnology.
- Apply the fundamental knowledge of science to characterize the Nano Materials.
- Synthesize carbon Nano tubes and Nano materials.
- Evaluate tools in Nano science for applications in various sectors.

UNIT I

Introduction to nanotechnology.

Introduction to physics of the solid state

Structure - size dependence of properties, crystal structures, face-centered cubic nanoparticles, tetrahedrally bonded semiconductor structures, and lattice vibrations; Energy bands - insulators, semiconductors, conductors, reciprocal space, energy bonds and gaps of semiconductors, effective masses, and Fermi surfaces; Localized particles - donors, acceptors, deep traps, mobility, and excitons.

UNIT II

Methods of measuring properties

Introduction; Structure - atomic structures, crystallography, particle size determination, and surface structure; Microscopy - transmission electron microscopy, field ion microscopy, scanning microscopy; Spectroscopy - Infrared and Raman spectroscopy, Photoemission and X-ray spectroscopy, and Magnetic resonance.

UNIT III

Properties of individual nanoparticles

Introduction; Metal nanoclusters - magic numbers, theoretical modeling of nanoparticles, geometric structure, electronic structure, reactivity, fluctuations, magnetic clusters, and bulk to nanotransition; Semi conducting nanoparticles - optical properties, photofragmentation, and Coulombic explosion**;** Rare gas and molecular clusters- inert gas cluster, superfluid clusters, and molecular clusters; Methods of synthesis - RF plasma, chemical methods, thermolysis, and pulsed laser methods.

UNIT IV

Carbon nanostructures

Introduction; Carbon molecules - nature of the carbon bond, and new carbon structures; Carbon clusters – small carbon clusters, discovery of C_{60}, structure of C_{60} and its crystal, alkali doped C_{60}, superconductivity in C_{60}, larger and smaller fullerenes, and other buckyballs; Carbon nano tubes - fabrication, structure, electrical properties, vibrational properties, and mechanical properties; Applications of carbon nanotubes - field emission/shielding, computers, fuel cells, chemical sensors, catalysis, and mechanical reinforcement.

UNIT V

Bulk nanostructured materials

Solid disordered nano structures - methods of synthesis, failure mechanisms of conventional grain-sized materials, mechanical properties, nanostructured multilayers, electrical properties, other properties, metal nanocluster composite glasses, and porous silicon; Nanostructured crystals - natural nanocrystals, computational prediction of cluster lattices, arrays of nanoparticles in zeolites, crystals of metal nanoparticles, nanoparticle lattices in colloidal suspensions, and photonic crystals

TEXT BOOK

Introduction to Nanotechnology *by* Charles P. Poole Jr. and Frank J. Ovens; *Publisher: John Wiley.*

REFERENCE

Springer Handbook of Nanotechnology *by* Bharat Bhusan.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective V	**3**	**0**	**3**

(R11MED1146) THEORY OF PLATES AND SHELLS

Course Prerequisites: Strength of Materials

Course Objectives:

- Understand about the knowledge of membrane, plates and shells
- Understand about the theories of membrane plates and shells
- Understand about static, dynamic, and non-linear motion of membrane, plate and shell structures
- Understand about numerical approximations

Course Outcomes:

Students will be able to:

- Apply the structural mechanics approximations of membrane, plates and shells.
- Derive simple modifications to the membrane plate and shell theories.
- Use analysis to determine the static, dynamic, and non-linear motion of membrane, plate and shell structures.
- Compute numerical approximations.

UNIT I

Bending of long rectangular plates to a cylindrical surface

Differential equation for cylindrical bending of plates; Cylindrical bending of uniformly loaded rectangular with simply supported edges; Cylindrical bending of a uniformly loaded rectangular plates with built-in edges; The effect on stresses and deflections of small displacements of longitudinal edges in the plane of the plate. An approximate method of calculating the parameter *u*; Long uniformly loaded rectangular plates having a small initial cylindrical curvature; Cylindrical bending of a plate on an elastic foundation.

UNIT II

Pure bending of plates

Slope and curvature of slightly bent plates; Relations between bending moments and curvature in pure bending of plates; Particular cases of pure bending; Strain energy in pure bending of plates; Limitations on the application of the derived formulas; Thermal stresses in plates with clamped edges.

Symmetrical bending of circular plates

Differential equation for symmetrical bending of laterally loaded circular plates; Uniformly loaded circular plates; Circular plate with a circular hole at the center; Circular plate concentrically loaded; Circular plate loaded at the center; Corrections to the elementary theory of symmetrical bending of circular plates.

UNIT III

Small deflections of laterally loaded plates

The differential equation of the deflection surface; Boundary conditions; Alternate method of derivation of the boundary conditions; Reduction of the problem of bending of a plate to that of deflection of a membrane; Effect of elastic constants on the magnitude of bending moments; Exact theory of plates.

UNIT IV

Simply supported rectangular plates

Simply supported rectangular plates under sinusoidal load; Navier solution for simply supported rectangular plates; Further applications of the Navier solution; Alternate solution for simply supported and uniformly loaded rectangular plates; Simply supported rectangular plates under hydrostatic pressure; Simply supported rectangular plate under a load in the form of a triangular prism; Partially loaded simply supported rectangular plate; Concentrated load on a simply supported rectangular plate.

UNIT V

(Contd) **Simply supported rectangular plates**

Bending moments in a simply supported rectangular plate with a concentrated load; Rectangular plates of infinite length with simply supported edges; Bending moments in simply supported rectangular plates under a load uniformly distributed over the area of a triangle; Thermal stresses in simply supported rectangular plates; The effect of transverse shear deformation on the bending of thin plates; Rectangular plates of variable thickness.

Overview of stresses in rotational elements like rings, disks, disk of uniform strength

TEXT BOOK

Theory of Plates and Shells *(International edition) by* S.P.Timoshenko and S. Woinowsky – Krieger; *Publisher: McGraw Hill.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective V	**3**	**0**	**3**

(R11MED1147) PRODUCTION PLANNING AND CONTROL

Course Prerequisites: Operations Research

Course Objectives:

- To understand the manufacturing planning systems in a shop floor
- To assess the importance of several stocks and the techniques of managing the inventory
- To analyze scheduling related problems in job shop, batch shop based on certain algorithms
- To know the future prospects in production planning and learning the concerned research associated with planning

Course Outcomes:

Students will be able to:

- Describe (identify/write) the various components that make up the manufacturing planning and control system and the interaction among them.
- Develop the models that are applicable for supply chain inventory management, including those for quantity discounts, safety stocks, and order quantity and reorder point interactions.
- Develop the algorithms that are appropriate for solving single-machine, two-machine, parallel- machines and flow shop scheduling problems
- Identify, discuss, and implement important research topics within production planning and control.

GENERAL

UNIT I

Functions of production planning and control (PPC)

Introduction; Materials; Methods; Machines and equipments; Routing; Estimating; Loading and scheduling; Dispatching; Expediting; Inspection; Evaluating;

Broad categories of functions of production planning and control - Preplanning, planning and control; Other industrial engineering functions that have interdependency with PPC - Plant layout, simplification and standardization, time and motion study, and Inventory control.

Manufacturing systems

Types of production - job production, batch production, and continuous production; Size of pants; Types of industry.

Production procedure

The production cycle; Coordination of production decisions - the product, the components and assemblies (or semi finished products), the means (7 M's; management: skill and potentialities; manpower; management: finance planning; matrix; materials; methods; machines); Departmental responsibilities.

Organization

Department sectionalization - Production planning, production control, and inventory control; Variations on the conventional pattern of organization – motion and time study, standards section, transportation section, and central statistics office; Centralized and decentralized production planning and control.

PREPLANNING

Product development and design

Company policy – Effect of competition on design, and long-range planning;

Product analysis – marketing aspect, and the product characteristics (functional aspect; operational aspect; durability and dependability; aesthetic aspect);

Economic analysis – profit and competitiveness, the three S's (simplification; specialization; standardization; preferred numbers), the break-even analysis, and the economics of a new design; Production aspect.

UNIT II

Sales forecasting and estimating

About forecasting;

Restrictions of consumption – the product and its limitations, the consumer and his potential buying power, analysis of competition (competing for a share of the market), saturation (selling to satisfy demand; replacement), distribution and promotion methods (advertising; effectiveness of distribution channels; terms of sale), and state of business (pricing policies; business cycles);

Making the forecast – the market share, sales trend analysis, forecasting in seasonal demand, a trend analysis in seasonal demand, the use of indicators and correlation analysis, and combination of methods;

Effects of forecast on the production order; Accuracy of forecasts; Case studies in sales forecasting.

Plant layout

Introduction; Flow systems – horizontal flow lines (I-flow, L-flow, U-flow, S-flow, O-flow, unidirectional or retractional flow, integration of flow lines into an assembly line), and vertical flow lines (processing downwards or upwards; centralized or decentralized elevation; unidirectional or retractional flow; vertical or inclined flow; single or multiflow; flow between buildings);

Types of layouts – classification (product layout; process layout; static product layout), machine layout, materials handling, effect of automation on layout, symptoms of a bad layout, factors to be considered in layout planning, and templates and models.

Evaluation of materials and methods

Introduction; Value analysis – consideration of new techniques and materials;

Efficient utilization and selection of materials – criteria for selection of materials, machine speeds, hot processes, machine speeds, hot processes, surface characteristics, new materials, dimensional specifications, material utilization of a shop or a process, analysis of processes, and case studies; Design for production – scope of modifications.

PLANNING

UNIT III

The production order

Schematic process outlines, process, and activity charts;

Production master programs – required data, long-term planning, programming component production; Operation and route sheets; Breakline of the production order; Stock planning; Basic production planning problems.

Quantities in batch production

Stock control; Definition of batch sizes; Minimum cost batch size – formulae, raymond's formula, lehoczky's formula, davis formula, use of formula, use of a monograph, a graphical method, a modified graphical method, equating the variable costs; The production range – determination of the production range, and effect on production costs; Maximum-profit batch size; Maximum return; Maximum rate of return; Comparison of the various criteria.

Batch-size determination under boundary conditions

Abrupt changes in the constant cost term, *c*; Breaks in the carrying cost factor, K; Breaks in the preparation costs; Combined breaks.

Machine capacity – typical problems**.**

UNIT IV

Scheduling

Forms of schedules – loading and scheduling, and basic scheduling problems;

Flow production scheduling for fluctuating demand – decision process, and production loading; Multiproduct scheduling in batch production;

The assignment problems – Distribution according to capacity, cost of operating production facilities, and effects of overtime or subcontracting;

Scheduling orders with random arrivals – problems of random-order scheduling, the simulation technique, other applications of the simulation technique; Product sequencing – sequence analysis, and minimum processing time.

Batch production scheduling

Introduction – sequence of batches; Optimizing the production schedule – maintaining stock level, specifying batch sizes, minimum costs per unit, maximium profit for the whole schedule, maximum returns to the whole schedule, and maximum rate of return for the whole schedule; Deriving a realistic solution – procedure; Multischeduling six products-a case study – preliminary data and first solution, determining the production range, testing the solution, methods of leading to modified solutions, increase the consumption period, relaxation of the production ranges, increase the capacity of the plant, modify the requirements, and relaxation of *p* for two-cycle production plans; Application of the theory to assembly work.

CONTROL

UNIT V

Elements of control procedures

Stages and activities of control – control of processes and production activities, quantity or inventory control, quality control, cost control; Dispatching and expediting; Recording progress – visual charts, and cumulative and weekly charts.

Computer-assisted production control

Introduction – computer requirements, and computer types and operation; Media for recording data – sales information, production control, payroll and assignment, and materials control; Installation of a computer-assisted production control system – sales analysis, product and materials analysis, schedule analysis, and designing a new procedure; Programming; Applications – stock control, and control of job production.

Inventory control

Significance; Effect of demand on inventories – restrictions on output increase, stock control systems, ordering procedures, the two-bin system, the ordering cycle system, and combinations of the two-bin and the ordering cycle systems; Reorder quantity – reorder range, effect of splitting an order; Reorder procedure – reorder point in the two-bin system, and reorder procedure in the cycle system; Effect of uncertainity – insufficient supply to customers, and insufficient supply to assembly line; Comparison of replenishment policies - the optimistic policy, the realistic policy, and the pessimistic policy.

TEXT BOOK

Elements of Production Planning and Control *by* Samuel Eilon; *Publisher: Universal Publishing Corporation (UPC)*.

REFERENCE

1. Fundamentals of Production Planning and Control *by* S.N.Chapman; *Publisher: Pearson Education*.

2. Operations Management *by* Chase; *Publisher: PHI*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective V	**3**	**0**	**3**

(R11MED1148) REFRIGERATION AND AIR CONDITIONING

Course Prerequisites: Thermodynamics, Heat & Mass Transfer

Course Objectives:

- Understand the fundamentals of Thermodynamics and its relative laws and effect on the system.
- Understand the concept of Heat and Mass Transfer on the system.
- Understand the various Thermodynamic cycles used in the Refrigeration and AC systems
- Understand about the performance of air conditioning system

Course Outcomes:

Students will be able to:

- Develop and analyze a system which totally based on the refrigeration concept.
- Apply the basic principles on the Thermodynamics to solve an engineering problem related to Refrigeration and Air conditioning.
- Select suitable Refrigeration cycle and apply the concept of Heat and Mass Transfer and obtain the result.
- Develop and Evaluate the performance of air conditioning system

UNIT I

Applications of refrigeration and air conditioning

Major uses; Air conditioning of medium-sized and large buildings; Industrial air conditioning; Residential air conditioning; Air conditioning of vehicles; Food storage and distribution; Food processing; Chemical and process industries; Special applications of refrigeration.

Thermal principles

Roots of refrigeration and air conditioning; Concepts, models, and laws; Thermodynamic properties; Thermodynamic processes; Conservation of mass; Steady-flow energy equation; Heating and cooling; Adiabatic process; Compression work; Isentropic compression; Bernoulli's equation; Heat transfer; Conduction; Radiation; Convection; Thermal resistance; Cylindrical cross section; Heat exchangers; Heat-transfer processes used by the human body; Metabolism; Convection; Radiation; Evaporation.

UNIT II

Psychrometry and wetted-surface heat transfer

Importance; Review of psychrometric chart, saturation line, relative humidity, and humidity ratio; Enthalpy; Specific volume; Combined heat and mass transfer; The straight-line law; Adiabatic saturation and thermodynamic wet-bulb temperature; Deviation between enthalpy and wet-bulb lines; Wet-bulb thermometer; Processes; Comment on the basis of 1 kg of dry air; Transfer of sensible and latent heat with a wetted surface; Enthalpy potential; Insights provided by enthalpy potential.

Heating- and cooling-load calculations

Introduction; Health and comfort criteria; Thermal comfort; Air quality; Estimating heat loss and heat gain; Design conditions; Thermal transmission; Infiltration and ventilation loads; Summary of procedure for estimating heating loads; Components of the cooling load; Internal loads; Solar loads through transparent surfaces; Solar loads on opaque surfaces; Summary of procedures for estimating cooling loads.

UNIT III

Air conditioning systems

Thermal distribution systems; Classic single-zone system; Outdoor-air control; Single-zone-system design calculations; Multiple-zone systems; Terminal-reheat system; Dual-duct or multi-zone system; Variable-air-volume systems; Water systems; Unitary systems.

UNIT IV

The vapor compression cycle

Most important refrigeration cycle; Carnot refrigeration cycle; Coefficient of performance; Refrigerant; Condition for highest coefficient of performance; Temperature limitations; Carnot heat pump; Using vapor as a refrigerant; Revisions of the Carnot cycle; Wet compression versus dry compression; Expansion process, Standard vapor-compression cycle; Properties of refrigerants; Performance of the standard vapor-compression cycle.

UNIT V

Vapor-compression system analysis

Balance points and system simulation; Reciprocating compressor; Condenser performance; Condensing-unit subsystem - graphic analysis, and mathematical analysis; Evaporator performance; Performance of complete system – graphic analysis; Simulation of complete system – mathematical analysis; Some performance trends; The expansion device; Sensitivity analysis; Introduction to Refrigerants.

Absorption refrigeration

Relation of the Absorption to the vapor-compression cycle; The absorption cycle; coefficient of performance of the ideal absorption cycle; Temperature-pressure-concentration properties of LiBr-water solutions; Calculation of mass flow rates in the absorption cycle; Enthalpy of Li-Br solution; Thermal analysis of simple absorption system; Absorption cycle with heat exchangers; Configurations of commercial absorption units; Crystallization; Capacity control; Double-effect system; Steam-driven combination with vapor compression; Aqua-ammonia system; Role of the absorption unit in refrigeration practice.

TEXT BOOK

Refrigeration and Air Conditioning *by* Wilbert F. Stoecker and Jerold W.Jones; *Publisher: McGraw Hill.*

REFERENCE

1. Principles of Refrigeration *by* Dossat; *Publisher: Pearson Education.*
2. Refrigeration and Air Conditioning Technology by W.C.Whitman, W.M.Jhonson, and J.Tomczyk.
3. Refrigeration and Air Conditioning by C.P. Aurora; *Publisher: TMH*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective V	**3**	**0**	**3**

(R11MED1149) OPERATIONS RESEARCH

Course Prerequisites: Mathematics, Industrial Engineering

Course Objectives:

- To impart the knowledge on solving problems Assignment, Transportation, Sequencing, Replacement, Inventory and Queuing problems
- Understand the knowledge on theory of games
- Impart the knowledge on linear programming
- Understand the knowledge involved in dynamic programming and simulation models

Course Outcomes:

Students will be able to:

- Analyze Assignment, Transportation, Sequencing, Replacement, Inventory and Queuing problems.
- Apply Theory of games in various applications.
- Evaluate the Problems using Linear Programming.
- Apply dynamic programming problem solving and simulation models.

UNIT I

Introduction

The origins of operations research; The nature of operations research; The impact of operations research; Algorithms and OR courseware.

Overview of the operations research modeling approach

Defining the problem and gathering data; Formulating a mathematical model; Deriving solutions from the model; Testing the model; Preparing to apply the model; Implementation; Conclusions.

UNIT II

Introduction to linear programming

Applications; The linear programming model; Assumptions of linear programming; Some classic case studies; Formulating and solving linear programming models on a spreadsheet; Formulating very large linear programming models.

UNIT III

Solving linear programming problems: the simplex method

The essence of the simplex method; Setting up the simplex method; The algebra of the simplex method; The simplex method in tabular form; Tie breaking in the simplex method; Adapting to other model forms; Postoptimality analysis; Computer implementation; The interior-point approach to solving linear programming problems; Case studies.

The theory of the simplex method

Foundations of the simplex method; the revised simplex method; A fundamental insight.

UNIT IV

Duality theory and sensitivity analysis

The essence of duality theory; Economic interpretation of duality; Primal-dual relationships; Adapting to other primal forms; The role of duality theory in sensitivity analysis; The essence of sensitivity analysis; Applying sensitivity analysis; Performing sensitivity analysis on a spreadsheet; Case studies.

The transportation and assignment problems

Transportation problem**;** a streamlined simplex method for the transportation problem**;** Assignment problem.

UNIT V

Network optimization models

Applications; The terminology of networks; The shortest- path problem; The minimum spanning tree problem; The maximum flow problem; The minimum cost flow problem; The network simplex method; a network model for optimizing a projects time-cost trade-off; Case Studies.

Dynamic programming

A prototype example for dynamic programming; Characteristics of dynamic programming problems; Deterministic dynamic programming; Probability dynamic programming.

TEXT BOOK

Introduction to Operations Research *by* Frederick Hillier and Gerald Libermann; *Publisher: McGraw Hill.*

REFERENCE

1. Operations Research *by* Wagner; *Publisher: PHI*.
2. Operations Research *by* J.K.Sharma, 3rd edition; *Publisher: MacMillan*
3. Operations Research: A Practical Introduction *by* M.W.Carter and C.C.Price; *Publisher: CRC Press.*

4. Operations Research: Methods and Problems *by* Maurice Saseini, Arthur Yaspan and Lawrence Friedman
5. The Operations Research Problem Solver *by* Research and Education Association; *Publisher: Research and Education Associates*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective V	**3**	**0**	**3**

(R11MED1150) TOOL DESIGN

Course Prerequisites: Design Principles, Machine Tools, Process Engineering

Course Objectives:

- Understand the properties of tool materials such as ferrous, non ferrous, non metallic materials and their heat treatment .
- To design single and multi point cutting tools for various applications
- Must gain the knowledge of designing Jigs and Fixtures.
- Understand design of sheet metal tools for blanking, piercing, bending, forming and drawing etc.

Course Outcomes:

Students should be able to:

- Evaluate single and multi point cutting tools for various methods.
- Analyze design for jigs and fixtures for several components depending on quantity requirement.
- Analyze the sheet metal tools for blanking, piercing, bending, forming and drawing.
- Apply an appropriate heat treatment for the tools.

UNIT I

Tool materials and heat treatment

Introduction; Properties of materials; Tool steels; Cast iron; Mild or low carbon steels; Non metallic tooling materials; Nonferrous tooling materials; Heat treating; Appearance of carbon in steel; Factors affecting heat treatment; Heat treatment and tool design.

UNIT II

Design of cutting tools

Introduction; A brief history of metal cutting; The metal cutting process - the basic requirements of a cutting tool, mechanism and geometry of chip formation, general considerations for metal cutting; Metal cutting tools - single point cutting tools, milling cutters, drills and drilling, types of drills, reamers, reamer classification, taps, tap classification; The selection of carbide cutting tools - carbide tools, determining shank size for single point carbide tools; Determining the insert thickness for carbide tools.

UNIT III

Gages and gage design

Introduction; Fixed gages; Gage tolerances; The selection of material for gages; Indicating gages; Automatic gages.

Locating and clamping methods

Introduction; the basic principles of location; locating methods and devices; The basic principles of clamping.

UNIT IV

Design of drill jigs

Introduction; Definition of a drill jig; Types of drill jigs; Chip formation in drilling; General considerations in the design of drill jigs; Drill bushing; Methods of construction; Drill jigs and modern manufacturing.

UNIT V

Design of fixtures

Introduction; Fixtures and economics; Types of fixtures - vice fixtures, milling fixtures, boring fixtures, broaching fixtures, lathe fixtures, grinding fixtures.

TEXT BOOK

Tool Design *by* Cyril Donaldson, George H. LeCain, and V.C. Goold; *Publisher: Tata McGraw Hill*.

REFERENCE

Fundamentals of Tool Design *by* David Spitler, Jeff Lantrip, J.G.Nee, D.A.Smith; *Publisher: Society of Manufacturing Engineers*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective VI	**3**	**0**	**3**

(R11MED1151) BIOMECHANICS AND BIOMATERIALS

Course Prerequisites: Mechanics of Solids, Metallurgy and Material Science

Course Objectives:

- Understand about the mechanical and anatomical terminology
- Impart the knowledge on tissues
- Impart the knowledge on forces involved in skeletal joint
- Understand about the motion of the human body

Course Outcomes:

Students should be able to:

- Describe motion with precise, well-defined mechanical and anatomical terminology.
- Identify relationships between structure and function in tissues and the implications/importance of these relationships.
- Analyze the forces at a skeletal joint for various static and dynamic human activities.
- Analyze the structure, function and motion of the human body as well as evaluate basic principles of human skeletal muscle mechanics.

BIOMECHANICS

UNIT I

Introduction to biomechanics

Biomechanics; Historical background; Mechanics in physiology; Contributions of biomechanics made to health science; Method of approach; Tools of investigation; Contribution of biomechanics made to mechanics; Law of Laplace.

UNIT II

Constitutive equation

Introduction; Stress; Strain; Strain Rate; Introduction to constitutive equations; Non-viscous fluid; Newtonian viscous fluid; Hookean elastic solid; Effect of temperature; Materials with complex mechanical behaviour; Viscoelasticity; Response of a viscoelastic body to harmonic excitation; Viscoelastic models; Methods of testing; Mathematical development.

UNIT III

Soft tissues

Introduction; Some elastic materials – Actin, Elastin, Fixation of elastin in aldehyde, Elastin molecule, Resilin and abduction, Elasticity due to entropy and internal energy changes, fibres, crystallization due to strain; Collagen..

BIOMATERIALS

Introduction to biomaterials

Definition of biomaterials; Performance of biomaterials; Historical background.

UNIT IV

Structure of solids

Atomic bonding; Crystal structure; Imperfections in crystalline structures; Long-chain molecular compounds; Supercooled and network Solids; Composite material structure;

UNIT V

Metallic implant materials

Stainless steels; Co-based alloys; Ti and Ti based alloys; Dental metals; Other metals; Corrosion of metallic implants.

Ceramic implant materials

Structure-property relationship of ceramics; Aluminum oxides; Zirconuim oxides; Calcium phosphate; Glass ceramics; Other ceramics; Carbons; Deterioration of ceramics.

TEXT BOOK

For BioMechanics Part:

Mechanical Properties of Living Tissues *by* Y.C.Fung; *Publisher: Springer*

For BioMaterials Part:

BioMaterials: An Introduction *by* Joon Park and R.S.Lakes; *Publisher: Springer*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective VI	**3**	**0**	**3**

(R11MED1152) PRECISION ENGINEERING

Course Prerequisites: Metrology, Machine Drawing

Course Objectives:

- Understand about the knowledge on geometric dimensioning and tolerancing
- Understand about the concepts involved in process capability
- Impart the knowledge on inspection components
- Impart the knowledge on precision machines

Course Outcomes:

Students should be able to:

- Apply fundamental knowledge of machine tool accuracy and geometric dimensioning for component s.
- Apply the concept of process capability while choosing the machine.
- Decide on measuring system for inspection components.
- Apply the acquired knowledge to design precision machines and other fields as well.

UNIT I

Introduction to precision machine design

Significance;

Fundamentals of economic analysis - cashflow timelines, compound interest factors, economic analysis of projects, machine cost determination, machine operator costs, and case studies;

Overview of project management (theory and implementation);

The design of a design engineer - what makes a good design engineer, how to keep informed, formulating a personal design methodology, developing conceptual designs, self principles, choice of the design possibilities, safety considerations, design plan for a machine tool, and the moral responsibility of a design engineer.

UNIT II

Case studies

Design case study - A high speed machining center (HSMC) - Initiation of the design process, definition of machine function and specifications, conceptual design of the HSMC, detailed design (sources of error; linear bearing selection; actuators; axis drive motors; spindle design; structural design; hydraulic and pneumatic support systems; and sensor systems).

Design case study - A coordinate measuring machine (CMM) - Foundation of functional specifications, technology assessment, design evolution of the Apollo Ring Bridge CMM; Design of the Apollo CMM (sources of error; machine geometry; machine dynamics; thermal

effects; work piece effects; mechanical systems design; sensor and electronic systems; design follow-up).

UNIT III

Principles of accuracy, repeatability, and resolution

Introduction - Accuracy, repeatability, resolution, and amplification of angular errors;
Overview of formulating the system error budget.
Quasi-static mechanical errors - geometric errors, kinematic errors, external load-induced errors (errors caused by gravity; errors caused by accelerating axes; errors caused by cutting forces; load induced errors from machine assembly; errors caused by thermal expansion; case studies of thermal expansion; identification, control, and isolation of heat sources); Errors caused by material instability; Instrumentation errors;
Errors caused by dynamic forces - structural vibration, and frictional errors;
Design case study - Carriage straightness errors caused by leadscrew misalignment – forced geometric congruience, and effect of constant axial and torsional leadscrew stiffness on system compliance.

UNIT IV

Analog sensors

Introduction - sensor definitions, and system dynamics.

Nonoptical sensor systems

Capacitance sensors - use of capacitance sensors, probe design for capacitance sensors, and typical characteristics of capacitance sensors;
Hall effect sensors - magnets for Hall effect sensors, typical applications, and typical characteristics of Hall effect sensors;
Inclinometers; Inductive digital On/Off proximity sensors; Inductive distance measuring sensors;
Inductosyns – typical linear and rotary inductosyn characteristics, and typical characteristics of LVDTs and RVDTs; Linear and Rotary variable differential transformers; Magnetic scales;
Magnetostrictive sensors – noncontact torsion sensors, linear position sensors, and typical properties of linear motion magnetostrictive effect sensors; Mechanical switches;
Overview of piezoelectric material based sensors; Potentiometers;
Ultrasonic sensors; Velocity sensors (linear velocity transducers, tachometers, typical characteristics of DC tachometers).

UNIT V

Sensor mounting and calibration

Introduction; Sensor location – linear displacement sensors, and angular displacement sensors; Sensor alignment; Sensor mounting structure design; Sensor mounting environment;
Contact between curved surfaces – approximate solution for point contact between objects, allowable contact stress, rolling contact stress considerations, fretting corrosion, “Exact” solution for point contact between objects, line contact between objects, and tangential stiffness of the contact interface;
Metrology frames; Sensor calibration.

TEXT BOOK

Precision Machine Design *by* Alexander H. Slocum; *Publisher: Prentice Hall*.

REFERENCE

1. Precision Manufacturing *by* David Dornfeld and Dae-Eun Lee; *Publisher: Springer*.
2. Machine Tools for High Performance Machining (Volume 10) by L.N.L.D. Lacalle and A. Lamikiz; *Publisher: Springer*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective VI	**3**	**0**	**3**

(R11MED1153) PRINCIPLES OF ENTERPRENEURSHIP

Course Prerequisites: General Management & Financial Accounting concepts, Enthusiasm towards Entrepreneurship

Course Objectives:

- Understand the entrepreneurial process involved in creating, managing a new enterprise.
- Understand the background and tools necessary to participate in the entrepreneurial process
- Understand fundamental business framework.

Course Outcomes:

Students should be able to:

- Identify the key steps required for exploiting an innovative idea or opportunity to develop an existing business, launch a new venture, or initiate a social enterprise.
- Recognize and evaluate business opportunities under dynamic economic settings.
- Identify and create opportunities to solve entrepreneurial issues while starting an enterprise.
- Master the relevance of entrepreneurship to the economic development of the nation especially regarding job creation and poverty alleviation in general

THE ENTREPRENEURIAL PERSPECTIVE

UNIT I

The nature and importance of entrepreneurs

Sample profile; Nature and development of entrepreneurship; Definition of entrepreneurship; The entrepreneurial decision process - change from present lifestyle, desirability of new venture formation, and possibility of new venture formation; Types of start-ups; Role of entrepreneurship in economic development - government as an innovator, intrapreneurship, and entrepreneurship; Entrepreneurial careers and education; Ethics and social responsibility of entrepreneurs; The future of entrepreneurship.

The entrepreneurial and intrapreneurial mind

Sample profile; The entrepreneurial process - identify and evaluate the opportunity, develop a business plan, determine the resources required, and manage the enterprise; Managerial versus entrepreneurial decision making - strategic orientation, commitment to opportunity, commitment of resources, control of resources, and management structure; Causes for interest in intrapreneurship; Corporate versus intrapreneurial culture; Climate for intrapreneurship; Intrapreneurial leadership characteristics; Establishing intrapreneurship in the organization; Problems and successful efforts.

The individual entrepreneur

Sample profile; Entrepreneurial feelings - locus of control, feelings about independence and need for achievement, and risk taking; Entrepreneur background and characteristics - childhood family environment, education, personal values, age, and work history; Motivation; Role models and support systems - moral-support network, and professional-support network; Male versus female entrepreneurs; Minority entrepreneurship; Entrepreneurs versus inventors.

International entrepreneurship opportunities

Sample profile; The nature of international entrepreneurship; The importance of international business to the firm; International versus domestic entrepreneurship - economics, stage of economic development, balance of payments, type of system, political-legal environment, cultural environment, technological environment, and strategic issues; Entrepreneurial entry into international business - exporting, nonequity arrangements, and direct foreign investment; Barriers to international trade - general agreements on tariffs and trade, Increasing protectionist attitudes, Trade blocs and free trade areas; Entrepreneur's strategy and trade barriers, and entrepreneurial partnering; Case studies for "The entrepreneurial perspective".

CREATING AND STARTING THE VENTURE

UNIT II

Creativity and the business idea

Sample profile; Sources of new ideas - consumers, existing products and services, distribution channels, federal government, and research and development; Methods of generating ideas - focus groups, brainstorming, and problem inventory analysis; Creative problem solving - brainstorming, reverse brainstorming, brainwriting, Gordon method, checklist method, free association, forced relationships, collective notebook method, attribute listing, big-dream approach, and parameter analysis; Opportunity recognition; Product planning and development process - establishing evaluation criteria, idea stage, concept stage, product development stage, and test marketing stage; E-commerce and business start-up - using e-commerce creativity, website, tracking customer information, and doing e-commerce as an entrepreneurial company.

Legal issues for the entrepreneur

Sample profile; Intellectual property; Need for a lawyer; Select a lawyer; Legal issues in setting up the organization; Patents - international patents, the disclosure document, the patent application, and patent infringement; Business method patents; Trademarks - registering the trademark; Copyrights; Trade secrets; Licensing; Product safety and liability; Insurance; Contracts.

The business plan - creating and starting the venture

Sample profile; Planning as part of the business operation; Business plan; Writing the plan; Scope and value of the business plan—reading of the plan; evaluation of the plan by potential lenders and investors; Presenting the plan; Information needs - market information, operations information needs, and financial information needs; Using the internet as a resource tool; Writing the business plan - introductory page, executive summary, environmental and industry analyses, description of venture, production plan, operations plan, Marketing plan, organizational plan; assessment of risk, and financial plan; Using and

implementing the business plan - measuring plan progress, and updating the plan; Failure of business plan.

UNIT III

The marketing plan

Sample profile; Industry analysis - competitor analysis; Marketing research for the new venture - defining the purpose or objectives, gathering data from secondary sources, gathering information from primary sources, analyzing and interpreting the results; Understanding the marketing plan; Characteristics of a marketing plan; The marketing mix; Steps in preparing the marketing plan - defining the business situation, defining the target market/opportunities and threats, considering strengths and weaknesses, establishing goals and objectives, defining marketing strategy and action programs, *marketing strategy*-consumer versus business-to-business markets, budgeting the marketing strategy, implementation of the market plan, and monitoring progress of marketing actions; Contingency planning; Failure of plans.

The organizational plan

Sample profile; Developing the management team; Legal forms of business - ownership, liability of owners, costs of starting a business, continuity of business, transferability of interest, capital requirements, management control, distribution of profits and losses, and attractiveness for raising capital; Tax attributes of forms of business - tax issues for proprietorship, tax issues for partnership, and tax issues for corporation;

(In the national and international context) The limited liability company versus the S corporation; S corporation - advantages and disadvantages of an S corporation; The limited liability company;

Designing the organization; Building the management team and a successful organization culture; The role of a board of directors; The board of advisors; The organization and use of advisors.

The financial plan

Sample profile; Operating and capital budgets; Pro Forma income statements; Pro Forma cash flow; Pro Forma balance sheet; Break-even analysis; Pro forma sources and applications of funds; software packages; Case studies for "creating and starting the venture".

UNIT IV

Financing the new venture: sources of capital

Sample profile; An overview - debt or equity financing, and internal or external funds; Personal funds; Family and friends; Commercial banks - types of bank loans, cash flow financing, and bank leading decisions; Role of SBA in small business financing; Research and development limited partnerships - major elements, procedure, benefits and costs, and case studies; Government grants – procedure; Private placement - types of investors, private offerings, and regulations; Bootstrap financing.

Informal risk capital and venture capital

Opening profile; Financing the business; Informal risk-capital market; Venture capital - nature of venture capital, overview of the venture-capital industry, venture-capital process, locating venture capitalists, and approaching a venture capitalist; Valuing your company -

factors in valuation, ratio analysis, liquidity ratios, activity ratios, leverage ratios, profitability ratios, general valuation approaches, general valuation method, and evaluation of an internet company; Deal structure; Case studies for "financing the new venture".

MANAGING, GROWING, AND ENDING THE NEW VENTURE

UNIT V

Entrepreneurial strategy: generating and exploiting new entries

Sample profile; New entry; Generation of a new entry opportunity - resources as a source of competitive advantage, and creating an effective resource bundle; Assessing the attractiveness of a new entry opportunity - information on a new entry, comfort with making a decision under uncertainty, and decision to exploit or not to exploit the new entry; Entry strategy for new entry exploitation - environmental instability and first-mover (dis)advantages, customers' uncertainty and first-mover (dis)advantages, and lead time and first-mover (dis)advantages; Risk reduction strategies for new entry exploitation - market scope strategy, imitation strategies, and managing newness.

Strategies for growth and managing the implications of growth

Sample profile; Growth strategies - Avenues for growth opportunities - penetration strategies, market development strategies, product development strategies, diversification strategies, and case studies; Economic implications of growth; Implications of growth for the firm - pressures on existing financial resources, pressures on human resources, pressures on the management of employees, and pressures on the entrepreneur's time; Overcoming pressures on existing financial resources; Financial control - managing cash flow, managing inventory, mananging fixed assets, managing costs and profits, taxes, and record keeping; Overcoming pressures on existing human resources; Overcoming pressures on the management of employees; Overcoming pressures on entrepreneurs' time - basic principles of time management; Implications of firm growth to the entrepreneur - a categorization of entrepreneurs and their firms' growth.

Accessing resources for growth from external sources

Sample profile; Using external parties to help grow a business; Franchising - advantages of franchising to the franchisee and the franchisor, disadvantages of franchising, and types of franchises; Investing in a franchise; Joint ventures - types of joint ventures, and factors in the joint venture success; Acquisitions - advantages of an acquisition, disadvantages of an acquisition, synergy, structuring the deal, locating acquisition candidates; Mergers; Leveraged buyouts; Overcoming constraints by negotiating for more resources.

Going public

Sample profile; Advantages and disadvantages of going public; The alternatives to going public; Timing of going public and underwriter selection - timing, and underwriter selection; Registration statement and timetable - the prospectus, and procedure; Legal issues, and blue-sky qualifications; After going public - aftermarket support, relationship with the financial community, and reporting requirements; myths concerning going public.

Ending the venture

Sample profile; Bankruptcy—an overview; Surviving bankruptcy; Prepackaged bankruptcy; Extended time payment plans; Liquidation; Strategy during reorganization; Keeping the venture going; Warning signs of bankruptcy; Starting over; The reality of failure; Business turnarounds; Exit strategy; Succession of business - transfer to family members and non–

family members; Harvesting strategy - direct sale, employee stock option plan, and management buyout; case studies for “managing, growing and ending the new venture”.

TEXT BOOK

Principles of Entrepreneurship *by* Robert D. Hisrich, Michael P. Peters, and Dean A. Shepherd; *Publisher: McGraw Hill.*

REFERENCE

1. Small Scale Industries and Entrepreneurship in the Twenty-First Century *by* Vasanth Desai; *Publisher: Himalaya Publishing House*.
2. Entrepreneurship: Successfully Launching New Ventures *by* Bruce R.Barringer and R. Duane Ireland; *Publisher: Pearson Education*.

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective VI	**3**	**0**	**3**

(R11MED1154) INTERACTIVE COMPUTER GRAPHICS

Pre-requisites: C Language, Engineering Graphics

Course Objectives:

- To provide students with a foundation in graphics applications programming.
- To give basics of application programming interface (API) implementation based on graphics pipeline approach.
- To provide students with an overview of the key concepts of digital production of animation and visual effects with reference to workflow, people and technology.
- To give students practical experience in the production of 2D,3D computer animation and Morphing.

Course Outcomes:

Students should be able to:

- Apply the relevant mathematics of computer graphics and be able to write basic graphics application programs including animation
- Use the basic aspects of 2D image representations and transformations
- Implement different methods of digitally representing 3D Object representations and transformations.
- Name the traditional principles of visible surface detection methods that can be applied to computer animation.

TWO AND THREE DIMENSIONAL GRAPHICS CONCEPTS

UNIT I

Geometric transformations

Introduction; Transformations of geometric models – translation, scaling, reflection, rotation, homogeneous representation, and concatenated transformations; Mappings of geometric models- translational mapping, rotational mapping, general mapping, and mappings as changes of coordinate system; Inverse transformations and mappings; Projections of geometric models - orthographic projections, and perspective projections; Design and engineering applications;

Visual realism

Introduction; Model clean up; Hidden line removal - visibility of object views, visibility techniques, sorting, coherence, formulation and implementation, sample hidden line algorithms, and hidden line removal for curved surfaces; Hidden surface removal - the z-buffer algorithm, and Warnock's algorithm; Hidden solid removal - Ray-tracing algorithm; Shading - shading models, shading surfaces, shading enhancements, and shading solids; Coloring- color models; User interface or shading and coloring.

INTERACTIVE TOOLS

UNIT II

Graphics aids

Introduction; Geometric modifiers; Names; Layers; Colors; Grids; Groups; Dragging and rubberbanding; Clipping.

Graphics manipulations and editings

Introduction; Entity selection methods - individual entity, all displayed entities, groups, enclosing polygon or window, chaining contiguous entities, and width; Manipulation operations - verification of model and database parameters, entity verification, entity copying (duplication), geometric arrays, transformation, entity blanking/ unblanking, geometric measurements, and entity offsetting; Editing operations-entity trimming, entity division, entity stretching, and entity editing; Design and engineering applications.

UNIT III

Finite element modeling and analysis

Introduction; General procedure of the finite element method; Finite element analysis - development of integral equations, method of weighted residuals, continuum discretization, assembly of element equations, imposing boundary conditions, lumping external applied loads, solution of global equations, other finite element analyses, and convergence of finite element solutions; Isoparametric evaluation of element matrices - element mapping, shape functions by inspection, and evaluation of element matrices; Finite element modeling; Mesh generation - mesh requirements, semi-automatic methods, and fully automatic methods; Design and engineering applications.

UNIT IV

Part programming and manufacturing

Introduction; Part production cycle; Manufacturing systems; Manufacturing processes - removing processes, forming processes, deforming processes, and joining processes; Integration requirements; Process planning - manual approach, variant approach, generative approach, hybrid approach, and geometric modeling for process planning; Part programming - fundamentals of NC, Basics of NC programming , and NC programming languages; Overview of tool path generation and verification.

UNIT V

Computer aided quality control

Introduction; Contact inspection methods; Noncontact inspection methods - machine vision, scanning laser beam devices and photogrammetry; Overview of Nonoptical-Noncontact inspection methods.

Computer aided manufacturing

Computer assisted process planning (CAPP); Group technology - methodology, steps required for the execution of group technology, and group technology concepts;

Computer aided production management system (CAPMS); Materials requirement planning (MRP)- master production schedule; Shop floor control system – shop floor control, and functions of shop floor control; Overview of computer assisted production scheduling; Overview of flexible manufacturing system; Overview of parts based manufacturing information system.

TEXT BOOK

CAD/CAM - Theory and Practice *by* Ibrahim Zeid; *Publisher: McGraw Hill.*

REFERENCE

Computer Graphics by Harrington; *Publisher: McGraw Hill.*

VNR Vignana Jyothi Institute of Engineering and Technology
Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective VI	**3**	**0**	**3**

(R11MED1155) STATISTICAL QUALITY CONTROL AND TQM

Course Prerequisites: Mathematics & Statistics

Course Objectives:

- To introduce students to the importance of quality control , statistical quality control , quality assurance and process capabilities for successful operations and to enable them to apply complex statistical analysis for quality management
- Describe variation in a process or data, using frequency distribution, histogram, stem-and-leaf plot, box plot, and normal probability plot
- Apply experimental design techniques in real world problems and in research
- To apply and evaluate best practices for the attainment of Total Quality

Course Outcomes:

Students should be able to:

- Develop in-depth knowledge on various Statistical Quality Control tools and apply techniques of quality management in a given situation
- Construct a frequency distribution, histogram, normal probability of data readings of a process, using MS EXCEL, Minitab and SPSS Software.
- Demonstrate motivation and responsibility to advocate for quality in business
- Select and apply appropriate techniques in identifying customer needs, as well as the quality impact that will be used as inputs in TQM methodologies

UNIT I

Introduction and overview

The meaning of quality; The control-chart viewpoint; Scientific sampling; Use of examples; Meanings and usage of the words 'defective' and 'defect'; Significance of the viewpoint of statistical quality control; statistical quality control and useful by–products; Reasons for the use of the adjective, "statistical'; Four different levels of understanding statistical quality control; Nonmanufacturing applications of statistical quality control techniques;

Directions for sample x and r chart

Setting up and operating control charts for X and R; Checklist of necessary steps in using X and R charts; Some comments on computer software for statistical process control.

UNIT II

Why the control chart works; statistical concepts

The need for understanding statistical principles; Description of patterns of variation; Graphic representation of a frequency distribution; Averages and measures of dispersion; Sampling statistics and universe parameters; The normal curve; Other frequency curves; Interpretation of average and standard deviation of a set of numbers.

Why the control charts works; examples

The use of control charts to judge whether or not a constant system of chance causes is present; Use of the control chart in interpretation of a frequency distribution; Contribution of the control chart to elimination of causes of trouble; Changes in universe average; Shift in universe dispersion with no change in universe average; Change in universe average and universe dispersion; A possible view of the question answered by a control chart; Nonproduct applications of control charts for variables; Conflicting expressions for the standard deviation of a set of numbers.

UNIT III

Some fundamentals of the theory of probability

Probability and its mathematical meaning; Modern concepts of probability theory; Some theorems of the theory of probability; Infinite and finite universes; The hypergeometric probability distribution; The binomial as a probability distribution; The Poisson law as a probability distribution; The normal distribution; Deciding on the method to be used for calculating probabilities in industrial sampling problems; Relationship between control charts and certain other statistical techniques; Random variables; Point estimates and estimators; The problem of selecting a parameter to describe universe dispersion and of choosing an estimator for that parameter; Sampling from a normal distribution; Theory of extreme runs.

UNIT IV

The control chart for fraction rejected

Some practical limitations of control charts for variables; Control charts for attributes; Control charts for fraction rejected; The binomial as a probability law that determines the fluctuations of fraction rejected; Control limits for the *p* chart; Problems introduced by variable subgroup size; Checklist of necessary steps in connection with control chart for fraction rejected; Sensitivity of the *p* chart; Nonproduct applications of *p* and *np* charts; *p* charts are not suitable for all data on fraction rejected – why.

The control chart for nonconformities

The place of the *c* chart in statistical process control; Distinction between a nonconforming article and a nonconformity; Limits for the *c* chart are based on the Poisson distribution; The combination of Poisson distributions; Conditions favorable to the economic use of the control chart for nonconformities; Adaptations of the *c* chart to variations in the area of opportunity for a nonconformity; Probability limits for *c* and *u* charts; The *u* charts for nonconformities per multiple units.

UNIT V

TQM principles and practices

Definition; Basic approach; Gurus of TQM; TQM framework; Awareness; Defining quality; Historical reviews; Obstacles; Benefits of TQM; TQM exemplary organization.

Continuous process improvement

Intoduction; Process; The Juran Trilogy; Improvement strategies; Types of problems; The PDSA Cycle; Problem-solving method; Kaizen; Reengineering; Six-Sigma; TQM exemplary organization.

TEXT BOOK

Statistical Quality Control *by* Eugene Grant; *Publisher: McGraw Hill.*

REFERENCE

1. Total Quality Control *by* Armand V. Feigenbaum; *Publisher: McGraw Hill.*
2. Introduction to Statistical Quality Control *by* D.C.Montgomery; *Publisher: John Wiley.*

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Department of Mechanical Engineering

IV Year B.Tech ME II Sem	**L**	**T/P/D**	**C**
Elective VI	**3**	**0**	**3**

(R11MED1156) FRACTURE MECHANICS

Course Prerequisites: Mechanics of Solids

Course Objectives:

- Impart the knowledge on fundamental background on fracture mechanics
- Understand about knowledge on determining fracture toughness
- Understand about the knowledge on materials and structures

Course Outcomes:

Students should be able to:

- Develop an understanding of the various aspects involved in the area of fracture mechanics
- Develop from first principles the basic ideas and equations needed for an understanding of fracture mechanics
- Define the advantages and disadvantages of this approach for studying the failure of materials and structures
- Indicate how the basic principles may be applied to a range of industrial problems and materials.

UNIT I

Introduction; Historical perspective; Fracture mechanics approach to design – energy criterion, stress intensity approach, time-dependant crack growth and damage tolerance; Effect of material properties on fracture; Brief review of dimensional analysis.

UNIT II

Linear elastic fracture mechanics

An atomic view of fracture; Stress concentration effect of flaws; Griffith energy balance – comparison with critical stress criterion, and modified Griffith equation; Energy release rate; Instability and the R Curve – Reasons for the R curve shape, load control vs. displacement control, and structures with finite compliance; Stress analysis of cracks – stress intensity factor, relationship between K and global behavior, effect of finite size, principle of superposition, and weight functions; Relationship between K and G.

UNIT III

(Contd) **Linear elastic fracture mechanics**

Crack Tip Plasticity – The Irwin Approach, Strip-yield model, Comparison of plastic zone corrections, plastic zone shape; K controlled fracture; Plane Strain fracture – Crack-tip triaxiality, effect of thickness on apparent fracture toughness, plastic zone effects, implications for cracks in structures; Mixed Mode fracture – propagation of an angled crack, equivalent Mode I crack, and Biaxial loading; Interaction of multiple cracks – coplanar cracks, and parallel cracks.

UNIT IV

Elastic plastic fracture mechanics

Crack tip opening displacement; J contour integral – nonlinear energy release rate, J as a path independent line integral, J as a stress intensity parameter, large strain zone, and laboratory measurement of J; Relationships between J and CTOD; Crack-growth resistance curves – stable and unstable crack growth, and computation of J for a growing crack; J controlled fracture – stationary cracks, and J controlled crack growth; Crack-tip constraint under large scale yielding – elastic T stress, and J-Q theory.

UNIT V

Dynamic and time dependent fracture

Dynamic fracture and crack arrest - rapid loading of a stationary crack; Rapid crack propagation and crack arrest – crack speed, elastodynamic crack tip parameters, dynamic toughness, and crack arrest; Dynamic contour integrals.

TEXT BOOK

Fracture Mechanics: Introduction and Applications *by* T.L. Anderson; *Publisher: CRC Press*